STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
DIVISION OF RESOURCES PLANNING

Bulletin No. 14

LAKE COUNTY INVESTIGATION

GOODWIN J. KNIGHT
Governor

HARVEY O. BANKS
Director of Water Resources

July, 1957

The ever-present landmark of the Clear Lake Area—Mt. Konocti

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TABLE OF CONTENTS

TABLE OF CONTENTS—Continued

APPENDIXES

TABLES

TABLE OF CONTENTS—Continued

PLATES

PHOTOGRAPHS

Photographs printed herein are shown on the pages noted, through the courtesy of the following:

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Abbreviations: t, top; b, bottom.

LETTER OF TRANSMITTAL

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STATE OF CALIFORNIA
Department of Water Resources
SACRAMENTO

June 30, 1957

HONORABLE GOODWIN J. KNIGHT, *Governor,*
and Members of the Legislature of the
State of California

GENTLEMEN:

I have the honor to transmit herewith Bulletin No. 14, entitled "Lake County Investigation," as authorized by Chapter 1514, Statutes of 1945, as amended.

Originally under the direction of the State Water Resources Board, the Lake County Investigation was conducted, and Bulletin No. 14 was prepared, by the Division of Water Resources of the Department of Public Works. The duties and responsibilities of the Board and Division have subsequently been assumed by the Department of Water Resources, and Bulletin No. 14 was completed by the Division of Resources Planning of that Department.

Bulletin No. 14 contains an inventory of the underground and surface water resources of Big Valley, Scott Valley, and Upper Lake area; estimates of present (1953) and probable ultimate supplemental water requirements; and preliminary plans and cost estimates for water development works.

Very truly yours,

Harvey O. Banks
Director

ACKNOWLEDGMENT

Valuable assistance and data used in the investigation were contributed by agencies of the Federal Government, cities, counties, public districts, and by private companies and individuals. This cooperation is gratefully acknowledged.

Special mention is also made of the helpful cooperation of the Board of Supervisors of Lake County, the Lake County Farm Advisor, the Lakeport office of the Soil Conservation Service of the United States Department of Agriculture, the Corps of Engineers of the U. S. Army, the Bureau of Reclamation of the United States Department of the Interior, and the Pacific Gas and Electric Company.

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CHAPTER I

INTRODUCTION

The area under investigation in Lake County has experienced an increase in population concurrently with an expansion and intensification of irrigated agriculture. These two factors have resulted in an increased draft on ground water and, as a result, the area is confronted with a need for more complete conservation of its water resources. The effects of the increased draft in ground water and the prevalence of shallow pumping installations have been to create an apparent shortage of irrigation and domestic ground water in the latter part of the irrigation season when shallow pumping installations fail to produce water sufficient to meet demands, and has brought about local concern regarding the adequacy of the ground water resources.

AUTHORIZATION FOR INVESTIGATION

As a result of the general concern regarding the ground water resources, members of the Board of Supervisors of Lake County presented to the State Water Resources Board a resolution dated August 30, 1948, which proposed a state-county cooperative survey of water conservation problems in Big Valley, Scott Valley, and Upper Lake area, all located in Lake County. The Board referred the request to the State Engineer for preliminary examination and report on the need for such an investigation, and an estimate of its scope, duration, and cost.

The State Water Resources Board on September 3, 1948, approved a recommendation by the State Engineer, based on findings of the preliminary examination, for a two-year cooperative investigation, and authorized negotiation of an agreement with local agencies. The agreement between the State Water Resources Board, the County of Lake, and the State Department of Public Works acting through the agency of the State Engineer, was executed on December 17, 1948. It provided that the work under the agreement

> " . . . shall consist of an investigation and report on the underground water supplies of Big Valley within the Big Valley Soil Conservation District and of Scotts Valley-Upper Lake Area within the Scotts Valley-Upper Lake Soil Conservation District, all in the county of Lake, including quality, replenishment and utilization thereof, and, if possible, a method or methods of solving the water problems involved."

This agreement authorized the provision of funds to meet the costs of investigation for one year. A supplemental agreement executed by the same parties on October 13, 1949, authorized funds to complete the investigation and report.

Funds to meet the costs of the investigation and report to the extent of $12,000 were provided as follows: State of California (State Water Resources Board), $6,000; County of Lake, $6,000. Additional funds have been expended in investigation of the area by the State Water Resources Board in connection with the current State-wide Water Resources Investigation, certain results of which have been used in connection with the Lake County Investigation.

A continuing investigation for one year beyond the periods covered by the foregoing contracts was made under an agreement between the State Water Resources Board, the Department of Public Works, and the County of Lake, dated January 1, 1953. This agreement provided for a series of ground water level measurements, stream flow measurements, operation and maintenance of certain stream gaging stations, collection and analysis of samples of surface and ground waters, collection of crop survey records, and compilation of results of measurements. Funds to meet the costs of the continuing investigation to the extent of $1,500 were provided as follows: $750 by the State of California (State Water Resources Board), and $750 by the County of Lake.

Effective on July 5, 1956, pursuant to Chapter 52, Statutes of 1956, the State Department of Water Resources was created. The Department succeeded to, and was vested with, all of the powers, duties, purposes, responsibilities, and jurisdiction in matters pertaining to water formerly vested in the Division of Water Resources of the Department of Public Works, the State Engineer, and the State Water Resources Board. In particular, the authority and responsibilities of the Board, relative to the Lake County Investigation and preparation of this bulletin, are now vested wholly in the Department of Water Resources.

Copies of the three agreements between the State Water Resources Board, the County of Lake, and the Department of Public Works are included as Appendix A. Also included in Appendix A is the text of Chapter 52, Statutes of 1956.

The State Water Board, at its regular meeting on December 2, 1955, approved release of the preliminary draft of Bulletin No. 14, "Lake County Investigation," to concerned agencies for their review and comment. The comments are included in Appendix O. These comments were reviewed, and suggested changes in the bulletin were adopted where the Department of Water Resources was in agreement with the changes suggested.

RELATED INVESTIGATIONS AND REPORTS

Prior investigations and reports reviewed in connection with this investigation include the following:

California State Department of Public Works, Division of Water Resources. "Sacramento River Basin." Bulletin No. 26. 1931.

——. "Report on Clear Lake-Cache Creek Flood Control Investigation." 1939.

——. "Summary Progress Statement of the Lake County Investigation." August, 1952.

California State Water Resources Board. "Water Resources of California." Bulletin No. 1. 1951.

——. "Interim Report, Cache Creek Investigation." March, 1955.

——. "Water Utilization and Requirements of California." Bulletin No. 2. June, 1955.

California State Department of Water Resources. "The California Water Plan." Bulletin No. 3. May, 1957.

Carpenter, E. J., and Storie, R. E. "Soil Survey of the Clear Lake Area." United States Department of Agriculture. 1927.

Central Valley Regional Water Pollution Control Board. "Pollution Study, Cache and Putah Creeks, Sacramento River Watershed." 1954.

United States Department of Agriculture, Soil Conservation Service. "Cache Creek Watershed Program, Soil Conservation and Flood Control." September, 1953.

United States Department of the Army, Corps of Engineers, Sacramento District. "Interim Flood Control Survey Report on Sacramento River and Tributaries (Collinsville to Shasta Dam), California." January 15, 1944. Published as House Document No. 649, Seventy-eighth Congress, Second Session.

——. "Comprehensive Flood Control Survey Report on Sacramento-San Joaquin Basin Streams, California." February 1, 1945. Supplement June 1, 1948. Published as House Document No. 367, Eighty-first Congress, First Session.

——. "Review Report on Cache Creek Basin, California." July 1, 1950.

Upson, J. E., and Kunkel, Fred. "Ground Water in the Lower Lake-Middletown Area, Lake County, California." United States Geological Survey Water-Supply Paper 1297, 1955.

SCOPE OF INVESTIGATION AND REPORT

It has been stated that under provisions of the authorizing agreements the general objectives of the Lake County Investigation included investigation and study of the underground water supply of the valley floor lands in the investigational area, including quality, replenishment, and utilization thereof, and, if possible, a method or methods of solving the water problems involved. In attaining these objectives it was necessary that the scope of the investigation include full consideration of surface as well as ground water supplies, and that it involve determination of present and ultimate water utilization, supplemental water requirements, and plans, with comparative costs, for securing supplemental water supplies.

Field work in the investigational area, as authorized by the initial and supplemental agreements, commenced in October, 1948, and continued into 1954.

In the course of the investigation, precipitation and stream flow records were collected and compiled in order to evaluate water supplies available to the investigational area. Three stream gaging stations installed previously by the Corps of Engineers, United States Army, were operated and maintained by the Department of Water Resources, to supplement available hydrologic data. These stations were on Scott Creek near Lakeport, Middle Creek at Hunter Point, and Clover Creek near Upper Lake. A stream gaging station on Adobe Creek at Bell Hill Road was installed by the Department of Water Resources and maintained during the course of the investigation. In addition to the aforementioned recording stations, staff gage readings were obtained at 10 stations, and weekly field checks of stream flows were made at 15 stations during the investigation.

In order to determine ground water storage capacity and yield, about 225 well logs were analyzed, and geologic features of the ground water basins underlying the area were investigated. Results of these phases of the investigation are presented in Chapter II under the heading "Underground Hydrology".

The effects of draft on and replenishment of the ground water basins were determined by measurements of static ground water levels made at about 160 wells during each spring and fall of the period of investigation. These wells were chosen to form a comprehensive measuring grid over the entire area. In addition, measurements to determine monthly fluctuations of water levels were made at approximately 65 control wells.

Present land use in the investigational area was determined by a complete survey of valley floor lands. This survey was conducted in 1949, and checked in 1950, 1951, and 1953, to determine changes in land use. The total area surveyed was about 32,600 acres. The land use survey data were used in conjunction with available data on unit water use to estimate total present water utilization in the investigational area.

In order to estimate future water utilization, all valley floor lands were classified with regard to their suitability for irrigated agriculture. This involved evaluation of land classification data collected during field surveys by the Bureau of Reclamation, United States Department of the Interior, and the Department of Water Resources.

Current irrigation practices in the investigational area were surveyed in order to determine unit application of water to important crops on lands of various soil types. During the 1949 irrigation season, records of application of water were collected at 45 plots, and at 14 plots during 1950. The data collected included records of pump discharge, acreage served, crops irrigated, and number and period of irrigations. These studies were made in cooperation with the Soil Conservation Service of the United States Department of Agriculture. Additional studies to determine seasonal unit consumptive use values for land use types existing in the Clear Lake Area were made by the Soil Conservation Service in cooperation with the Department of Water Resources.

Studies were made of the mineral quality of surface and ground waters in order to evaluate their suitability for irrigation use. Data used in these studies included 103 partial and 59 complete mineral analyses of ground water from wells. In addition, a large number of analyses of surface water supplies, covering the period since 1949, were collected and studied.

Field reconnaissance surveys, including geologic examinations, were made to locate and evaluate possible dam and reservoir sites for conservation of surface runoff. Reconnaissance surveys were also made of possible routes for conveyance of water to areas of use.

Results of the Lake County Investigation are presented in this bulletin in the four ensuing chapters. Chapter II, "Water Supply," contains evaluations of precipitation, and surface and subsurface inflow and outflow. It also includes results of investigation and study of ground water basins, and contains data regarding mineral quality of surface and ground waters. Chapter III, "Water Utilization and Supplemental Requirements," includes data and estimates of present and probable ultimate land use and water utilization, and contains estimates of present (1953) and probable ultimate supplemental water requirements. It also includes available data on demands for water with respect to rates, times, and places of delivery. Chapter IV, "Plans for Water Development," describes preliminary plans for flood control and for conservation and utilization of available water supplies to meet supplemental water requirements, including operation and yield studies, design considerations and criteria, and cost estimates. Chapter V, "Summary of Conclusions, and Recommendations," comprises a summary statement of the conclusions resulting from the investigation and studies, together with recommendations for action relating to solution of water problems on the part of the concerned local interests.

AREA UNDER INVESTIGATION

The area under investigation generally comprises those valley portions of Lake County lying adjacent to Clear Lake, and situated within the Big Valley and Scott Valley-Upper Lake Soil Conservation Districts. Clear Lake, with a water surface elevation of about 1,320 feet and an area of about 64 square miles, lies in an intermediate valley in the Coast Range between the Mayacmas Mountains and the Russian River watershed on the west, and Bartlett Mountain and the Sacramento Valley on the east. All lands in the investigational area are tributary to Clear Lake which drains by way of Cache Creek to the Yolo By-pass near Woodland in the Sacramento Valley. For purposes of this bulletin the investigational area has been designated the "Clear Lake Area." The location of the investigational area is shown on Plate 1, entitled "Location of Clear Lake Area," and is shown in greater detail on Plate 2, entitled "Hydrologic Units and Principal Organized Water Agencies."

In order to facilitate reference to its several parts, the Clear Lake Area was divided into three principal units. These were designated "Big Valley Unit," "Scott Valley Unit," and "Upper Lake Unit," and are shown on Plate 2. The Big Valley Unit is bordered by Clear Lake on the north and extends southerly about seven miles to a spur of the Coast Range. It extends on the east from the base of Mount Konocti westerly about seven miles to the base of the Mayacmas spur of the Coast Range. The Scott Valley Unit lies about two miles northwest of Lakeport, and is separated from Clear Lake by a low ridge of hills. The Scott Valley Unit is about three miles long in a northerly direction and about 1.5 miles wide. The Upper Lake Unit lies north of Clear Lake. It extends from the shore line of Clear Lake on the south about seven miles northerly to a point where Middle Creek enters the unit, and from the lake shore northwest about seven miles to the northern boundary of Bachelor Valley.

Drainage Basins

Stream systems draining the Clear Lake Area are all tributary to Clear Lake. Principal streams of the area are Kelsey, Adobe, Scott, and Middle Creeks.

The Big Valley Unit consists of a gently rolling plain sloping downward generally from south to north, with elevations ranging from about 1,500 feet to about 1,320 feet at Clear Lake, and encompassing some 19,600 acres. Mount Konocti to the east of the Big Valley Unit rises abruptly from the valley floor to an elevation of about 4,100 feet. The unit is drained by Kelsey, Adobe, Manning, and Cold Creeks, and a number of minor creeks.

The Scott Valley Unit ranges in elevation from about 1,400 feet at its lowest point along Scott Creek to about 1,450 feet at the base of the surrounding hills. The unit includes about 2,500 acres. Scott Creek flows through the unit in a northerly direction, thence easterly through Tule Lake and southeasterly into Robinson Slough and Clear Lake.

The Upper Lake Unit extends northerly from Clear Lake at an elevation of about 1,320 feet to an elevation of about 1,450 feet in Bachelor Valley, and to an elevation of about 1,500 feet in both Clover and Mid-

Big Valley from slope of Mt. Konocti

Scott Valley from near southerly rim

dle Valleys. The unit includes an area of some 10,500 acres. Middle and Clover Creeks flow into Robinson Slough, an arm of Clear Lake. Drainage from Bachelor Valley is by Dayle and Cooper Creeks, which are small meandering streams with little slope. The area of the various stream drainage basins is given in the following tabulation.

Unit and stream	*Area, in square miles*
Big Valley Unit	
Cold Creek	26
Kelsey Creek	38
Adobe Creek	24
Manning Creek	5
Miscellaneous, including valley floor	38
Subtotal	131
Scott Valley Unit	
Scott Creek	53
Hendricks Creek	6
Miscellaneous, including valley floor	6
Subtotal	65
Upper Lake Unit	
Dayle Creek	3
Cooper Creek	5
Middle Creek	47
Alley Creek	9
Clover Creek	14
Miscellaneous, including valley floor and Scott Creek below Scott Valley	51
Subtotal	129
Total	325

Climate

The climate of the Clear Lake Area is generally characterized by dry summers with high daytime temperatures and warm nights, and wet winters with moderate temperatures. Almost 85 per cent of the seasonal precipitation occurs during the five-month period from November through March. The growing season is long, with 217 days between killing frosts, as indicated by the average of the 38 years of record at Upper Lake. Temperatures at Upper Lake have ranged from 13° F. to 111° F., and average monthly temperatures range from 43.9° F. in January to 73.1° F. in July.

Geology

The geologic formations of the Clear Lake Area include sediments of the Cache formation of Pliocene or Pleistocene age, beds of volcanic fragments which are probably the same age as the Cache sediments, and younger clays, sands, and gravels, including Recent alluvium. Volcanic lavas and tuffs of middle and upper Pleistocene age comprise the western slopes of Mount Konocti, east of Big Valley. The principal aquifers of the several units are gravel strata or lenses occurring in the alluvium. The geologic formations and their occurrence are treated in greater detail in Appendix E.

Soils

Soils of the Clear Lake Area vary in their chemical and physical properties in accordance with differences in parental material, drainage, and age or degree of development since their deposition. The Big Valley Unit has two general types of soils: those of the lower alluvial fan, and those of the upper alluvial fan. The lower fan is characterized by somewhat compact subsoils. However, poor subsurface drainage is reported only in the case of several large bodies of clay adobe soils. The upper fan is a loam soil dissected by many natural surface drains, and presents a rolling to steep topography with little or no subsurface drainage problem.

The Scott Valley Unit is composed principally of productive soils, but has inadequate subdrainage. The Upper Lake Unit is generally made up of shallow clay loams in Bachelor Valley, while gravelly loam and clay loam predominate in Clover Valley, and clay loam, poorly drained Yolo loam, and Bayside silty clay occur in Middle Valley. Bachelor Valley soils are devoted mostly to grazing, except for the lower reaches where Bayside silty clay loam produces vegetables. Clover Valley clay loams are poorly drained. Middle Valley soils are productive, but poorly drained except for limited areas. A more detailed description of soils in the several units is included in Appendix J.

Present Development

Development in the Clear Lake Area has progressed slowly since arrival of the first white settlers around the middle of the nineteenth century. Farming and supporting industries have been in the past and are at the present time the major contributors to the economy of the area. However, the favorable recreational aspects of Clear Lake are becoming of significant importance.

The 1950 federal census showed that the population of Lake County was 11,380. The principal urban center is Lakeport, the county seat, located on the west shore of Clear Lake. The principal trading center of the Upper Lake Unit is the town of Upper Lake, located at the approximate center of the unit. Kelseyville, the major urban development in the Big Valley Unit, is located in the eastern portion of Big Valley. The towns of Lakeport, Upper Lake, and Kelseyville had 1950 populations of 1,974, 450, and 500, respectively, some 26 per cent of the total county population.

Recent development in the Clear Lake Area began when the first settlers arrived about the middle of the nineteenth century. At that time the land was inhabited by Indians of the Pomo tribes who were attracted by the abundance of fish and wildlife and obsidian from which to make arrowheads. The Indians were maltreated by some of the early settlers, and a period of frequent skirmishes between the Indians and the settlers and soldiers occurred in the middle 1880's.

After the Indians had been established on reservations, or "rancherias," the population of settlers steadily increased and farming began in the fertile valleys. Agricultural development in the Clear Lake Area began with the first settlers, and livestock and grain were the earliest farm products. Cheese-making was among the first industries. Prunes were extensively planted in the early 1880's. Later, following a decline in prices, most of the prune orchards were pulled out. Bartlett pears, now the foremost agricultural product of the area, were first grown in about 1885.

The first crops and orchards were dry-farmed. In the 1880's the valleys were described as being "well watered," and it was also stated that there would never be an occasion to use artificial means to insure good crops. Although there are some diversions of surface water for irrigation, most of the irrigation water is pumped from the ground water basins. The most notable exception, and a fairly recent one, is the use of surface water in the Tule Lake, Edmands, and Helms Reclamation Districts. It is reported that a well was drilled in the 1880's to a depth of 525 feet in the northern portion of Big Valley near Clear Lake. This well was used for farm purposes and was described as a "never failing source of water," the water being raised by a windmill.

It has been reported that the first attempt at irrigation from ground water in Big Valley was made in 1910 from a dug well 20 feet deep, and a small acreage of pasture and hay land was irrigated. Irrigation of any extent from ground water first began to develop during the period from about 1918 to 1930. This trend has been greatly accelerated during recent years.

A survey conducted in 1953 as a part of the current investigation showed that the irrigated lands in the area totaled about 11,400 acres, while approximately 13,600 acres were dry-farmed. Principal irrigated crops in order of acreage devoted to each were pears, pasture, and alfalfa. Principal dry-farmed crops were pasture, walnuts, and grain.

Industry, though limited in the Clear Lake Area, is supported largely by agricultural production. Numerous processing plants for agricultural products are operated during harvest seasons to can and dehydrate vegetables, fruits, and nuts. There are two large sand and gravel plants near Kelseyville.

Water service agencies in the area are described in Chapter III. However, several public agencies have been organized to deal with the problems of land reclamation and drainage. The provisions of the California reclamation district laws have been used to effect the unwatering of low lands and their protection from overflow. Active reclamation districts in the area and data concerning them are listed in the following tabulation.

Reclamation district	*Year organized*	*Gross area of district, in acres*
No. 695 (Tule Lake)	1900	756
No. 2070 (Edmands)	1925	735
No. 2083 (Helms)	1945	201

Areas included within the boundaries of the foregoing agencies are shown on Plate 2.

Reclaimed land near Upper Lake and low-lift pumping installation used to supplement subirrigation

CHAPTER II

WATER SUPPLY

The sources of water supply of the Clear Lake Area are precipitation on overlying lands, and tributary surface and subsurface inflow. The water supply of the area is considered and evaluated in this chapter under the general headings "Precipitation," "Runoff," "Underground Hydrology," and "Quality of Water."

The following terms are used as defined in connection with the discussion of water supply in this bulletin.

Annual—This refers to the 12-month period from January 1st of a given year through December 31st of the same year, sometimes termed the "calendar year."

Seasonal—This refers to any 12-month period other than the calendar year.

Precipitation Season—This refers to the 12-month period from July 1st of a given year through June 30th of the following year.

Runoff Season—This refers to the 12-month period from October 1st of a given year through September 30th of the following year.

Investigational Seasons—This is used in reference to the three runoff seasons from 1948-49 through 1950-51 during which most of the field work on the Lake County Investigation was performed.

Mean Period—This is used in reference to periods chosen to represent conditions of water supply and climate over a long period of years.

Base Period—This is used in reference to periods chosen for detailed hydrologic analysis because prevailing conditions of water supply and climate were approximately equivalent to mean conditions, and because adequate data for such hydrologic analysis were available.

In studies for the State-wide Water Resources Investigation it was determined that the 50 years from 1897-98 through 1946-47 constituted the most satisfactory period for estimating mean seasonal precipitation generally throughout California. Similarly, the 53-year period from 1894-95 through 1946-47 was selected for determining mean seasonal runoff. In studies for the Clear Lake Area conditions during these periods were considered representative of mean conditions of water supply and climate.

Studies were made to select a base period for hydrologic analysis of the Clear Lake Area during which conditions of water supply and climate would approximate mean conditions, and for which adequate data on inflow, outflow, and ground water levels were available. It was determined that the three-year period from 1948-49 through 1950-51 was the most satisfactory in this respect. Conditions during this period closely approached conditions prevailing during the mean period and were considered to be equivalent. For this reason, determined relationships between base period water supply and present and probable ultimate water utilization were assumed to be equivalent to corresponding relationships which might be expected under mean conditions of water supply and climate.

PRECIPITATION

The Clear Lake Area lies within the southern fringe of storms which periodically sweep inland from the North Pacific Ocean during the winter months. Although the rainfall resulting from these storms is moderate on the average, direct precipitation provides a substantial portion of the water supply of the area.

Precipitation Stations and Records

Fourteen precipitation stations in or adjacent to the Clear Lake Area have unbroken records of 10 years' duration or longer. These stations are fairly well distributed areally and their records were sufficient to provide an adequate pattern of precipitation. Most of the records of precipitation have been published in bulletins of the United States Weather Bureau. Five of the records which were unpublished or were obtained from private individuals are included as Appendix B. Locations of the precipitation stations within the area of investigation are shown on Plate 3, entitled "Lines of Equal Mean Seasonal Precipitation," with reference numbers corresponding to those utilized in State Water Resources Board Bulletin No. 1, "Water Resources of California." The stations and reference numbers are listed in Table 1, together with elevations of the stations, periods and sources of record, and mean, maximum, and minimum seasonal precipitation. In those instances where it was necessary, precipitation records were extended to cover the 50-year mean period by comparison with records of nearby stations having records covering the mean period.

Precipitation Characteristics

The general precipitation pattern in the Clear Lake Area is irregular, as indicated on Plate 3. However, a comparison of records showed seasonal rainfall at

TABLE 1

MEAN, MAXIMUM, AND MINIMUM SEASONAL PRECIPITATION AT SELECTED STATIONS IN OR NEAR CLEAR LAKE AREA

Station number on Plate 3	Station	Elevation, in feet	Period of record	Source of record	Mean seasonal precipitation, in inches	Maximum and minimum seasonal precipitation	
						Season	Inches
1-40	Hullville	1,925	1907-37	USWB	48.77	1913-14 1923-24	78.47 23.87
5-81	Upper Lake	1,343	1886-1955	USWB	29.79	1940-41 1886-87	58.05 14.80
5-81A	Upper Lake, 7 west	1,620	1940-55	USWB	33.40	1940-41 1946-47	70.59 27.14
5-94	Lakeport	1,450	1901-55	USWB	27.90	1940-41 1923-24	47.17 14.09
5-94A	Scott Valley	1,375	1928-55	Private	31.00	1940-41 1930-31	56.64 14.39
5-94B	Upper Scott Valley	1,375	1931-55	Private	33.80	1940-41 1938-39	57.88 20.93
5-95	Kono Toyee	1,350	1874-1904	USWB	24.04	1877-78 1876-77	37.33 12.08
5-101	Kelseyville	1,390	1932-55	USWB	22.02	1940-41 1938-39	39.49 11.77
5-101A	Kelseyville, 2 north	1,345	1935-55	Private	22.95	1940-41 1939-40	41.44 13.12
5-101B	Lower Lake, 1 west	1,345	1935-55	Private	26.22	1937-38 1938-39	46.62 11.13
5-101C	Middletown	1,105	1940-55	USWB	40.43	1940-41 1946-47	76.04 32.42
5-102	Hobergs	3,350	1930-55	USWB	59.04	1937-38 1930-31	112.50 32.10
5-103	Clear Lake	1,350	1911-55	USWB	48.77	1913-14 1923-24	78.47 23.87
5-112	Helen Mine	2,760	1900-22	USWB	82.73	1908-09 1919-20	126.29 45.23

USWB United States Weather Bureau.

Lakeport to be a suitable index of general precipitation over the area. The record of precipitation at Lakeport is available since 1901-02. Recorded seasonal precipitation at this station is presented in Table 2 and shown graphically on Plate 4, entitled "Recorded Seasonal Precipitation at Lakeport."

Precipitation in the Clear Lake Area consists almost entirely of rainfall, and snowfall is rare. It decreases generally from west to east, with the lowest isohyet centered near Kelseyville in the Big Valley Unit. Mean seasonal precipitation ranges from about 23 inches near Kelseyville to about 33 inches near the base of the surrounding mountains.

Precipitation varies over wide limits from season to season, ranging at Lakeport from 50 per cent of the seasonal mean to 170 per cent. Maximum seasonal precipitation at Lakeport occurred in 1940-41 when 47.17 inches of rain were recorded. In 1923-24, the minimum season at this station, only 14.09 inches were recorded. Long-term trends of precipitation in the Clear Lake Area are shown on Plate 5, entitled "Accumulated Departure From Mean Seasonal Precipitation at Lakeport."

Almost 85 per cent of the seasonal precipitation in the Clear Lake Area occurs, on the average, during the five months from November through March, and summers are dry. Mean monthly distribution of precipitation at Lakeport is presented in Table 3.

Quantity of Precipitation

In order to facilitate certain phases of the analysis of ground water hydrology, presented later in this chapter, it was considered desirable to estimate the total quantity of precipitation on units of the Clear Lake Area. The mean seasonal quantity of precipitation was estimated by plotting on a map the recorded or estimated mean seasonal depth of precipitation at stations in or near the respective units. Lines of equal mean seasonal precipitation, or isohyets, were then drawn, as are shown on Plate 3. By planimetering the

TABLE 2

RECORDED SEASONAL PRECIPITATION AT LAKEPORT
(In inches)

Season	Precipitation	Season	Precipitation	Season	Precipitation
1901–02	34.44	1920–21	35.99	1940–41	47.17
02–03	26.30	21–22	21.76	41–42	38.32
03–04	43.15	22–23	26.61	42–43	30.86
04–05	36.27	23–24	14.09	43–44	21.48
		24–25	38.70	44–45	25.66
1905–06	37.33				
06–07	34.33	1925–26	24.24	1945–46	28.09
07–08	21.65	26–27	36.86	46–47	21.11
08–09	44.47	27–28	26.70	47–48	26.77
09–10	23.22	28–29	16.64	48–49	19.29
		29–30	23.46	49–50	21.86
1910–11	25.99				
11–12	19.22	1930–31		1950–51	34.26
12–13	23.47	31–32	21.80	51–52	36.69
13–14	44.56	32–33	16.70	52–53	31.12
14–15	40.37	33–34	22.24	53–54	26.50
		34–35	29.93		
1915–16	26.25			Average for 3-year base period, 1948-49 through 1950-51	25.14
16–17	21.75	1935–36	31.29		
17–18	17.49	36–37	24.62		
18–19	27.02	37–38	44.28		
19–20	14.19	38–39	17.83		
		39–40	34.71	Average for period of record	28.44
				Mean	27.90

areas between these isohyets, the weighted mean seasonal depth and total quantity of precipitation were estimated.

In order to determine seasonal depth and quantity of precipitation during the base period and investigational seasons, the foregoing estimates for the mean period were adjusted on the basis of recorded precipitation at Lakeport. The results of the estimates are presented in Table 4, which also shows the precipitation index for the base period and each of the investigational seasons. The term ''precipitation index'' refers to the ratio of the amount of precipitation during a given season to the mean seasonal amount, and is expressed as a percentage.

TABLE 3

MEAN MONTHLY DISTRIBUTION OF PRECIPITATION AT LAKEPORT

Month	Precipitation: In inches	Precipitation: In percent of seasonal total
July	0.02	0.1
August	0.02	0.1
September	0.39	1.4
October	1.28	4.6
November	2.98	10.7
December	5.19	18.6
January	6.14	22.0
February	5.59	20.0
March	3.66	13.1
April	1.56	5.6
May	0.78	2.8
June	0.29	1.0
Totals	27.90	100.0

In Table 4, the amount of rainfall on the Tule Lake, Edmands, and Helms Reclamation Districts and on Bachelor Valley was omitted. This omission was made as a result of findings which indicate that ground water problems are insignificant in the area lying within the boundaries of these reclamation districts. These districts are irrigated principally by diversion from Clear Lake and Robinson Slough. In Bachelor Valley, little success has been realized in attempts to obtain irrigation wells. As a result, this area is mainly dry-farmed. Therefore, the foregoing portions of the Upper Lake Unit were excluded from hydrologic studies for the determination of present supplemental requirements. Rainfall upon the pressure zone of the Big Valley Unit was also omitted in Table 4, since the unconsumed portion of this part of the water supply cannot return to the confined aquifers for re-use in this unit, and is not measured as outflow from the area because of the location of the stream gaging station measuring outflow from the Big Valley Unit. However, requirements for wa-

TABLE 4

ESTIMATED WEIGHTED SEASONAL DEPTH AND TOTAL QUANTITY OF PRECIPITATION IN UNITS OF CLEAR LAKE AREA

Season	Index of wetness	Big Valley Unit[a]		Scott Valley Unit		Upper Lake Unit[b]	
		Average depth, in inches	Quantity, in acre-feet	Average depth, in inches	Quantity, in acre-feet	Average depth, in inches	Quantity, in acre-feet
1948-49	69	18.3	22,600	22.1	4,600	20.6	11,300
1949-50	78	20.7	25,600	25.0	5,200	23.3	12,800
1950-51	123	32.4	40,100	39.2	8,100	36.5	20,100
1951-52	132	34.7	43,000	42.0	8,700	39.1	21,500
1952-53	112	29.4	36,400	35.6	7,400	33.2	18,200
Average for 3-year base period, 1948-49 through 1950-51	90	23.8	29,400	28.8	6,000	26.8	14,700
Mean	100	26.4	32,700	31.9	6,600	29.8	16,400

[a] Excluding Pressure Zone.
[b] Excluding the Tule Lake, Edmands, and Helms Reclamation Districts, and Bachelor Valley.

ter for lands in these excluded areas which are presently not irrigated, but are possible of irrigation in the future, were determined and are presented later in this bulletin.

RUNOFF

The area under investigation lies within the Clear Lake drainage basin. Major streams tributary to the units of the Clear Lake Area, and originating in the surrounding hills, discharge directly into Clear Lake with the exception of Scott Creek, which first discharges into Tule Lake Basin and Robinson Slough in the Upper Lake Unit, and thence into Clear Lake. Outflow from Clear Lake to Cache Creek is controlled by a dam located about five miles southeast of the natural rim of the lake near the town of Lower Lake. Streams tributary to the area are largely undeveloped and unregulated.

Stream Gaging and Lake Level Stations and Records

Records of stream flow of the principal streams of the Clear Lake Area were sufficient in number, length, and reliability for purposes of hydrologic studies. All of the streams within the area, however, possess records of relatively short duration. In order to estimate runoff of streams of the area, records of Kelsey Creek near Kelseyville were extended by comparison with the natural flow of Cache Creek near Lower Lake which has a relatively long record. The runoff of other streams in the area was then estimated by correlation with the estimated flow of Kelsey Creek.

Table 5 lists those stream gaging stations pertinent to the hydrography of the Clear Lake Area, together with their map reference numbers as shown on Plate 3, drainage areas above the stations, and periods and sources of records. Five of the records listed were obtained by use of continuous water stage recorders, while the remainder were obtained from staff gages which were read periodically. Continuous recorders were located on Kelsey Creek near Kelseyville, Scott Creek near Lakeport, Middle Creek at the bridge south of Upper Lake, Clover Creek near Upper Lake, and Adobe Creek at Bell Hill Road. The station on Kelsey Creek was installed, operated, and maintained by the United States Geological Survey, while that on Adobe Creek was installed, operated, and maintained by the Department of Water Resources. The remaining three stations were installed by the Corps of Engineers, and operated and maintained by the Department of Water Resources during the investigation. Those records which have not been published previously by the United States Geological Survey are included in Appendix C.

The Clear Lake level staff gage located at Lakeport, and known as the "Rumsey Gage," has long been recognized as the standard for measurement of water

TABLE 5

STREAM GAGING STATIONS IN UNITS OF CLEAR LAKE AREA

Station number on Plate 3	Stream	Station	Drainage area, in square miles	Period of record	Source of record*
		Big Valley Unit			
L-1	Adobe Creek	at Bell Hill Road	24	1948-50	D.W.R.
L-2	Adobe Creek	at Soda Bay Road		1948-50	D.W.R.
L-3	Adobe Creek	at Highland Cutoff		1949-50	D.W.R.
L-4	Cold Creek	at Konocti Road	26	1948-50	D.W.R.
L-5	Cold Creek	at Soda Bay Road		1949-50	D.W.R.
L-6	Highland Creek	at bridge above Adobe Creek	14	1948-50	D.W.R.
L-7	Hill Creek	at Bell Hill Road	15	1949-50	D.W.R.
L-8	Hill Creek	at Soda Bay Road		1949-50	D.W.R.
L-9	Hill Creek	at State Highway No. 29		1949-50	D.W.R.
L-10	Kelsey Creek	near Kelseyville	38	1946-54	U.S.G.S.
L-11	Kelsey Creek	at Soda Bay Road		1948-50	D.W.R.
L-12	Manning Creek	near Hopland Highway	5	1949-50	D.W.R.
L-13	Manning Creek	at State Highway No. 29		1948-50	D.W.R.
		Scott Valley Unit			
L-14	Hendricks Creek	near junction with Scott Valley Road		1949-50	D.W.R.
L-15	Scott Creek	at bridge south of Bachelor Valley		1949-50	D.W.R.
L-16	Scott Creek	near Lakeport	54	1948-54	U.S.E.D.
L-17	Scott Creek	at bridge to Hidden Lakes		1948-50	D.W.R.
		Upper Lake Unit			
L-18	Alley Creek	above junction with Clover Creek	9	1948-50	D.W.R.
L-19	Clover Creek	near Upper Lake	14	1948-54	U.S.E.D.
L-20	Clover Creek	at bridge south of Upper Lake		1949-50	D.W.R.
L-21	Middle Creek	near Upper Lake	47	1948-54	U.S.E.D.
L-22	Middle Creek	at bridge south of Upper Lake		1948-50	D.W.R.
L-23	Dayle Creek	near lower end of Bachelor Valley		1948-49	D.W.R.
L-24	Dayle Creek	at lower West Valley Road		1949-50	D.W.R.
L-25	Dayle Creek	at upper West Valley Road		1949-50	D.W.R.

* D.W.R.—Department of Water Resources.
U.S.G.S.—United States Geological Survey.
U.S.E.D.—Corps of Engineers, U. S. Army.

Typical of the coast ranges surrounding Clear Lake are these gently rolling, dry, grass-covered hills surface elevation of Clear Lake. Zero on the Rumsey gage corresponds to an elevation of 1,318.59 feet above mean sea level. The Department of Water Resources has corrected previous lake level measurements to present Rumsey gage readings, and has estimated the years of missing record. The recorded and estimated annual maximum and minimum water surface elevations for each year since 1873 are listed in Appendix D. Location of the Rumsey gage is shown on Plate 3.

Runoff Characteristics

Surface runoff from any watershed may be considered under one of two general classifications—either "natural flow" or "impaired flow." The term "natural flow" refers to the flow of a stream as it would be if unaltered by upstream diversion, storage, import, export, or change in consumptive use caused by modification of land use. The term "impaired flow" refers to the actual flow of a stream with any given stage of upstream development. Runoff to the Clear Lake Area closely approaches natural flow. There exist several minor diversions in the area, but these have little effect on the seasonal runoff.

As stated previously, the discharge of Kelsey Creek near Kelseyville was considered characteristic of runoff in other streams originating in the Clear Lake Area. The measured and estimated seasonal runoff at this station for the period from 1894-95 through 1952-53 is presented in Table 6, and depicted graphically on Plate 6, entitled "Recorded and Estimated Seasonal Runoff of Kelsey Creek Near Kelseyville."

Long-term trends of seasonal runoff considered typical of those for the Clear Lake Area are indicated on Plate 7, entitled "Accumulated Departure From Mean Seasonal Runoff of Kelsey Creek Near Kelseyville." The estimated mean monthly distribution of runoff of Kelsey Creek near Kelseyville is presented in Table 7.

TABLE 6

RECORDED AND ESTIMATED SEASONAL RUNOFF OF KELSEY CREEK NEAR KELSEYVILLE

(In acre-feet)

Season	Runoff	Season	Runoff	Season	Runoff
1894–95	83,500	1914–15	68,500	1934–35	36,500
95–96	56,000	15–16	42,500	35–36	43,000
96–97	44,000	16–17	29,000	36–37	30,500
97–98	20,000	17–18	22,000	37–38	85,000
98–99	23,000	18–19	33,500	38–39	18,500
1899–1900	34,000	1919–20	16,500	1939–40	57,000
00–01	42,000	20–21	57,000	40–41	82,500
01–02	53,500	21–22	29,500	41–42	61,000
02–03	41,000	22–23	30,000	42–43	43,000
03–04	75,000	23–24	15,000	43–44	27,000
1904–05	45,000	1924–25	48,000	1944–45	33,000
05–06	54,000	25–26	33,000	45–46	42,000
06–07	68,500	26–27	70,000	46–47	23,580
07–08	31,500	27–28	39,000	47–48	28,160
08–09	89,000	28–29	20,000	48–49	32,090
1909–10	31,000	1929–30	33,000	1949–50	29,110
10–11	43,000	30–31	17,500	50–51	53,430
11–12	21,000	31–32	30,000	51–52	71,480
12–13	28,000	32–33	23,000	52–53	61,280
13–14	76,500	33–34	25,000		
				Mean	42,000

TABLE 7

ESTIMATED MEAN MONTHLY DISTRIBUTION OF RUNOFF OF KELSEY CREEK NEAR KELSEYVILLE

Month	Percent of seasonal total	Month	Percent of seasonal total
October	0.2	April	10.7
November	1.9	May	3.4
December	14.9	June	1.2
January	20.1	July	0.2
February	27.3	August	0.0
March	20.1	September	0.0
		Total	100.0

Quantity of Runoff

Available records of stream flow, including those obtained from measurements made in connection with the investigation, were sufficient to permit estimates of the amount of runoff in the Clear Lake Area. However, the records cover such a short period that the estimates may be subject to some error, and should be considered tentative until confirmed by additional future records.

Inflow to and outflow from the Clear Lake Area was measured during portions of the period of investigation on all major streams and during all three years of the period of investigation on Kelsey Creek near Kelseyville, Scott Creek near Lakeport, and Middle Creek at the bridge south of Upper Lake. Unmeasured inflow was estimated for the period of investigation and was small in amount.

Measured and estimated seasonal surface inflow to and outflow from units of the Clear Lake Area during the investigational seasons, and averages for the base period as well as estimated mean seasonal values are presented in Table 8, together with respective runoff indices. The term "runoff index," appearing in Table 8, refers to the ratio of the average inflow of the base period to the mean inflow for the 53-year period, and is expressed as a percentage. It will be noted that surface outflow from the Scott Valley and Upper Lake Units generally exceeds inflow. This difference may be attributed in part to return flow from unconsumed precipitation on the units.

UNDERGROUND HYDROLOGY

The three separate and distinct ground water basins investigated in the Clear Lake Area contain both free and confined ground water aquifers, and furnish most of the water applied to irrigated lands. Replenishment of these basins is from percolation of rainfall, stream flow, drainage from adjacent hills, and the uncon-

TABLE 8

MEASURED AND ESTIMATED SEASONAL SURFACE INFLOW TO AND OUTFLOW FROM UNITS OF CLEAR LAKE AREA

(In acre-feet)

Unit and stream	1948-49	1949-50	1950-51	Average for 3-year base period 1948-49 through 1950-51	53-year mean	Average runoff index
INFLOW						
Big Valley						
Adobe Creek	11,200	11,900	18,000	13,700	14,100	
Cold Creek	1,000	600	1,500	1,000	1,200	
Hill Creek	200	200	400	300	300	
Kelsey Creek	32,100	29,100	53,400	38,200	42,000	
Manning Creek	1,500	1,300	2,500	1,800	1,900	
Totals	46,000	43,100	75,800	55,000	59,500	92
Scott Valley						
Scott Creek	33,300	24,100	53,600	36,700	42,000	
Estimated unmeasured inflow	3,000	3,200	5,600	3,900	4,200	88
Totals	36,300	27,300	59,200	40,600	46,200	88
Upper Lake						
Alley Creek	6,500	6,600	14,200	9,100	8,800	
Clover Creek	6,100	7,900	14,200	9,400	8,800	
Middle Creek	24,500	24,700	27,700	25,600	26,700	
Estimated unmeasured inflow	2,800	2,800	4,900	3,500	3,000	
Totals	39,900	42,000	61,000	47,600	47,300	101
OUTFLOW						
Big Valley						
Adobe Creek	14,800	11,700	33,300	19,900		
Cold Creek	800	500	1,600	1,000		
Hill Creek	300	300	800	500		
Kelsey Creek	14,000	17,300	39,300	23,500		
Manning Creek	1,900	2,900	6,000	3,600		
Totals	31,800	32,700	81,000	48,500		
Scott Valley						
Hendricks Creek	2,500	2,000	4,400	2,900		
Scott Creek	36,800	27,600	60,000	41,500		
Totals	39,300	29,600	64,400	44,400		
Upper Lake						
Middle Creek	42,900	40,000	68,000	50,300		
Totals	42,900	40,000	68,000	50,300		

sumed portion of applied irrigation water, together with some possible subsurface inflow from adjacent hills and mountains.

The term "free ground water," as used in this bulletin, generally refers to a body of ground water not overlain by impervious materials, and which moves under control of the water table slope. "Confined ground water" refers to a body of ground water overlain by material sufficiently impervious to sever free hydraulic connection with overlying water, and which moves under pressure caused by the difference in static head between the intake and discharge areas of the confined ground water body. In areas of free ground water the ground water basin provides regulatory storage to smooth out fluctuations in available water supplies, and changes in ground water storage are indicated by changes in ground water levels. Changes of water levels in confined ground water areas are indicative of changes in pressure of the confined water and do not indicate changes in storage capacity.

Data and information collected during the course of the Lake County Investigation indicate that both free and confined ground water exist in present zones of pumping in the Big Valley Unit, Scott Valley Unit, and Upper Lake Unit. Study of fluctuations of water levels in these units under varying conditions of draft and replenishment permitted a determination of changes in ground water storage in the free ground water basins, and the yield of ground water under stated conditions.

Ground Water Geology

The Big Valley Unit, Scott Valley Unit, and Upper Lake Unit are relatively flat alluviated valleys bordered in part by highlands composed of older rocks. Terraces underlain in part by sands and gravels older than Recent alluvium, and in part by still older formations, lie southwest of Kelseyville between Adobe and Kelsey Creeks, and east of Scott Valley. A list of geologic formations encountered in the Clear Lake Area follows.

Formation	*Age*
Franciscan formation	Jurassic
Cache formation	Lower Pleistocene or Upper Pliocene
Volcanic rocks	Middle and Upper Pleistocene
Older lake and terrace deposits	Upper Pleistocene (?)
Alluvium	Recent

Sandstone, shale, and serpentine of the Franciscan formation underlie most of the highlands surrounding the valleys of the investigational area. The rocks of this formation are highly sheared, contorted, and fractured. Water occurs in the formation principally in fractures in the rock, and wells in this formation do not generally yield enough water for other than domestic purposes.

Outcrops of the Cache formation are mostly buff-colored sandy silt and very fine sand, with some shale and pebble layers. The material composing this formation is generally poorly consolidated. Sediments of the Cache formation are exposed in road cuts on the east side of the terrace in the Big Valley Unit, and the formation probably underlies all the terrace, although beneath more recent deposits in most places. Beds of this formation outcrop in few places elsewhere in the area but may underlie extensive areas beneath more recent formations. The permeability of the formation is generally low, although a few course sedimentary strata and volcanic deposits are moderately to highly permeable.

Lava flows and tuffs of Middle and Upper Pleistocene age make up the western slopes of Mount Konocti east of Kelseyville. The predominant rock type is dacite or rhyodacite. The tuffs are interbedded with the lava flows and are principally composed of ash with some fragments of pumice. Beds of volcanic fragments forming an unconsolidated coarse ash or fine breccia have been encountered in a number of wells in the Big Valley Unit. Some or all of these beds probably represent a fall of volcanic material into quiet lake waters. The ash beds are highly permeable and have proved to be excellent water producers. The lavas of Mt. Konocti are apparently highly fractured and undoubtedly contain considerable ground water.

Sediments evidently younger than the Cache formation, yet older than Recent alluvium, have been recognized in the area. Deposits are of two types: terrace deposits now topographically higher than adjacent parts of the Big Valley Unit, Scott Valley Unit, and Upper Lake Unit; and, in these units, older lake deposits now buried by Recent alluvium. Terrace materials in the Scott Valley and Upper Lake Units include sands, gravels, and clays, with gravels being most common and generally occurring in a matrix of residual clay. The older lake deposits were probably laid down at a time when Clear Lake stood at a level higher than at the present. These sediments are generally blue lake clays and silts, and cannot be differentiated in well logs from the still older blue clays of the Cache formation which probably underlie them in some locations. The permeability of terrace materials is generally low, mainly because of their high clay content. The permeability of the older lake beds is likewise low since they are principally composed of clays and silts.

Recent alluvium comprises the uppermost deposits in the three units. In Big Valley, these deposits consist of alternating strata of gravel, sand, silt, and clay. The sand and gravel deposits generally occur as stringers, and therefore are dissimilar from clay beds which are generally continuous over a greater areal extent. Confined water exists below the clay beds in northern Big Valley. The northern part of Scott Valley is underlain by a thick blanket of sandy and silty clay which is mostly blue in color. This is underlain by strata which contain confined ground water. The structure in the Upper Lake Unit is similar to that of Big Valley in that it contains alternating strata of the various sediments. A thick stratum of sandy and silty clay occurs in the vicinity of Upper Lake and serves as a capping bed for an artesian aquifer of sand and gravel.

Both free and confined ground water characteristics are found in the three units. Data collected, and studies made, indicate that in the Big Valley Unit, the free ground water area, or forebay zone, exists generally south of a line coincident with the boundary of Township 13 North and Township 14 North. The area of confined ground water, the pressure zone, extends northward from the aforementioned line to beneath Clear Lake. Substantial recharge to the free ground water area of the Big Valley Unit occurs from percolation of waters in Kelsey and Adobe Creeks. The confined ground water area in the Scott Valley Unit covers most of the northerly portion of the valley. The free ground water area is rather limited in this unit and receives most of its recharge from percolation of Scott Creek water. Confined ground water in the Upper Lake Unit underlies about 75 per cent of that unit and extends northward from beneath Clear Lake. The free ground water lies north of the confined aquifers, and receives its recharge mostly from percolation of the waters of Middle, Clover, and Alley Creeks.

Specific Yield and Ground Water Storage Capacity

The term "specific yield," when used in connection with ground water, refers to the ratio of the volume of water a saturated soil will yield by gravity to its own volume, and is commonly expressed as a percentage. Ground water storage capacity is estimated as the product of the specific yield and the volume of material in the depth interval considered.

From geologic analysis of 225 well logs, specific yields of the free ground water basins in the three units were determined for a total depth of 100 feet at 20-foot intervals. Estimated storage capacities and specific yields of the free ground water basins within the units of the Clear Lake Area are presented in Table 9.

Ground Water Levels

In connection with the current investigation the Department of Water Resources conducted a series of measurements to static ground water levels in the Clear Lake Area at approximately 160 wells, of which about 40 were in confined ground water zones in the area. These measurements were made in the spring and fall of each year beginning with the fall of 1948, and were continued through the fall of 1953. The wells were chosen to form a comprehensive grid covering the area. In addition, monthly measurements were made at approximately 65 control wells during 1949 in order to observe behavior of ground water levels under varying conditions of draft and recharge. Available records of depth to ground water at wells in or adjacent to the Clear Lake Area are included in Appendix F.

Wells were numbered by the system utilized by the United States Geological Survey, according to township, range, and section. Under this system each sec-

TABLE 9

ESTIMATED SPECIFIC YIELD AND GROUND WATER STORAGE CAPACITY IN FREE GROUND WATER ZONES IN UNITS OF CLEAR LAKE AREA

Depth interval, in feet below ground surface	Big Valley Unit		Scott Valley Unit		Upper Lake Unit	
	Specific yield, in per cent	Storage capacity, in acre-feet	Specific yield, in per cent	Storage capacity, in acre-feet	Specific yield, in per cent	Storage capacity, in acre-feet
0- 20	7	20,900	10	1,400	6	1,700
20- 40	10	29,600	4	600	8	2,300
40- 60	9	26,600	5	700	6	1,700
60- 80	8	23,700	7	1,000	6	1,700
80-100	5	14,800	15	2,200	12	3,500
0-100	8	115,600	8	5,900	8	10,900

tion is divided into 40-acre plots which are lettered as follows:

D	C	B	A
E	F	G	H
M	L	K	J
N	P	Q	R

Wells were numbered within each of these 40-acre plots according to the order in which they are located. For example, a well having a number 13N/9W-14L2 would be found in Township 13 North, Range 9 West, and in Section 14. It would be further identified as the second well located in the 40-acre plot lettered L.

Depths to ground water in the Clear Lake Area, as measured each fall from 1948 to 1953, were plotted on maps, and lines of equal depth were drawn. An example of these plates is shown as Plate 8, entitled "Lines of Equal Depth to Ground Water, Fall of 1953." Plate 9, entitled "Lines of Equal Elevation of Ground Water, Fall of 1953," was prepared from data used for Plate 8, depth to ground water being subtracted from elevation of the measuring points above sea level to obtain elevations of the water level. Prior to the fall of 1948 little or no data on depth to ground water were available. Measurements of depth to ground water levels in confined zones within the area were not reported since many of the wells were flowing and facilities for obtaining these water level measurements were not available.

Table 10 shows depths from the surface of the ground to the water level at selected wells in free ground water zones in the several units of the Clear Lake Area during the spring and fall of the years from 1948 through 1953. The measurements were made prior to and following the period of summer pumping draft. Fluctuations in depth to ground

TABLE 10

MEASURED DEPTHS TO GROUND WATER AT REPRESENTATIVE WELLS IN FREE GROUND WATER ZONES IN UNITS OF CLEAR LAKE AREA

(In feet)

Year	Time of measurement	Well number			
		Big Valley Unit		Scott Valley Unit	Upper Lake Unit
		13N/9W-9D1	13N/9W-20P1	14N/10W-22A1	16N/10W-36J1
1948	Spring	----	----	---	----
	Fall	11.1	12.7	27.9	22.1
1949	Spring	3.8	7.8	20.1	0.6
	Fall	14.6	15.6	36.3	24.5
1950	Spring	4.7	6.0	20.8	2.2
	Fall	13.5	11.4	31.5	14.1
1951	Spring	3.1	4.2	21.3	3.0
	Fall	16.1	16.9	35.3	24.0
1952	Spring	2.7	5.3	----	----
	Fall	14.9	15.3	33.4	----
1953	Spring	3.8	5.8	22.9	4.6
	Fall	15.0	13.6	33.5	22.1
1954	Spring	----	----	19.7	----

water at these wells are depicted graphically on Plate 10, entitled "Measured Depths to Ground Water at Selected Wells."

From a study of available well measurements, estimates were made of the approximate average depth to ground water in free ground water zones of the Scott Valley Unit, Big Valley Unit, and Upper Lake Unit in the fall of each year from 1948 through 1953. These estimates, which constitute arithmetic averages of measurements of a grid of selected wells, are presented in Table 11 and are illustrated graphically on Plate 11, entitled "Average Fall Depth to Ground Water."

It is indicated that in the Big Valley Unit a lowering of the average ground water level occurred in the fall of 1949, followed by a small rise in the fall of 1950. The fall of 1951 average level again showed a small recession, lowering slightly again in the fall of 1952, and with a rise in the fall of 1953. The lowest average depth to ground water, 19.2 feet, was in the fall of 1952, which was also the time of the lowest average depths to ground water in the Scott Valley and Upper Lake Units which were 24.7 and 22.6 feet, respectively. The most notable indications from the data presented in Table 11, are that the average fall ground water levels did not reach excessive depths in any of the units during the period from the fall of 1948 to the fall of 1953, and that there was apparently an almost total recovery of water levels in each spring of the following years. This indicates that water utilization under present development does not exceed the mean water supply available to the area. Plate 12, entitled "Lines of Equal Change in Ground Water Elevation, Fall of 1948 to Fall of 1953," shows

TABLE 11

AVERAGE MEASURED DEPTH TO GROUND WATER IN FREE GROUND WATER ZONES IN UNITS OF CLEAR LAKE AREA

(In feet)

Season	Big Valley Unit	Scott Valley Unit	Upper Lake Unit
Fall, 1948	16.9	20.3	21.9
Spring, 1949	8.2	13.7	6.9
Fall, 1949	18.9	24.6	23.2
Spring, 1950	9.2	15.2	8.5
Fall, 1950	18.1	22.1	17.5
Spring, 1951	7.9	14.9	9.6
Fall, 1951	19.1	23.9	21.9
Spring, 1952	7.5	16.8	9.8
Fall, 1952	19.2	24.7	22.6
Spring, 1953	8.4	15.7	10.0
Fall, 1953	18.2	24.0	20.3

the changes in ground water levels over the five-year period of measurements made for the current investigation.

Estimated average changes in ground water elevations during the three-year base period and each of the investigational seasons were determined as the differences between average depths to ground water as given in Table 11, and are presented in Table 12.

In the Upper Lake and Scott Valley Units there were relatively few wells available for measurement in the free ground water zone, and indicated changes in water levels in those units may be greatly influenced by the large fluctuations in the few wells measured.

Change in Ground Water Storage

In an area of free ground water, the volume of soil unwatered or resaturated over a period of time, when multiplied by the specific yield, measures the change in ground water storage during that time. Available data on fluctuations of water levels at wells in the Clear Lake Area were sufficient to estimate the volume of soil unwatered or resaturated during the base period and the period of investigation. Changes in ground water storage were estimated for each unit by multiplying changes in depth to ground water, presented in Table 12, by the area of the free ground water zone in each unit, and by the specific yield of the appropriate depth zone. The results of these estimates are presented in Table 13.

It is indicated in Table 13 that a total net decrease in ground water storage in the Clear Lake Area of 2,550 acre-feet occurred during the three-year base period, in which conditions of water supply and climate were approximately equivalent to conditions during the mean period. As shown in Table 13, in the Big Valley and Scott Valley Units, a 2,290 and 260 acre-foot decrease in free ground water storage occurred, respectively, while in the Upper Lake Unit there was no change in free ground water storage during the base period. It should be noted that changes both in the average depth to ground water and in ground water storage were relatively small. In the Big Valley Unit, the average seasonal net decrease in ground water storage during the three-year base period was about 780 acre-feet per year, representing a seasonal drop in ground water levels of about 0.7 foot.

Subsurface Inflow and Outflow

Lines of equal elevation of ground water in the Clear Lake Area in the fall of 1953 are shown on Plate 9. Slopes of the water plane, as defined by these ground water contours, indicate the directions of subsurface flow.

In the Big Valley Unit, the ground water plane generally slopes northward toward Clear Lake. Subsurface inflow to this unit is mostly from the south and west. In the Scott Valley Unit free ground water flows northerly toward the outlet of Scott Valley. In

TABLE 12

ESTIMATED AVERAGE SEASONAL CHANGES IN GROUND WATER ELEVATIONS IN FREE GROUND WATER ZONES IN UNITS OF CLEAR LAKE AREA

(In feet)

Unit	1948 to 1949	1949 to 1950	1950 to 1951	1951 to 1952	1952 to 1953	Total for 3-year base period, 1948-49 through 1950-51	Total for period 1948-49 through 1952-53
Big Valley							
Spring to spring	------	−1.0	+1.3	+0.4	−0.9	------	------
Fall to fall	−2.0	+0.8	−1.0	−0.1	+1.0	−2.2	−1.3
Scott Valley							
Spring to spring	------	−1.5	+0.3	−1.9	+1.1	------	------
Fall to fall	−4.3	+2.5	−1.8	−0.8	+0.7	−3.6	−3.7
Upper Lake							
Spring to spring		−1.6	−1.1	−0.2	−0.2	------	------
Fall to fall	−1.3	+5.7	−4.4	−0.7	+2.3	0.0	+1.6

Irrigated lands near Lakeport provide rich pasture for fattening of beef cattle

2—57111

TABLE 13

ESTIMATED SEASONAL CHANGES IN GROUND WATER STORAGE IN UNITS OF CLEAR LAKE AREA

(In acre-feet)

Unit	1948 to 1949	1949 to 1950	1950 to 1951	1951 to 1952	1952 to 1953	Total for 3-year base period, 1948-49 through 1950-51	Total for period 1948-49 through 1952-53
Big Valley, 14,870 acres							
Spring to spring		—1,040	+1,350	+420	—940		
Fall to fall	—2,080	+830	—1,040	—100	+1,040	—2,290	—1,350
Scott Valley, 710 acres							
Spring to spring		—110	+20	—130	+80		
Fall to fall	—310	+180	—130	—60	+50	—260	—260
Upper Lake, 1,470 acres							
Spring to spring		—260	—180	—30	—30		
Fall to fall	210	+930	—720	—110	+380	0.0	+260
Totals, spring		—1,410	+1,190	+260	—890		
Totals, fall	—2,600	+1,940	—1,890	—270	+1,470	—2,550	—1,350

Minus indicates lowering water levels and a decrease in ground water storage.

the Upper Lake Unit subsurface inflow occurs in the upper ends of Bachelor, Middle, and Clover Valleys. The direction of flow is southeasterly in Bachelor Valley, southerly in Middle Valley, and westerly in Clover Valley.

An indirect method was used to estimate the net effect of subsurface inflow to and outflow from the several units of the Clear Lake Area. This involved evaluation of the difference between subsurface inflow and outflow as the item necessary to effect a balance between water supply and disposal. The sum of the items comprising the water supply of a given hydrologic unit must be equal to the sum of the items of water disposal. In the case of the Clear Lake Area, values for pertinent items other than the difference between subsurface inflow and outflow, including surface inflow, precipitation, change in ground water storage, and use of water, were quantatively measured or estimated. Determination of values for use of water is explained in Chapter III. Retention of subsurface inflow, or the difference between subsurface inflow and outflow, was the remaining unknown quantity in the equation of hydrologic equilibrium. Table 14 sets forth this equation for the Big Valley, Scott Valley, and Upper Lake Units.

Certain of the values presented in Table 14 are of large magnitude as compared to the derived excess of subsurface inflow or subsurface outflow. Small percentage errors in these larger quantities might introduce relatively large errors in the derived remainder.

Inspection of the totals for water supply and disposal during the three-year base period, given in Table 14, shows close agreement. For each of the investigational seasons, the derived remainders of subsurface inflow or outflow do not exceed about 7 per cent of either the total supply or disposal and do not exceed 1 per cent during the three-year base period. Thus, the indicated excess of subsurface flows is considered to be the result of natural discrepancies in measurements of hydrologic data. The results shown in Table 14 indicate that subsurface inflow is not a significant source of water supply to units of the Clear Lake Area when compared with surface inflow and precipitation.

Yield of Wells

Yield of wells is an important factor in the use of ground water in the Clear Lake Area. In Bachelor Valley in the Upper Lake Unit, irrigation with ground water is negligible because of the inability to obtain wells of adequate capacity. However, in the Big Valley and Scott Valley Units, and in the remainder of the Upper Lake Unit, wells of adequate capacity can generally be obtained.

Data on yield of wells in the Clear Lake Area were obtained from pump tests made by the Pacific Gas and Electric Company. Results of analyses of these data are presented in Table 15, which shows for the Big Valley, Scott Valley, and Upper Lake Units the number of wells tested, their average discharge, specific capacity, and depth. The term "specific capacity" refers to the number of gallons per minute produced by a pumping well per foot of drawdown. "Drawdown" refers to the lowering of the water level in a well caused by pumping and is measured in feet.

High Ground Water Areas

One of the major water problems facing the Clear Lake Area is the existence of large bodies of land subject to high ground water and with inadequate facilities for the drainage and removal of this water.

In the Big Valley Unit, lands subject to high ground water exist along the shore line of Clear Lake. In two locations this condition extends from the lake

TABLE 14

ESTIMATED EXCESS OF SEASONAL SUBSURFACE INFLOW OVER SUBSURFACE OUTFLOW IN UNITS OF CLEAR LAKE AREA

(In acre-feet)

Item and unit	Season 1948-49	1949-50	1950-51	Average for 3-year base period, 1948-49 through 1950-51
Big Valley				
Water Supply				
Precipitation	24,700	26,300	43,400	31,500
Surface inflow	46,000	43,100	75,800	55,000
Change in ground water storage	2,100	800	1,000	2,300
Subtotals	72,800	68,600	120,200	88,800
Water Disposal				
Surface outflow	31,800	32,700	81,000	48,500
Use of water	39,800	41,000	43,000	41,200
Subtotals	71,600	73,700	124,000	89,700
Difference—excess of subsurface inflow over subsurface outflow	—1,200	5,100	3,800	900
Scott Valley				
Water Supply				
Precipitation	4,600	5,200	8,100	6,000
Surface inflow	36,300	27,300	59,200	40,600
Change in ground water storage	300	—200	100	300
Subtotals	41,200	32,300	67,400	46,900
Water Disposal				
Surface outflow	39,300	29,600	64,400	44,400
Use of water	2,200	2,500	2,700	2,400
Subtotals	41,500	32,100	67,100	46,800
Difference—excess of subsurface inflow over subsurface outflow	300	—200	—300	—100
Upper Lake				
Water Supply				
Precipitation	11,300	12,800	20,100	14,700
Surface inflow	39,900	42,000	61,000	47,600
Change in ground water storage	200	—900	700	0
Subtotals	51,400	53,900	81,800	62,300
Water Disposal				
Surface outflow	42,900	40,000	68,000	50,300
Use of water	11,800	12,700	13,600	12,700
Subtotals	54,700	52,700	81,600	63,000
Difference—excess of subsurface inflow over subsurface outflow	3,300	—1,200	—200	700

south into Big Valley. One area subject to high ground water extends from the lake along Hill Creek for a distance of about three miles. The other is located between Kelsey and Cold Creeks and extends southerly from the lake for a distance of about 2.5 miles. Most of the lands so affected are not suitable for agricultural use at the present time. Correction of the high ground water conditions of these lands would make possible their utilization for a greater range of agricultural purposes.

In the Scott Valley Unit, lands subject to high ground water are in the lower reaches of Scott Valley.

TABLE 15

ESTIMATED AVERAGE YIELD OF WELLS IN UNITS OF CLEAR LAKE AREA

Unit	Number of wells tested	Average discharge, in gallons per minute	Average specific capacity, in gallons per minute per per foot of drawdown
Big Valley			
Free ground water zone	30	374	31
Confined ground water zone	11	395	77
Scott Valley			
Free ground water zone	2	339	80
Confined ground water zone	2	672	61
Upper Lake			
Free ground water zone	3	343	47
Confined ground water zone	8	230	31

The situation is accentuated during seasons of high precipitation and runoff. Adequate control of the runoff of Scott Creek, and provision of proper drainage facilities in the lower end of the valley, would probably alleviate the situation.

In the Upper Lake Unit, lands subject to high ground water include the overflow lands of Clover, Middle, Bachelor, and Scott Creeks. Most of these lands are underlain with high ground water at least part of the year. Drainage of these lands is presently accomplished by pumping. In the reclaimed areas bordering Clear Lake the ground water is regulated to some degree by subirrigation. The alluvial flood plains of Clover, Middle, Bachelor, and Scott Creeks are subject to high ground water during periods of heavy precipitation and runoff. Provision of proper drainage facilities in these areas and control of stream runoff would doubtlessly alleviate the problem.

Safe Ground Water Yield

The term "safe ground water yield" refers to the maximum rate of extraction of water from a ground water body which, if continued over an indefinitely long period of years, will result in the maintenance of certain desirable fixed conditions. Commonly, safe ground water yield is determined by one or more of the following criteria:

1. Mean seasonal extraction of water from the ground water body does not exceed mean seasonal replenishment to the body.

2. Water levels are not so lowered as to cause harmful impairment to the quality of the ground water by intrusion of other water of undesirable quality, or by accumulation and concentration of degradants or pollutants.

3. Water levels are not so lowered as to imperil the economy of ground water users by excessive costs of pumping from the ground water body.

Safe ground water yield, as derived in this bulletin, was measured as net extraction of ground water from the several ground water basins of the Clear Lake Area, as differentiated from total pumpage from these basins. In each of the units of the Clear Lake Area there exist free and confined ground water zones. The unconsumed portion of water pumped from and applied to lands overlying free ground water zones returns to the ground water body by percolation and is available for re-use, whereas the unconsumed portion of water pumped from confined aquifers and applied to overlying lands is not available for recharge to the confined aquifers since the impervious strata confining the aquifer precludes return thereto. Thus, water applied to lands overlying confined ground water bodies is considered as being wholly utilized, either being entirely consumed or in part returned to perched ground water or contributing to surface or subsurface outflow. The net rate of extraction, therefore, was taken to be only that portion of total pumpage from the ground water basin which was consumptively used or irrecoverably lost.

Under natural conditions, ground water is expended by consumptive use from seep lands and from lands where the water table is close to the ground surface, by effluent stream flow, and by subsurface outflow. Artificial development and utilization of ground water salvages all or a portion of such natural disposal by lowering ground water levels. This, in turn, affords opportunity for additional replenishment of ground water.

Analyses and data presented in this bulletin indicate that in the Big Valley, Scott Valley, and Upper Lake Units, present mean seasonal ground water extractions do not result in yields which exceed the safe ground water yields of the several units. It is indicated that the average change in ground water storage during the base period, during which period utilization of ground water increased, was insignificant in amount. Furthermore, it appears that ground water yields of the Big Valley, Scott Valley, and Upper Lake Units could be increased, since opportunity exists for additional ground water replenishment. The possibility of increasing ground water replenishment is discussed in Chapter IV.

Results of mineral analyses of ground water, discussed in a later section in this chapter, indicate that the ground waters found in the Big Valley, Scott Valley, and Upper Lake Units are generally of good mineral quality and well suited for irrigation and other uses. Furthermore, pumping lifts in these units have not been so lowered during the pumping season as to imperil the economy of ground water users, since present pumping lifts in the Big Valley, Scott Valley, and Upper Lake Units average about 40 feet, 25 feet, and 35 feet, respectively, as indicated by averages of available pump tests.

As discussed in Chapter III, seasonal utilization of ground water under present development and mean conditions of water supply and climate, in the Big Valley, Scott Valley, and Upper Lake Units, is estimated at 24,500 acre-feet, 2,300 acre-feet, and 10,500 acre-feet, respectively. These estimates are considered equivalent to the ground water yields of the respective units under the present pattern of pumping and utilization of ground water storage.

QUALITY OF WATER

The principal objective of the water quality investigation of the Clear Lake Area was determination of the quality of surface and ground waters with respect to their suitability for irrigation use. The surface water supplies of the Clear Lake Area are generally of excellent mineral quality and well suited from that standpoint for irrigation and other beneficial uses. Ground water of good mineral quality occurs generally throughout the area except in certain locations which possess excessive concentrations of boron.

It is desirable to define certain terms commonly used in connection with discussion of quality of water.

Quality of Water—Those characteristics of water affecting its suitability for beneficial uses.

Mineral Analysis—The quantitative determination of inorganic impurities or dissolved mineral constituents in water.

Contamination—Impairment of the quality of water by sewage or industrial waste to a degree which creates a hazard to public health through poisoning or spread of disease.

Degradation—Impairment of the quality of water due to causes other than disposal of sewage and industrial wastes.

Pollution—Impairment of the quality of water by sewage or industrial waste to a degree which does not create a hazard to public health, but which adversely and unreasonably affects such water for beneficial uses.

Complete mineral analysis included a determination of three cations, consisting of calcium, magnesium, and sodium; four anions, consisting of bicarbonate, chloride, sulphate, and nitrate; total salts; boron; and computation of per cent sodium. Partial analysis included only the determination of chlorides and total mineral solubles.

With the exception of boron, the concentrations of cations and anions in a water sample are expressed in this bulletin in terms of "equivalents per million." This was done because ions combine with each other on an equivalent basis, rather than on a basis of weight, and a chemical equivalent unit of measurement provides a better and more convenient expression of concentration. This is especially true when it is desired to compare the composition of waters having variable concentrations of mineral solubles. In the case of boron, concentrations are expressed on a weight basis of "parts per million" of water. In order to convert equivalents per million to parts per million, the concentration, expressed in equivalents per million, should be multiplied by the equivalent weight of the cation or the anion in question. Equivalent weights of the common cations and anions are presented in the following tabulation:

Cation	Equivalent weight	Anion	Equivalent weight
Calcium	20.0	Bicarbonate	61.0
Magnesium	12.2	Chloride	35.5
Sodium	23.0	Sulphate	48.0
		Nitrate	62.0

Data utilized in the determination of quality of water in the Clear Lake Area comprised complete mineral analyses of 14 surface water samples, including four samples from Clear Lake. Complete mineral analyses of ground water were made of 75 samples obtained from 63 wells. The data also included 132 partial analyses of ground water samples collected from 57 wells during the 1949 irrigation season. Additional samples were obtained during following seasons. Other data used during the course of the investigation included analyses of ground water obtained from the Rubidoux Laboratory of the United States Department of Agriculture, Riverside, California. Results of mineral analyses of water are presented in Appendix G of this bulletin.

Standards of Quality for Water

Investigation and study of the quality of surface and ground waters of the Clear Lake Area were largely limited to consideration of mineral constituents of the waters, with particular reference to their suitability for irrigation use. However, it may be noted that within the limits of the mineral analyses herein reported, a water which is determined to be suitable for irrigation may also be considered as being either generally suitable for municipal and domestic use, or susceptible to such treatment as will render it suitable for that purpose.

The criteria which were used as a guide to judgement in determining suitability of water for irrigation use comprised the following: (1) chloride concentration, (2) total soluble salts, (3) boron concentration, and (4) per cent sodium.

(1) The chloride ion is usually the most troublesome element in irrigation waters. It is not considered to be essential to plant growth, and excessive concentrations will inhibit growth.

(2) Total soluble salts furnish an approximate indication of the over-all mineral quality of the water, and may be approximated, in units of parts per million, by multiplying specific electrical conductance ($Ec \times 10^6$ at 25° C.) by 0.7. The presence of excessive amounts of dissolved salts in irrigation water will result in reduced crop yield.

(3) Crops are sensitive to boron concentration, but require a small amount (less than 0.1 part per million) for growth. They will usually not tolerate more than 0.5 to 2 parts per million, depending on the crop in question.

(4) Per cent sodium reported in the analyses is the proportion of the sodium cation to the sum of all cations, and is obtained by dividing sodium by the sum of calcium, magnesium, and sodium, all expressed in equivalents per million, and multiplying by 100. Water containing a high per cent sodium has an adverse effect upon the physical structure of the soil by dispersing the soil colloids and making the soil "tight," thus retarding movement of water through the soil, retarding the leaching of salts, and making the soil difficult to work.

The following excerpts from a paper by Dr. L. D. Doneen, of the Division of Irrigation of the University of California at Davis may assist in interpreting water analyses from the standpoint of their suitability for irrigation:

> "Because of diverse climatological conditions, crops, and soils in California, it has not been possible to establish rigid limits for all conditions involved. Instead, irrigation waters are divided into three broad classes based upon work done at the University of California, and at the Rubidoux, and Regional Salinity laboratories of the U. S. Department of Agriculture.
>
> "Class 1. EXCELLENT TO GOOD—Regarded as safe and suitable for most plants under any condition of soil or climate.
>
> "Class 2. GOOD TO INJURIOUS—Regarded as possibly harmful for certain crops under certain conditions of soil or climate, particularly in the higher ranges of this class.
>
> "Class 3. INJURIOUS TO UNSATISFACTORY—Regarded as probably harmful to most crops and unsatisfactory for all but the most tolerant.
>
> "Tentative standards for irrigation waters have taken into account four factors or constituents, as listed below.

Factor	Class 1 Excellent to good	Class 2 Good to injurious	Class 3 Injurious to unsatisfactory
Conductance ($Ec \times 10^6$ at 25° C.)	Less than 1000	1000-3000	More than 3000
Boron, ppm	Less than 0.5	0.5-2.0	More than 2.0
Percent sodium	Less than 60	60-75	More than 75
Chloride, epm	Less than 5	5-10	More than 10

(End of quotation)

The occurrence of boron in the Clear Lake Area in toxic quantities in certain irrigation waters has been noted during the investigation. Because of this, additional data giving permissible limits of boron for several classes of irrigation water with respect to the boron sensitivity of crops, as shown in the United States Department of Agriculture Technical Bulletin, No. 962, are presented in the following tabulation:

Class		In parts per million		
Rating	Grade	Sensitive crops	Semitolerant crops	Tolerant crops
1	Excellent	less than 0.33	less than 0.67	less than 1.00
2	Good	0.33 to 0.67	0.67 to 1.33	1.00 to 2.00
3	Permissible	0.67 to 1.00	1.33 to 2.00	2.00 to 3.00
4	Doubtful	1.00 to 1.25	2.00 to 2.50	3.00 to 3.75
5	Unsuitable	greater than 1.25	greater than 2.50	greater than 3.75

The relative tolerance of plants to boron, some of which are common to the Clear Lake Area, are presented in the following tabulation. The plants listed first in each group are considered most sensitive to boron, with sensitivity decreasing toward the end of each group. This information was also obtained from United States Department of Agriculture Technical Bulletin, No. 962.

SENSITIVITY OF CROPS TO BORON

Sensitive	Semitolerant	Tolerant
Apricot	Lima bean	Carrot
Peach	Sweet potato	Lettuce
Cherry	Bell pepper	Cabbage
Kadota fig	Tomato	Turnip
Grape (Sultanina and Malaga)	Pumpkin	Onion
	Zinnia	Broad bean
Apple	Oat	Gladiolus
Pear	Milo	Alfalfa
Plum	Corn	Garden beet
American elm	Wheat	Margel
Navy bean	Barley	Sugar beet
Jerusalem artichoke	Olive	Asparagus
Persia (English) walnut	Pugged Robin Rose	Athel (*Tomarix aphylla*)
Black walnut	Field pea	
Pecan	Radish	
	Sweet pea	
	Pina cotton	
	Acala cotton	
	Potato	
	Sunflower (native)	

Tolerance of plants to boron cannot be measured absolutely since such tolerance is in part dependent on the type of soil on which the plants are grown, amount of irrigation application, and other factors encountered in actual farming practices. It may be possible in the laboratory to render insoluble a portion of the boron content of a solution; however, it is not possible to apply such methods on the large scale required to make such water suitable for irrigation. In areas of high boron concentrations, measures must be undertaken which will minimize the toxic effects of the mineral. The only known practical measures are either blending with water of low boron concentration, substitution of good water for the degraded irrigation source, or cultivation of less sensitive crops.

Quality of Surface Water

Analysis of 14 surface water samples collected during the investigation from Clear Lake and from tributary streams which pass through the Big Valley, Scott Valley, and Upper Lake Units, indicates that the waters in the streams were generally of excellent quality but that water in Clear Lake could only be considered good. The higher concentration of boron in Clear Lake is the principal consideration in designating the quality of its water as only good.

Samples of water from Clear Lake and its tributaries have been collected periodically by several agencies since 1936. During 1938, analysis of Clear Lake waters showed the boron content near Lakeport, Lucerne, and Clear Lake Oaks was lower than that indicated at Lower Lake. These data seem to indicate a source of boron somewhere between Mount Konocti and Lower Lake. Concentration of boron in the lake has been observed to decrease with large inflows and increase with small inflows. Also, a high lake level is characterized by a lower concentration of boron than is a low lake level. Such changes in boron content may be considered to be the result of dilution by inflow, and concentration by evaporation.

Results of analysis of representative surface waters in the Clear Lake Area are presented in Appendix G.

Quality of Ground Water

Analysis of samples of ground water in the Clear Lake Area collected during the investigation indicate that this water is generally of excellent or good quality for irrigation. During the investigation complete analyses were made of 75 ground water samples and partial analyses of 132 ground water samples. Of the total number of 75 complete mineral analyses, 57 showed the water to be of excellent mineral quality and well suited for irrigation uses.

As in the case of surface water, the major degradant of ground water quality was found to be boron. Boron was found to exist in toxic quantities at a limited number of wells in the Upper Lake and Big Valley Units. In the Upper Lake Unit one well having ground water of poor quality was found in the Edmands Reclamation District, one in Bachelor Valley, and one along Scott Creek near the Tule Lake Reclamation District. In the Big Valley Unit the areas affected by boron seem to be along the lower edges of the valley. However, since the wells which contain boron in toxic amounts occur in the immediate vicinity of other wells producing good quality water, no distinct area may be said to produce water of a quality injurious to crops. Analyses of ground water samples discussed herein are presented in Appendix G.

CHAPTER III

WATER UTILIZATION AND SUPPLEMENTAL REQUIREMENTS

The nature and extent of water utilization and of requirements for supplemental water in the Lake County Area, both at the present time (1953) and under probable conditions of ultimate development, are considered in this chapter. In connection with the discussion, the following terms are used as defined:

Water Utilization—This term is used in a broad sense to include all employments of water by nature or man, whether consumptive or nonconsumptive, as well as irrecoverable losses of water incidental to such employment, and is synonymous with the term "water use."

Demands for Water—Those factors pertaining to rates, times, and places of delivery of water, quality of water, losses of water, etc., imposed by control, development, and use of the water for beneficial purposes.

Water Requirement—The amount of water needed to provide for all beneficial uses of water and for irrecoverable losses incidental to such uses.

Supplemental Water Requirement—The water requirement over and above the sum of safe ground water yield and safe surface water yield.

Consumptive Use of Water—This refers to water consumed by vegetative growth in traspiration and building of plant tissue, and to water evaporated from adjacent soil, from water surfaces, and from foliage. It also refers to water similarly consumed and evaporated by urban and nonvegetative types of land use.

Applied Water—The water delivered to a farmer's headgate in the case of irrigation use or to an individual's meter in the case of urban use, or its equivalent. It does not include direct precipitation.

Ultimate—This term is used in reference to conditions after an unspecified but long period of years in the future when land use and water supply development will be at a maximum and essentially stabilized. It is realized that any present forecasts of the nature and extent of such ultimate development, and resultant water utilization, are inherently subject to possible large errors in detail and appreciable error in the aggregate. However, such forecasts, when based upon best available data and present judgment, are of value in establishing long-range objectives for development of water resources. They are so used herein, with full knowledge that their re-evaluation after the experience of a period of years may result in considerable revision.

The present (1953) water requirement in the Lake County Area was estimated by the application of appropriate factors of unit water use to the present land use pattern as determined from survey data. The probable ultimate water requirement was similarly estimated, by use of an ultimate land use pattern projected from the present pattern on the basis of land classification data, the assumption being made that under ultimate conditions of development all irrigable lands would be irrigated.

Certain possible nonconsumptive requirements for water, such as those for flood control, conservation of fish and wildlife, recreation, etc., will be of varying signficance in the design of works to meet supplemental consumptive requirements for water in the Clear Lake Area. In most instances, the magnitudes of such nonconsumptive requirements are relatively indeterminate and dependent upon allocations made after consideration of economic factors. For these reasons, water requirements for flood control, conservation of fish and wildlife, and recreation are discussed in general terms in this chapter, but not specifically evaluated.

Water utilization is considered and evaluated in this chapter under the general headings "Present (1953) Water Supply Development," "Land Use," "Unit Use of Water," "Past and Present (1953) Water Requirements," "Probable Ultimate Water Requirements," "Nonconsumptive Water Requirements," and "Factors of Water Demand." Supplemental water requirements are similarly treated under the two general headings "Present (1953) Supplemental Water Requirements" and "Probable Ultimate Supplemental Water Requirements."

WATER UTILIZATION

Of the total amount of water presently utilized in the Clear Lake Area, approximately 50 per cent is consumed in the production of irrigated crops, while the remainder is consumed by dry-farmed and fallow lands, native vegetation, and lands given over to miscellaneous types of use, including domestic and municipal.

Of the total area of about 32,600 acres within the Clear Lake Area, it is indicated that ultimately about 27,900 acres will require organized water service. The remainder, approximately 4,700 acres, comprises lands considered not suitable for irrigation. It is probable that the predominant importance of irrigated agriculture, as related to utilization of water in the Clear Lake Area, will continue to prevail in the future.

Present (1953) Water Supply Development

Clear Lake has been utilized for many years as a reservoir for storage of water for irrigation use in Yolo County. Because of this use of water originating in the Clear Lake Area, the use of surface water in the area has been limited and further development for such purposes is restricted. As a result, the present water supply development within the invesitgational area is, with few exceptions, limited to pumping from ground water basins.

Within recent years there has been an increase in irrigation development with a resultant increase in the use of ground water. During 1953 there were 232 wells of heavy draft with pumps powered by motors of five horsepower or more, and of this number 224 were used for irrigation. The remaining wells supplied water for urban and industrial uses. A number of additional wells of light draft supplied water for domestic purposes. Of the 224 irrigation wells of heavy draft, 195 were located in Big Valley, 11 in Scott Valley, and 18 in the Upper Lake Unit.

The major surface diversion within the investigational area is made from Clear Lake to serve the Edmands and Helms Reclamation Districts, located in the Upper Lake Unit adjacent to Clear Lake. Here a system of canals and ditches supplies water to irrigated land which has been reclaimed from Clear Lake overflow lands by levees. Individually owned pumps raise the water from sloughs of Clear Lake for irrigation. Drainage pumps operated by the reclamation districts expel excess winter water and overflow from Scott Creek, and unconsumed water from irrigation, into Robinson Slough.

The largest single nonagricultural user of water is the town of Lakeport, where about 135,000,000 gallons, or 410 acre-feet of water, have been pumped each year during the past several years. The water supply for Lakeport is obtained from two wells located in the bed of Scott Creek, about two miles west of Lakeport. Some business establishments and small acreages in Lakeport have their own water systems, pumping from shallow wells. The town of Kelseyville is served water by the Kelseyville County Water District which maintains two wells on the east bank of Kelsey Creek in Kelseyville. It is estimated that the production of this water system was about 31 acre-feet in 1949. There is no industrial use of ground water of any consequence in Kelseyville.

Industrial use of water in the Clear Lake Area is of minor importance, the cannery near Upper Lake probably being the greatest user during the canning season. The water supply is obtained from ground water.

The respective areas within the several units of the Clear Lake Area served by ground water and surface water in 1949 are shown in Table 16.

Table 17 lists the water service agencies in Lake County, together with their general locations and approximate number of services in 1952.

TABLE 16

GROUND AND SURFACE WATER SERVICE AREAS IN UNITS OF CLEAR LAKE AREA IN 1949

(In acres)

Unit	Ground water	Surface water
Big Valley	5,480	150
Scott Valley	420	30
Upper Lake	680	1,270
Totals	6,580	1,450

TABLE 17

WATER SERVICE AGENCIES IN LAKE COUNTY, 1952

Type and name of agency	Location, in or near	Number of services
City Waterworks Municipally Owned		
Lakeport	Lakeport	860
Privately Owned Water Companies		
Anderson Springs Water Company	Anderson Springs	90
Clear Lake Park Water Company	Clearlake	470
Lucerne Water Company	Lucerne	180
Mutual Water Companies		
Clearlake Oaks Water Company	Clearlake Oaks	400
Crescent Bay Improvement Company	Lower Lake	30
Glenhaven Mutual Water Company	Glenhaven	50
Highlands Water Company	Clearlake Highlands	420
Jago's Resort Water Supply	Lower Lake	10
Lakewood Resort Water Supply	Kelseyville	10
Loch Lomond Mutual Water Company	Kelseyville	120
Manakee Mutual Water Company, Inc.	Clearlake Highlands	60
Nice Mutual Water Company	Nice	30
Sulphur Bank Mine	Clearlake Oaks	10
County Waterworks Districts		
Lower Lake County Waterworks District No. 1	Lower Lake	110
Kelseyville County Waterworks District No. 3	Kelseyville	140
Flood Control and Water Conservation Districts		
Lake County Flood Control and Water Conservation District		

Appropriation of Water. Since the effective date of the Water Commission Act on December 19, 1914, about 18 applications to appropriate water of streams of the investigational area have been filed with the State Water Rights Board or its predecessors. These applications are listed in Appendix H, together with pertinent information on the proposed diversions and uses of water and present status of the applications.

The applications listed in Appendix H should not be construed as comprising a complete or even partial statement of water rights in the Clear Lake


Upstream face

Clear Lake Dam conserves water of Clear Lake

Downstream face

Area. They do not include appropriative rights initiated prior to December 19, 1914, riparian rights, correlative rights of overlying owners in ground water basins, nor prescriptive rights which may have been established on either surface streams or ground water basins, none of which are of record with the State Water Rights Board. In general, water rights may be firmly established only by court decree.

The rights of the Clear Lake Water Company, a public utility and the principal appropriator of Clear Lake water, were acquired before the Water Commission Act went into effect, and consequently its application is one of those which is not listed in Appendix II. The company bases its claim to the use of waters from Clear Lake under filings made in accordance with the Civil Code and under certain purchased rights.

Court Decrees Regarding Operation of Clear Lake. In order to effectively utilize waters of Clear Lake, the Yolo Water and Power Company, predecessor to the Clear Lake Water Company, in 1914 and 1915 constructed a dam across the channel of Cache Creek about five miles downstream from the rim of the lake. The dam is capable of impounding water in the lake to an elevation of 10.3 feet on the Rumsey gage. The gage is of the staff type and is located on the city wharf in Lakeport. The zero of the gage is 20.1 feet lower than the center of a large cement star in the northeast corner of the Courthouse Yard at Lakeport and 21.56 feet below the iron step at the front entrance to the Bank of Lake Building. The gage for many years has been utilized and recognized as the standard for measurement of the levels of Clear Lake. Zero on the Rumsey gage corresponds to an elevation of 1,318.59 feet above mean sea level.

The erection or maintenance of a dam or dams across the Cache Creek outlet of Clear Lake has been a source of much litigation. In the case of Grigsby vs. Clear Lake Water Works Company, reported in 40 Cal. 396 (1870), it will be found that controversy first commenced in 1853 upon the construction of such a dam. The dams in question in the action, however, were built some eight years later. This action was brought by a rim land owner to abate a nuisance claimed from overflow and for damages. Judgment for the plaintiff was reversed and a new trial ordered. Further litigation occurred when the Clear Lake Water Works Company brought action to recover damages against Lake County for destruction of the company's property by mobs or riots. This case is reported in 45 Cal. 90 (1872), where the Supreme Court held the company was entitled to a trial of its cause.

In Yolo Water and Power Company vs. Fannie J. Hudson, 182 Cal. 48, 186 Pac. 722 (1920), the company then owning the present dam appealed from a decision of the Superior Court in condemnation of certain rim lands around Clear Lake. Some years later B. F. Conaway, et al sued the Yolo Water and Power Company, see 204 Cal. 125, 266 Pac. 944 (1928), to prevent the company from draining water originating in Clear Lake into Willow Slough to the damage of the plaintiff's lands along Willow Slough.

In 1919, the Yolo Water and Power Company, in order to improve conditions for outflow from the lake, commenced to deepen the outlet channel and had completed the work for a distance of about two miles when it was stopped by injunction. The suit to stop the work was brought by owners of land around the lake who had not conveyed any rights to the company, in a case entitled "Gopcevic vs. Yolo Water and Power Company," in the Superior Court of Mendocino County. Pursuant to stipulation by all of the parties to this action, a decree, a copy of which is included in Appendix I, was entered by the court on October 7, 1920. The salient points of this decree are as follows:

1. The defendant is perpetually enjoined from excavating the outlet of Clear Lake to any depth greater than four feet below zero on the Rumsey gage.
2. The defendant in its operation of the dam is perpetually enjoined from lowering the level of the lake below zero on the Rumsey gage.
3. The defendant is perpetually enjoined in its operation of the dam from raising the level of the lake in excess of 7.56 feet above zero on the Rumsey gage except during storms and floods, for a period of not to exceed ten days, but in no event over 9.00 feet above zero on said gage.
4. The operation of the dam of the defendant is made subject to control by the State Railroad Commission.
5. If the injunction is violated, or if the defendant ceases to operate its dam, the plaintiffs and intervenors are entitled to restore the natural rim of the lake (Grigsby Riffle) to either one or two feet above zero on Rumsey gage, in accordance with certain specified conditions.

The lake has been operated for irrigation storage in accordance with the terms of this decree, so far as is possible, since 1920.

Following widespread flooding around the rim of Clear Lake in the winter season of 1937-38, the Clear Lake Water Company, together with the County of Lake, and assisted by the Department of Public Works, undertook to enlarge the outlet of Clear Lake to enable better control of water levels of the lake. A complaint to this action was filed in the Superior Court of Yolo County by downstream interests along Cache Creek. As a result the "Bemmerly Decree," a copy of which is included in Appendix I, was entered by the court on December 18, 1940. The salient point of this decree is as follows:

The defendants are perpetually enjoined from widening, deepening, or enlarging the outlet of Clear Lake so as to increase the flow of water from Clear Lake into Cache Creek.

Dams Under State Supervision. The Department of Water Resources supervises the construction, enlargement, alteration, repair, maintenance, operation, and removal of dams for the protection of life and property within California. All dams in the State, excepting those under federal jurisdiction, are under the jurisdiction of the Department. "Dam" means any artificial barrier, together with appurtenant works, if any, across a stream, watercourse, or natural drainage area, which does or may impound or divert water, and which either (a) is or will be 25 feet or more in height from natural stream bed to crest of spillway, or (b) has or will have an impounding capacity of 50 acre-feet or more. Any such barrier, which is or will be not in excess of six feet in height, regardless of storage capacity, or which has or will have a storage capacity not in excess of 15 acre-feet, regardless of height, is not considered a dam. A list of dams in Lake County presently under state supervision, together with pertinent data, is given in Appendix J.

Land Use

As a first step in estimating the amount of the water requirements in the Clear Lake Area during the base period and investigational seasons, determinations were made of the nature and extent of land use prevailing during these periods. Similarly, the probable nature and extent of ultimate land use, as related to water requirement, was forecast on the basis of land classification survey data which segregated lands of the area in accordance with their suitability for irrigated agriculture.

Past and Present Patterns of Land Use. In connection with the United States Census, figures for the total amount of irrigated land in Lake County are available for 10-year intervals since 1919. According to these figures the amount of irrigated land in Lake County increased from 1,107 acres in 1919 to 9,358 acres in 1949. Most of the irrigated land in Lake County is located within the area of investigation, the most notable exception being the irrigated area in the vicinity of Middletown. In 1946 the Bureau of Reclamation, United States Department of the Interior, made a complete land use survey in Big Valley. A comprehensive land use survey of the Clear Lake Area was made in 1948-49 as a part of the current investigation. The area was checked in 1949-50, 1950-51, and resurveyed in 1952-53 to obtain data on changes in land use and on increases in surface and ground water utilization.

Data available from the foregoing surveys were sufficient to determine the average land use pattern in the Clear Lake Area during the three-year base period. For purposes of this bulletin, the most recent land use pattern available, that for the 1952-53 season, was considered to represent present conditions of land use and development in the area, and is so referred to in subsequent discussions. Summaries of present land use in the various units of the Clear Lake Area are presented in Table 18. Summaries of the results of the land use surveys of the Clear Lake Area made in connection with the current investigation, and the average land use pattern for the base period, are presented in Table 19. Detailed results of the 1948-49 land use survey are presented as Table 2 of Appendix K. This appendix is described hereinafter. The base period and present land use patterns of the Clear Lake Area, summarized by general classes of land use and for the forebay and pressure zones of the several units, are presented in Table 20. Lands presently irrigated in the Clear Lake Area are shown on Plate 13, entitled "Irrigated and Irrigable Lands, 1953."

TABLE 18

PRESENT PATTERN OF LAND USE IN UNITS OF CLEAR LAKE AREA

(In acres)

Class and type of land use	Big Valley Unit	Scott Valley Unit	Upper Lake Unit	Total
Irrigated Lands				
Alfalfa	560	200	1,330	2,090
Beans	0	0	360	360
Corn	20	10	180	210
Grain	0	0	0	0
Hops	0	120	0	120
Pasture	1,340	150	1,010	2,500
Pears	3,010	550	290	3,850
Pears with permanent cover crop	230	0	0	230
Prunes	130	0	0	130
Truck	0	0	0	0
Walnuts, young	150	10	20	180
Walnuts, young, with alfalfa	140	0	90	230
Walnuts and grain	0	0	0	0
Walnuts and alfalfa	20	0	40	60
Walnuts	530	100	80	710
Vineyard	720	10	20	750
Subtotals	6,850	1,150	3,430	11,430
Dry-farmed Lands				
Pasture and orchard	3,430	460	2,220	6,110
Other crop	3,900	490	3,090	7,480
Subtotals	7,330	950	5,310	13,590
Native Vegetation				
Swamp	320	0	340	660
Heavy brush	2,380	60	0	2,440
Light brush	270	30	140	440
Sparse brush	400	50	150	600
Subtotals	3,370	140	630	4,140
Miscellaneous				
Urban and farmstead	940	80	560	1,580
Water surface	700	140	460	1,300
Roads and highway	220	30	110	360
Wasteland	140	0	20	160
Subtotals	2,000	250	1,150	3,400
Totals	19,550	2,490	10,520	32,560

A blossoming pear orchard near Finley

TABLE 19

RECENT PATTERNS OF LAND USE IN CLEAR LAKE AREA

(In acres)

Class and type of land use	1948-49	1949-50	1950-51	Present, 1952-53	Base period average, 1948-49 through 1950-51
Irrigated Lands					
Alfalfa	1,180	1,410	1,640	2,090	1,410
Beans	290	300	320	360	300
Corn	60	90	120	210	90
Grain	80	60	20	0	60
Hops	110	110	140	120	110
Pasture	1,980	2,120	2,240	2,500	2,120
Pears	3,220	3,380	3,540	3,850	3,380
Pears with permanent cover crop	280	270	250	230	270
Prunes	110	110	110	130	110
Truck	20	20	10	10	20
Walnuts, young	50	70	110	180	70
Walnuts, young, with alfalfa	40	90	140	230	9
Walnuts and grain	20	10	10	0	10
Walnuts and alfalfa	40	50	50	60	50
Walnuts	520	560	620	710	560
Vineyard	20	200	380	750	200
Subtotals	8,020	8,850	9,700	11,430	8,850
Dry-farmed Lands					
Pasture and orchard	9,910	8,960	7,990	6,110	8,960
Other crops	6,740	6,950	7,150	7,480	6,950
Subtotals	16,650	15,910	15,140	13,590	15,910
Native Vegetation					
Swamp	650	650	660	660	650
Heavy brush	2,560	2,530	2,500	2,440	2,530
Light brush	460	460	450	440	460
Sparse brush	820	760	710	600	760
Subtotals	4,490	4,400	4,320	4,140	4,400
Miscellaneous					
Urban and farmstead	1,580	1,580	1,580	1,580	1,580
Water surface	1,300	1,300	1,300	1,300	1,300
Roads and highways	360	360	360	360	360
Wasteland	160	160	160	160	160
Subtotals	3,400	3,400	3,400	3,400	3,400
Totals	32,560	32,560	32,560	32,560	32,560

TABLE 20

SUMMARY OF PRESENT AND BASE PERIOD LAND USE IN HYDROLOGIC ZONES IN UNITS OF CLEAR LAKE AREA

(In acres)

Unit and class of land use	Average for 3-year base period, 1948-49 through 1950-51		Present, 1952-53	
	Forebay zone	Pressure zone	Forebay zone	Pressure zone
Big Valley				
Irrigated lands	4,120	1,790	4,810	2,040
Dry-farmed lands	6,590	1,580	5,890	1,440
Native vegetation	2,610	860	2,620	750
Miscellaneous	1,550	450	1,550	450
Totals	14,870	4,680	14,870	4,680
Scott Valley				
Irrigated lands	240	380	410	740
Dry-farmed lands	290	1,150	150	800
Native vegetation	110	70	80	60
Miscellaneous	70	180	70	180
Totals	710	1,780	710	1,780
Upper Lake				
Irrigated lands	290	2,030	810	2,620
Dry-farmed lands	1,970	4,330	1,490	3,820
Native vegetation	250	500	210	420
Miscellaneous	220	930	220	930
Totals	2,730	7,790	2,730	7,790

Probable Ultimate Pattern of Land Use. Lands of the Clear Lake Area were classified with respect to their suitability for irrigated agriculture. For the Big Valley Unit use was made of a land classification survey made by the United States Bureau of Reclamation. These data were supplemented and checked in the course of the field surveys made in the other units as a part of the investigation.

The land classification made during the investigation was based on standards involving physical factors and known inherent conditions of soils, topography, and drainage. The conditions relative to the soils that largely determine their suitability for irrigation are depth, texture, and structure. These physical factors to a large extent determine the moisture-holding capacity, the root zone area, the ease of irrigation and cultivation, and the available nutrient capacity of the soil. Topographic conditions considered were the degree of slope and undulation. These affect the ease of irrigation and the type of irrigation practice required to provide water at a proper rate to cropped land. A proper rate of irrigation application will permit the soil to absorb and hold moisture without erosion or excessive losses through runoff or percolation. As a general rule, no lands with smooth slopes in excess of a 30-foot rise in 100 feet of horizontal distance were considered to be suitable for development by irrigation. Drainage is highly important and is closely associated with problems of salinity, alkalinity, and water-logging of lands. It was assumed that under conditions of ultimate development all land suitable for reclamation will be reclaimed.

Economic factors relating to the development, production, or marketing of adaptable crops were not considered in making the land classification, nor were costs of clearing, leveling, or other operations required to prepare lands for cultivation. The classification was predicated on the ultimate potential of the land, without regard to availability of water or present land utilization. On the basis of the foregoing standards, agricultural lands of the Clear Lake Area were classified as irrigable or nonirrigable. Results of the land classification of the Lake County Area are presented in Table 21. Locations of the irrigable and nonirrigable lands are shown on Plate 13.

By use of the land classification data, a probable ultimate pattern of land use for the Clear Lake Area was forecast. The general assumptions were made that under an increasing pressure of demand for agricultural products all irrigable lands would eventually be provided with irrigation service and the crop pattern prevailing at present would not be substantially modified. Provision was also made for probable increase in lands devoted to farmsteads, roads, urban, and other miscellaneous purposes under conditions of probable ultimate development.

The estimated ultimate land use pattern of the Clear Lake Area, summarized by general classes of land use and by units of the area, is presented in Table 22. Irrigable lands, as determined by the land classification survey data, and as indicated by the probable ultimate land use pattern, are shown on Plate 13.

Unit Use of Water

The second step in evaluation of water requirements involved the determination of unit values of water use for each type of land use in the Clear Lake Area. Esimates of these unit values were based on the results of studies in the investigational area and of prior investigations in other areas.

Mean seasonal unit values of consumptive use of water were obtained generally from a report of the Soil Conservation Service of the United States Department of Agriculture which was prepared in cooperation with the Department of Water Resources. This report, entitled "Irrigation Practices and Consumptive Use of Water in Lake County, California," dated June, 1951, by Harry F. Blaney and Paul A. Ewing, is included in this bulletin as Appendix K. Unit values of consumptive use of irrigated crops, dry-farmed crops, and miscellaneous land use were assumed not to have varied for the three seasons of the investigation. This assumption was based on the facts that growing season temperatures during each season varied only slightly from the mean, and that precipitation during each winter season was more than sufficient to furnish the winter consumptive use of these classes of land use. However, estimates of seasonal unit values of consumptive use by native vegetation were varied, depending upon the amount of available rainfall during the investigational seasons as related to the amount that would occur under mean conditions of water supply and climate. Estimated mean seasonal unit values of consumptive use of water in the Big Valley Unit, and in the Scott Valley and Upper Lake Units, including consumptive use of precipitation, are presented in Table 23.

Consumptive use of water is the measure of water requirement in free ground water areas. In pressure zones, however, nearly all water utilized is pumped from confined aquifers and the unconsumed portion constitutes an irrecoverable loss. Consequently, the amount of ground water pumped, or the applied water, is the significant measure of water requirements in the pressure zones.

During the current investigation, measurements were made of the amount of water applied for irrigation of selected plots of principal crops in the Clear Lake Area. Records of such application of water pumped from wells were obtained for 45 plots during 1949, and 14 plots during 1950. For each well the pump discharge, acreage of each type of crop irrigated, number of irrigations, periods of irrigation, and amounts of water applied in each irrigation were recorded. From these data, monthly and total seasonal applications of water to each crop were determined. Results of these studies, which may be considered representative of prevailing irrigation practices in the Clear Lake Area, are summarized in Table 24. Detailed results of the plot studies are presented in

TABLE 21

CLASSIFICATION OF LANDS IN UNITS OF CLEAR LAKE AREA

(In acres)

Land class	Big Valley Unit	Scott Valley Unit	Upper Lake Unit	Total
Irrigable lands	16,230	2,370	9,280	27,880
Nonirrigable lands	3,320	120	1,240	4,680
Totals	19,550	2,490	10,520	32,560

TABLE 22

PROBABLE ULTIMATE LAND USE PATTERN IN UNITS OF CLEAR LAKE AREA

(In acres)

Class of land use	Big Valley Unit			Scott Valley Unit			Upper Lake Unit			Totals
	Forebay zone	Pressure zone	Total	Forebay zone	Pressure zone	Total	Forebay zone	Pressure zone	Total	
Irrigated lands	12,210	3,840	16,050	610	1,540	2,150	2,230	6,190	8,420	26,620
Dry-farmed lands	0	0	0	0	0	0	0	0	0	0
Native vegetation	0	0	0	0	0	0	0	0	0	0
Miscellaneous	2,660	840	3,500	100	240	340	480	1,620	2,100	5,940
Totals	14,870	4,680	19,550	710	1,780	2,490	2,730	7,790	10,520	32,560

TABLE 23

ESTIMATED UNIT VALUES OF MEAN SEASONAL CONSUMPTIVE USE OF WATER IN UNITS OF CLEAR LAKE AREA

(In feet of depth)

Class and type of land use	Consumptive use					
	Big Valley Unit			Scott Valley and Upper Lake Units		
	Pre-cipita-tion	Ap-plied water	Total	Pre-cipita-tion	Ap-plied water	Total
Irrigated crops						
Alfalfa	1.0	2.5	3.5	1.0	2.5	3.5
Beans	0.8	0.7	1.5	0.8	0.6	1.4
Corn	0.9	1.2	2.1	0.9	1.2	2.1
Grain	0.8	0.7	1.5	0.8	0.7	1.5
Hops	1.1	1.6	2.7	1.1	1.6	2.7
Pasture	1.0	2.5	3.5	1.0	2.5	3.5
Pears	1.1	1.3	2.4	1.1	1.3	2.4
Pears with permanent cover crop	1.0	2.4	3.4	1.0	2.4	3.4
Prunes	1.1	1.3	2.4	1.1	1.3	2.4
Truck	0.6	0.8	1.4	0.6	0.8	1.4
Walnuts, young	1.1	1.3	2.4	1.1	1.3	2.4
Walnuts, young, with alfalfa	1.0	2.4	3.4	1.0	2.4	3.4
Walnuts and grain	1.0	2.0	3.0	1.0	2.0	3.0
Walnuts and alfalfa	1.0	2.8	3.8	1.0	2.8	3.8
Walnuts	1.0	2.7	2.7	1.0	2.7	2.7
Vineyard	0.8	1.3	2.1	0.8	1.3	2.1
Dry-farmed lands						
Pasture and orchard	--	--	1.5		--	1.8
Other crops	--	--	1.3	--	--	1.5
Native vegetation						
Swamp	--	--	4.1	--	--	4.1
Heavy brush	--	--	4.9	--	--	4.9
Light brush	--	--	3.4	--	--	3.4
Sparse brush	--	--	2.5	--	--	2.4
Miscellaneous						
Urban and farmstead	0.7	1.3	2.0	0.7	1.3	2.0
Water surface	--	--	3.0	--	--	3.0
Roads and highways		--	0.8		--	0.8
Wasteland	--	--	1.0	--	--	1.0

Appendix L, and location of the plots is indicated on Plate 13.

Since the several units of the Clear Lake Area overlie both confined and free ground water bodies, it was necessary to evaluate the water requirement for each unit of the area as the sum of consumptive use in the forebay zones and applied water in the pressure zones. In all units of the area, weighted unit values of consumptive use and of applied water were determined for each land use class from data presented in Tables 23 and 24 and from land use acreages as measured in the 1948-49 land use survey. These weighted unit values of water use are presented in Table 25.

Past and Present (1953) Water Requirements

Water requirements in the several units of the Clear Lake Area for the base period, and for 1952-53, were estimated by multiplying the acreage of each class of land use during these periods by the appropriate weighted unit value of water use, as given in

Interplanting of cover crops in orchards adds nutrients to the soil and prevents erosion. This conservation measure is widely practiced in Lake County

TABLE 24

MEASURED AVERAGE SEASONAL APPLICATION OF IRRIGATION WATER ON SELECTED PLOTS OF REPRESENTATIVE CROPS IN UNITS OF CLEAR LAKE AREA

(In feet of depth)

Crop	Big Valley Unit		Scott Valley Unit		Upper Lake Unit	
	1949	1950	1949	1950	1949	1950
Alfalfa	3.5	3.1	2.5	--	2.1	2.1
Alfalfa and young walnuts	1.9	--	--	--	--	--
Clover	3.3	--	--	--	3.3	2.5
Hops	--	--	0.8	--	--	--
Mixed orchard	--	0.6	--	--	--	--
Pasture	2.9	--	--	--		1.9
Pears	2.6	2.2	1.3	--	--	--
Pears, young	--	--	0.3			
Pears, with permanent cover crop	7.1	4.8	--	--	--	--
Pears, with semipermanent cover crop	2.5	2.4	--	--	--	--
Sudan	1.7	--	--		--	--
Walnuts	0.8	0.6	--	--	--	--
Walnuts, with alfalfa	--	--	--	--	1.5	--
Walnuts, with corn	--	--		--	0.8	--

Table 25. The results of the estimates of seasonal water requirements during the base period, and with present land use under mean conditions of water supply and climate, are presented in Table 26, summarized by general classes of land use for each unit of the Clear Lake Area. These estimates include consumptive use of precipitation in the forebay zones.

In order to facilitate certain phases of the analysis of ground water hydrology, presented in Chapter II,

TABLE 25

BASE PERIOD AND MEAN WEIGHTED UNIT VALUES OF WATER USE IN HYDROLOGIC ZONES IN UNITS OF CLEAR LAKE AREA

(In feet of depth)

Unit and class of land use	Average for 3-year base period, 1948-49 through 1950-51				Mean			
	Forebay zone			Pressure zone	Forebay zone			Pressure zone
	Precipitation	Ground water	Total		Precipitation	Ground water	Total	
Big Valley								
Irrigated lands	1.06	1.85	2.91	2.53	1.06	1.85	2.91	2.53
Dry-farmed lands	1.44		1.44		1.44		1.44	
Native vegetation	1.30	3.08	4.38		1.30	3.42	4.72	
Miscellaneous			2.13	2.00			2.13	2.00
Scott Valley								
Irrigated lands	0.84	1.74	2.58	1.60	0.84	1.74	2.58	1.60
Dry-farmed lands	1.73		1.73		1.73		1.73	
Native vegetation	1.30	2.16	3.46		1.30	2.08	3.38	
Miscellaneous			2.58	2.00			2.58	2.00
Upper Lake								
Irrigated lands	0.74	2.42	3.16	3.06	0.74	2.42	3.16	3.06
Dry-farmed lands	1.75		1.75		1.75		1.75	
Native vegetation	1.30	1.68	2.98		1.30	1.32	2.62	
Miscellaneous			2.22	2.00			2.22	2.00

it was desirable to estimate the seasonal utilization of ground water in the Clear Lake Area. To accomplish this, unit values of consumptive use of ground water in the forebay zones and of applied water in the pressure zones were multiplied by the acreage of each class of land use. The estimates were made for the base period, and for present land use under mean conditions of water supply and climate. Consumptive use of ground water in the forebay zones was determined as consumptive use of applied water for irrigated lands and urban and farmstead lands, and as total consumptive use minus utilized precipitation for

TABLE 26

ESTIMATED SEASONAL WATER REQUIREMENT IN UNITS OF CLEAR LAKE AREA

(In acre-feet)

Unit and class of land use	Average for 3-year base period, 1948-49 through 1950-51	With present land use under mean conditions of water supply and climate
Big Valley		
Irrigated lands	16,500	19,200
Dry-farmed lands	9,500	8,500
Native vegetation	11,400	12,400
Miscellaneous	3,800	3,800
Subtotals	41,200	43,900
Scott Valley		
Irrigated lands	1,200	2,200
Dry-farmed lands	500	300
Native vegetation	400	300
Miscellaneous	300	300
Subtotals	2,400	3,100
Upper Lake		
Irrigated lands	7,100	10,600
Dry-farmed lands	3,500	2,600
Native vegetation	700	600
Miscellaneous	1,400	1,400
Subtotals	12,700	15,200
Totals	56,300	62,200

TABLE 27

ESTIMATED SEASONAL UTILIZATION OF GROUND WATER IN UNITS OF CLEAR LAKE AREA

(In acre-feet)

Unit and class of land use	Average for 3-year base period, 1948-49 through 1950-51	With present land use under mean conditions of water supply and climate
Big Valley		
Irrigated lands	12,200	14,100
Dry-farmed lands	0	0
Native vegetation	8,000	9,000
Miscellaneous	1,400	1,400
Subtotals	21,600	24,500
Scott Valley		
Irrigated lands	1,000	1,900
Dry-farmed lands	0	0
Native vegetation	200	200
Miscellaneous	200	200
Subtotals	1,400	2,300
Upper Lake		
Irrigated lands	6,200	9,200
Dry-farmed lands	0	0
Native vegetation	800	700
Miscellaneous	600	600
Subtotals	7,600	10,500
Totals	30,600	37,300

native vegetation. The estimates are summarized in Table 27 by general classes of land use for each unit of the Clear Lake Area.

Probable Ultimate Water Requirements

The total seasonal amount of water requirement in the Clear Lake Area was estimated as it would be under probable ultimate conditions of land use and under mean conditions of water supply and climate. This was accomplished by multiplying the acreage of each class of land use, as derived in the forecast of the ultimate land use pattern, by its appropriate seasonal unit value of water use. The estimate accounted for the increased contribution to ground water in the three units in the amounts of 9,000, 200,- and 700 acre-feet, respectively, resulting from change in consumptive use on lands presently devoted to native vegetation but which ultimately would be irrigated. However, this increased contribution would be, for the most part, irrecoverably lost since ground water basins in the Clear Lake Area would be filled each season and the potentially salvageable ground water would be spilled from the basins. The estimate of probable ultimate water requirement is summarized in Table 28 by general classes of land use for each unit of the Clear Lake Area. These estimates include consumptive use of precipitation in forebay zones.

TABLE 28

PROBABLE ULTIMATE MEAN SEASONAL WATER REQUIREMENT IN UNITS OF CLEAR LAKE AREA

(In acre-feet)

Class of land use	Big Valley Unit	Scott Valley Unit	Upper Lake Unit	Total
Irrigated lands	54,300	4,200	26,600	85,100
Dry-farmed lands	0	0	0	0
Native vegetation	0	0	0	0
Miscellaneous	6,600	400	2,600	9,600
Totals	60,900	4,600	29,200	94,700

Nonconsumptive Water Requirements

As has been stated, certain nonconsumptive requirements for water, such as those for flood control, recreation, and conservation of fish and wildlife, will be of significance in the design of works to meet consumptive requirements in Lake County. Except in the case of flood control, the magnitudes of the nonconsumptive requirements are relatively indeterminate and are dependent upon allocations made during design of works and after consideration of economic factors. Water requirements for flood control, recreation, and conservation of fish and wildlife are discussed in general terms in this section.

Flood Control. The regulation of flood runoff is one of the foremost problems facing the Clear Lake Area at the present time. Fluctuation of the level of Clear Lake, and the overflow from natural stream channels during high-water periods, create a flood problem which must be solved if maximum land utilization is to be achieved.

Channel capacities of streams tributary to Clear Lake are inadequate to carry the flood flows which occur almost every year. Consequently, about 14,000 acres of land lying adjacent to the lower reaches of principal streams are estimated by the U. S. Corps of Engineers to be subject to inundation. Most of the flooded area is devoted to agriculture, but the towns of Upper Lake, Finley, and Kelseyville also suffer periodic flooding. Other urban and suburban properties, roads, bridges, and utilities are also subject to damage. However, there is little threat to human life.

Cache Creek is the natural drain for Clear Lake, but has a restricted channel in the five-mile reach between the lake and the Clear Lake Water Company dam. The latter provides limited control of the level of Clear Lake, but flood flows from streams tributary to the lake are much greater than the maximum capacity of the outlet channel and, as a result, the lake surface rises rapidly during flood periods to inundate a maximum of about 4,000 acres in the flood plain around the rim of the lake. Much of the flooded area is occupied by residences and resort developments, but some portions are utilized for agricultural purposes. Despite the damages suffered in the immediate area, Clear Lake flood storage provides significant incidental flood protection for lands along the lower reaches of Cache Creek in Yolo County.

The Clear Lake Water Company utilizes the lake as a storage reservoir from which it supplies water for irrigation of lands in Yolo County. Its operations have been regulated since 1920 by the "Gopcevic Decree," which fixes the maximum and minimum lake levels, and specifies the permissible enlargement and operation of the lake outlet. However, it has been impossible to keep the water stages within specified limits during years of extremely high or low runoff. In a joint effort in 1938, the Department of Public Works, the Clear Lake Water Company, and the County of Lake attempted to enlarge the outlet. The work was halted by a temporary restraining order obtained by downstream property owners who feared that larger flows in Cache Creek would cause increased flood damage in lower Cache Creek basin. As a result of this action the "Bemmerly Decree" was entered by the court and still remains in effect.

Flood control improvements in the Clear Lake Area consist mainly of levees constructed by local interests. The principal levee project is located along the lower five miles of the east bank of Middle Creek, and protects the lands of Reclamation District No. 2070 from flows up to about 7,500 second-feet.

The record damage to lake shore properties caused by the 1938 flood was the motivating factor which led to an agreement in that year between the Counties of Yolo and Lake and the Department of Water Resources for a survey and formulation of a coordinated plan of flood control for the entire Cache Creek drainage basin. The report of this investigation, published in 1939 and entitled "Report on Clear Lake-Cache Creek Flood Control Investigation," proposed the enlargement of the Clear Lake outlet channel to a capacity of 8,500 second-feet, construction of Indian Valley Reservoir on the North Fork of Cache Creek to a capacity of 186,000 acre-feet, and improvement of lower Cache Creek channel to a capacity of 15,000 second-foot peak flow. Flood control storage in Clear Lake, combined with 40,000 acre-feet of storage in Indian Valley Reservoir, was to be utilized to achieve a substantial reduction in flood damage both around the rim of Clear Lake and along the lower reaches of Cache Creek. The report further envisioned the ultimate construction of a reservoir at the Capay site on Cache Creek to provide additional protection along lower Cache Creek. In all cases, flood control operations were to be coordinated with irrigation storage.

Flood problems in the Cache Creek Basin were recognized in the report of the Corps of Engineers, U. S. Army, entitled "Comprehensive Flood Control Survey Report on Sacramento-San Joaquin Basin Streams," dated February 1, 1945, and a supplement, dated June 1, 1948, which recommended construction of a 250,000 acre-foot reservoir at Indian Valley and levee and channel improvements on the Clear Lake tributaries of Scott, Middle, and Clover Creeks.

In its 1950 "Review Report on Cache Creek Basin," the Corps of Engineers again recommended the 250,000 acre-foot Indian Valley Reservoir on the North Fork of Cache Creek and levees and channel improvements on Middle, Clover, and lower Scott Creeks. In addition, the review report proposed the enlargement of the Clear Lake outlet channel to a capacity of 8,000 second-feet and the construction of a 40,000 acre-foot reservoir on Kelsey Creek. These projects, operated in the combined interest of flood control and irrigation, would reduce flooding in the protected areas of the Clear Lake tributary streams to that caused by storms of frequency greater than once in 100 years. Although there would be no reduction in frequency of flooding by Clear Lake, the 1-in-100-year stage would be reduced from 12.5 feet to 10.8 feet on the Rumsey gage. The coordinated operation of Indian Valley Reservoir with Clear Lake would also provide substantial protection along lower Cache Creek.

Preliminary comments by the Department of Water Resources on the proposed U. S. Corps of Engineers projects for Cache Creek Basin were sent to the Board of Engineers for Rivers and Harbors on January 17, 1951. The Department of Water Resources pointed out the need for the fullest practicable utilization of the waters of Cache Creek, and that a reservoir located on its lower reaches above Capay Valley would be in a position to control 89 per cent of the Cache Creek drainage area above the Sacramento Valley floor. This compares with 13.6 per cent controlled by the Indian Valley and Kelsey Creek Reservoirs, proposed by the plan of the U. S. Corps of Engineers. It was also proposed that further consideration be given to conservation and flood control storage on Scott, Middle, and Clover Creeks.

In 1953, the Soil Conservation Service, U. S. Department of Agriculture, published a report, entitled "Adobe Creek Watershed Protection Plan." This report describes a project that included detention reservoirs on Adobe Creek and its tributary, Highland Creek, and channel realignment and enlargement along a total of about 6.5 miles of Adobe Creek. The combined flood control storage in the two reservoirs would control a 1-in-10-year flood on Adobe Creek to a peak flow of 2,500 second-feet. Channel improvements would increase the channel capacity from 1,200 second-feet to 2,500 second-feet.

Flood control accomplishments of works proposed in this bulletin are described in Chapter IV.

Recreation, Fish, and Wildlife. Lake County, by virtue of its climatic advantages, its wide variety of natural attractions, and proximity and ease of access to the metropolitan area around San Francisco Bay, enjoys an outdoor recreational opportunity of great importance to her growth and economy, and of significant importance to the State as a whole. With anticipated continued growth in population, it is expected that the public demand for preservation and enhancement of recreational facilities will be sufficient to assure the provision of water supplies necessary for such purposes.

In the aggregate, the amount of water presently used for domestic and service facilities in recreational areas in Lake County is relatively small. In the Clear Lake Area recreational and fishing activities are centered around Clear Lake, which provides abundant facilities for fishing, boating, sailing, swimming, and other water sports.

A study to ascertain conditions of sport fishery of Clear Lake was initiated by the State Department of Fish and Game in May, 1946. Results of this study are reported in "California Fish and Game," Volume 37, Number 4, October, 1941, a publication of the Department of Fish and Game. The department found that Kelsey, Middle, and Scott Creeks, all tributary to Clear Lake, have perennial flows in their higher reaches and support limited trout fisheries. It was also found that the large run of squawfish, hitch, and splittail, which once entered these streams for spawning, no longer occurs. This condition has been brought about by the increased use of water of these streams for irrigation purposes. As a result, the streams presently dry up at their mouths in early summer or late spring, whereas in earlier years flows

Aquatic recreational activities are of great importance to Lake County probably prevailed until September. Works proposed on these streams in connection with the Lake County Investigation would improve late season flows, thereby making possible the probable return of stream spawners.

Factors of Water Demand

The term "factors of water demand," as used in this bulletin, refers to those factors pertaining to rates, times, and places of delivery of water, losses of water, quality of water, etc., imposed by the control, development, and use of water for beneficial purposes. Irrigation practices in the Clear Lake Area, as determined by rates of application, irrigation efficiencies, monthly demands, and permissible deficiencies in application of water, must be given consideration in preliminary design of works to meet supplemental water requirements. These factors of demand are discussed in the following sections.

Application of Water. During the current investigation, measurements were made of the amount of water applied for irrigation on selected plots of principal crops in the Clear Lake Area. These studies were described earlier in this chapter under the heading "Unit Use of Water," and the results of the studies, which may be considered representative of prevailing rates of application of irrigation water in the Clear Lake Area, were summarized in Table 24. Detailed results of the studies are presented in Appendix L, and location of the plots are indicated on Plate 13.

Irrigation Efficiency. Estimates of irrigation efficiency realized from application of ground water in the investigational area were made by the Soil Conservation Service in connection with studies of consumptive use. These estimates are given in Table 4 of Appendix K.

Irrigation efficiency is defined as the ratio of consumptive use of applied water to the total amount of applied water, and is commonly expressed as a percentage. In Appendix K it is indicated that the estimated average irrigation efficiency realized from studies of application of ground water in 1949 was about 55 per cent. It was impractical to make a corresponding estimate of irrigation efficiency realized from application of surface water in the investigational area, due to lack of data.

Monthly Demands for Water. Because of differences in water utilization by various crops grown in the Clear Lake Area, there is considerable variation in both rate and period of demand for irrigation water. Based on anaylsis of measurements of application of ground water for irrigation, made in 1949 and 1950, the estimated average monthly distribution of demand for irrigation water is as presented in Table 29.

TABLE 29

ESTIMATED AVERAGE MONTHLY DISTRIBUTION OF DEMAND FOR IRRIGATION WATER IN CLEAR LAKE AREA

Month	Percent of seasonal total
January	0
February	0
March	0
April	2
May	10
June	21
July	33
August	15
September	14
October	4
November	1
December	0
Total	100

Permissible Deficiencies in Application of Irrigation Water. Studies to determine deficiencies in the supply of irrigation water that might be endured without permanent injury to perennial crops were not made in connection with the Lake County Investigation. However, the results of past investigation and study of endurable deficiencies in the Sacramento River Basin are believed to be applicable to the Clear Lake Area. In this respect, the following is quoted from Water Resources Bulletin No. 26, "Sacramento River Basin," 1931.

> "A full irrigation supply furnishes water not only for the consumptive use of the plant but also for evaporation from the surface during application and from the moist ground surface, and for water which is lost through percolation to depths beyond the reach of the plant roots. Less water can be used in years of deficiency in supply by careful application and by more thorough cultivation to conserve the ground moisture. In these ways the plant can be furnished its full consumptive use with much smaller amounts of water than those ordinarily applied and the yield will not be decreased. If the supply is too deficient to provide the full consumptive use, the plant can sustain life on smaller amounts but the crop yield will probably be less than normal.
>
> "It is believed from a study of such data as are available that a maximum deficiency of 35 per cent of the full seasonal requirement can be endured, if the deficiency occurs only at relatively long intervals. It is also believed that small deficiencies occurring at relatively frequent intervals can be endured."

In the selection of sizes of conservation works for design purposes to serve units of the Clear Lake Area, it was assumed that deficiencies in the amount of 35 per cent of the average seasonal requirement for irrigation water may be endured in seasons of critically deficient water supply, provided that such deficiences do not occur frequently and in no case in consecutive seasons. It was further assumed that requirements for urban water would be met at all times without deficiency.

SUPPLEMENTAL WATER REQUIREMENTS

The previously presented data, estimates, and discussion regarding water supply and utilization in the Clear Lake Area indicate that present and probable future water problems of the Clear Lake Area, with the exception of flood control and drainage, are largely limited to those connected with ground water, and their effects are largely related to irrigated agriculture. It is further indicated that present ground water problems are not serious. These ground water problems are created by progressive lowering of water levels occurring as a result of development of use of the ground water basins. As the use of ground water increases with the expansion of irrigated agriculture, ground water levels will continue to lower until the lowering is limited or controlled by the development of supplemental water supplies to meet future water requirements.

The estimated present and probable ultimate requirements for supplemental water in the Clear Lake Area are discussed and evaluated in the following sections. For purposes of this bulletin, requirements for supplemental water refer to the amount of water over and above the sum of present ground water yield and safe surface water yield, which must be developed to satisfy water requirements. Water requirements in turn refer to the amount of water needed to provide for all beneficial consumptive use of water and for irrecoverable losses of water incidental to such beneficial use.

Present (1953) Supplemental Water Requirement

It is indicated that no present supplemental water requirement exists in the Clear Lake Area, since mean seasonal extraction of water from the free ground water areas of the Big Valley, Scott Valley, and Upper Lake Units has not exceeded average base period replenishment, as reflected by insignificant change in ground water storage during the base period. As shown in Table 13, average changes in ground water storage during the base period in the Big Valley and Scott Valley Units were only 2,290 acre-feet, and 260 acre-feet, respectively, with no change in the Upper Lake Unit. Furthermore, in each year during the base period, the available ground water storage capacity was filled in the spring of the year, as indicated by shallow depths to ground water existing at that time.

Non-irrigated walnut groves in Lake County often utilize relatively steep side-hill slopes

Probable Ultimate Supplemental Water Requirement

The probable ultimate requirement for supplemental water in the Clear Lake Area was evaluated as the difference between present and probable ultimate water requirement, plus the present requirement for supplemental water. Development and utilization of a supplemental water supply in the amount of this forecast would assure an adequate supply of water for lands presently irrigated in the area, as well as

TABLE 30

PROBABLE ULTIMATE MEAN SEASONAL SUPPLEMENTAL WATER REQUIREMENT IN UNITS OF CLEAR LAKE AREA

(In acre-feet)

	1	2	3	4	5
Unit	Present water requirement	Probable ultimate water requirement	Probable increase in water requirement (2 − 1)	Present supplemental water requirement	Probable ultimate supplemental water requirement (3 + 4)
Big Valley	43,900	60,900	17,000	0	17,000
Scott Valley	3,100	4,600	1,500	0	1,500
Upper Lake	15,200	29,200	14,000	0	14,000
Totals	62,200	94,700	32,500	0	32,500

for those irrigable lands not presently served with water.

Estimates of present and probable ultimate requirements for water in the Clear Lake Area, under mean conditions of water supply and climate, were presented in Tables 26 and 28. In the preceding section it was estimated that no present supplemental water requirement exists. Utilizing these estimates, the forecast of the probable ultimate seasonal requirement for supplemental water by units of the Clear Lake Area, under mean conditions of water supply and climate, is presented in Table 30.

CHAPTER IV

PLANS FOR WATER DEVELOPMENT

It has been shown heretofore that the present water problems in the Clear Lake Area are the need for supplemental water to meet requirements of irrigable lands presently not supplied with water, and the need for flood control. Solution of the flood control problem, and provision of water for irrigation of irrigable lands not presently served with water, will require conservation development of available water resources. In the preceding chapter, estimates were presented as to the amount of supplemental water required in the Clear Lake Area.

It has been stated that the water presently passing through the area is regulated in Clear Lake for further use downstream in the Cache Creek Basin. These flows occur during the rainy season from November through April, and frequently cause flood damage along the rim of Clear Lake and in the communities and farms adjacent to tributary streams. Although such flows replenish the present relatively minor draft on the ground water basins of the Clear Lake Area, they are substantially undeveloped at the present time for use in the area. Studies which are described in this bulletin indicate that the flows of streams tributary to Clear Lake, if properly controlled and regulated, could meet the probable ultimate water requirements of the Clear Lake Area and that flood hazards would be eliminated.

Plans for water development are described in this chapter under the two general headings, "The California Water Plan," and "Plans for Local Development." The discussion under the former heading pertains to water development plans at the State-wide level, formulated as the concluding phase of the State-wide Water Resources Investigation and deals briefly with the relationship of these plans to the Clear Lake Area. Under the latter heading, there are described the several plans for possible local development of supplemental water supplies and flood protection which were given consideration in connection with the Lake County Investigation. All such local plans considered would be subject to vested rights. Specific plans are presented for the more favorable of these projects, together with estimates of capital and annual costs and unit costs of the developed supplemental water supplies. Locations of the principal features of the several possible plans for both initial and future construction are shown on Plate 14, "Plans for Water Development."

THE CALIFORNIA WATER PLAN

The Department of Water Resources has recently completed the State-wide Water Resources Investigation in the publication of Bulletin No. 3, "The California Water Plan." The California Water Plan has as its objectives the full control, development, protection, conservation, distribution, and utilization of California's water resources for the benefit of all areas of the State and for all beneficial uses and purposes. The Plan, as presented in Bulletin No. 3, is a master plan to guide and coordinate all agencies in the planning and construction of the works required to meet these objectives.

The California Water Plan is an ultimate plan designed to meet the water requirements of the indefinite future when the land and other resources of the State are essentially fully developed. It consists of two principal categories of works: local works designed to meet the present and future water needs in each area of the State; and a major system of works to conserve and export surplus waters from the North Coastal Area and Sacramento River Basin, and to transfer these waters to areas of deficiency elsewhere in the State.

The local development plans presented in the ensuing section comprise a portion of the local works category of The California Water Plan in the Clear Lake Area. Therefore, the discussion herein is limited to a brief description of those features of the major works category of the Plan which are pertinent to the Clear Lake Area.

Development of surplus waters of the Eel River for export to deficient areas elsewhere in the State, as contemplated under The California Water Plan, would be of considerable significance to the Clear Lake Area, particularly in the effect upon the operation of Clear Lake. These works would consist of four major conservation reservoirs and associated pumping plants on the Eel River; a tunnel to convey water through the southerly divide to Clear Lake; a short diversion tunnel from Cache Creek to Putah Creek; and a series of reservoirs and power plants along Putah Creek.

Surplus water would be pumped from reservoir to reservoir up the Eel River to Willis Ridge Reservoir, the uppermost of the chain of reservoirs. From this reservoir the water would flow by gravity through a 12-mile tunnel to Middle Creek, thereafter utilizing this natural channel to enter Clear Lake. Clear Lake would be utilized to convey the Eel River water to

Clear Lake Dam. Here another tunnel would transfer the water to the Putah Creek watershed, where the available head in the drop to the floor of the Sacramento Valley would be utilized in the production of hydroelectric energy.

Works included in the foregoing development would consist of 9 reservoirs, including the 4 major conservation reservoirs on the Eel River and 5 regulatory reservoirs for power generation on Putah Creek; 7 hydroelectric power plants, including one on the Eel River and 6 on Putah Creek; and 2 pumping plants on the Eel River. The 4 major conservation reservoirs, with an aggregate active storage capacity of about 6,600,000 acre-feet, would develop some 2,140,000 acre-feet of water per season for export. About 2.6 billion kilowatt-hours of electric energy would be generated, of which amount 1.9 billion kilowatt-hours would be required for pumping the conserved water over the divide into Clear Lake.

Conveyance of Eel River water from Clear Lake to the floor of Sacramento Valley by way of Cache Creek has been considered as a possible alternative to the Putah Creek plan. However, the planning relative to this conveyance is quite preliminary, and would require considerable geologic exploratory work as well as further engineering studies before its feasibility could be established. The alternative development would consist of a series of dams and power plants down the course of Cache Creek in stairstep fashion, very similar to the Putah Creek system.

Export of Eel River water to the Sacramento Valley via Clear Lake would be contingent upon the enlargement of the present outlet of the lake in order to minimize fluctuation of the water surface. This would necessitate the modification of existing court decrees. However, with such enlargement, the lake level could be stabilized, and local flood problems around the lake would be greatly reduced. Moreover, the mineral quality of water in the lake would be substantially improved.

PLANS FOR LOCAL DEVELOPMENT

Possible plans for local development of supplemental water supplies and control of floods in the Clear Lake Area, together with cost estimates, are described in this section. Design of features of the plans was necessarily of a preliminary nature and primarily for cost estimating purposes. More detailed investigation, which would be required in order to prepare plans and specifications, might result in designs differing in detail from those presented in this bulletin. However, it is believed that such changes would not result in significant modifications in estimated costs.

In connection with the ensuing discussion of water development works, the following terms are used as indicated.

Safe Yield. The maximum sustained rate of draft from a reservoir that could have been maintained through a critically deficient water supply period to meet a given demand for water. For purposes of this bulletin, safe yield was determined on the basis of the critical period that occurred in the Sacramento Valley from 1920-21 through 1934-35.

Irrigation Yield. The maximum sustained rate of draft from a reservoir that could have been maintained through a critically deficient water supply period to meet a given irrigation demand for water, with certain specified deficiencies. For purposes of this bulletin, irrigation yield was determined on the basis of the critical period that occurred in the Sacramento Valley from 1920-21 through 1934-35.

New Water. The seasonal yield of water resulting from a proposed new water supply development and method of operation thereof, that would have been wasted without the proposed works, including all conserved water, whether vailable on a safe yield, irrigation yield, or other basis.

Capital costs of dams, reservoirs, diversion works, conduits, pumping plants, levees, and appurtenances were estimated from preliminary designs based largely on data from surveys made during the current investigation and by other agencies. Approximate construction quantities were estimated from these preliminary designs. Unit prices of construction items were determined from recent bid data on projects similar to those in question, or from manufacturers' cost lists, and are considered representative of prices prevailing in November, 1954. The estimates of capital cost included costs of rights of way and construction, and interest during one-half of the estimated construction period at 3.5 per cent per annum, plus 10 per cent for engineering, and 15 per cent of construction costs for contingencies. Estimates of annual costs included interest on the capital investment at 3.5 per cent, amortization over a 50-year period on a 3.5 per cent sinking fund basis, and replacement, operation, and maintenance costs, and costs of electrical energy for pumping.

Tentative plans for the control of floods and the conservation of waters of the Clear Lake Area include greater utilization of ground water storage in the several units of the area and the construction of several dams and reservoirs on streams tributary to Clear Lake. These plans which directly affect the area of investigation include the construction of a dam and reservoir on Kelsey Creek, about 3.5 miles south of Kelseyville in Big Valley. This dam and reservoir would protect lands adjacent to Kelsey Creek from floods, and would, in addition, supply water for irrigation, municipal, and domestic use in Big Valley. The proposed reservoir and additional works, operated in conjunction with the reservoir, including a by-pass channel adjacent to Adobe Creek, would protect virtually all lands in Big Valley from floods. Other proposed works on Clear Lake tributaries include the Lakeport Dam and Reservoir on Scott Creek about 2 miles west of Lakeport, the Pitney Ridge Dam and Reservoir on Middle Creek about 8 miles upstream from Upper Lake, and flood control works on Middle Creek and Clover Creek in the Upper Lake Unit. These works would provide flood protection to lands in Scott Valley and the Upper Lake Unit, and would also supply water for irrigation, domestic, and municipal use.

Big Valley Unit

It was shown in Chapter III that there is no present requirement for supplemental water in the Big Valley Unit, but that irrigable lands not presently irrigated will require the development of a supplemental water supply. For the Big Valley Unit the ultimate supplemental water requirement was estimated to be about 17,000 acre-feet per season. It was also indicated that there is a need for flood control on streams in Big Valley. Therefore, in the design of works for water development, it was considered desirable to provide multipurpose works to insure a water supply in an amount of about the estimated ultimate supplemental water requirement, and to control floods.

Three possible alternative plans of works for local construction to provide supplemental water and flood control were considered. For reasons hereinafter mentioned, and after preliminary investigation and study, the first two plans were given no further consideration for present cost estimating purposes, but may warrant future study. The third plan is described in some detail later in this section.

Alternative Plans Considered. The first of the alternative plans considered included the construction of relatively small dams and reservoirs on both Kelsey and Adobe Creeks. The reservoirs would be operated to provide sufficient water to supply the probable ultimate supplemental water requirement of the Big Valley Unit. Flood control would be accomplished under this plan by construction of levees along Kelsey and Adobe Creeks which would confine the peak flood flows to the leveed channels. Preliminary investigation and study of the plan indicated that right of way costs for the leveed channels would be excessive, a large area of the better lands would be removed from cultivation, difficulty would be encountered in establishing an alignment which would avoid the town of Kelseyville, and the small storage reservoirs would require expensive spillway construction, making the unit cost of irrigation water excessive. For these reasons, this plan was given no further present consideration.

The second of the alternative plans considered for initial construction would include the construction of a large dam and reservoir on Kelsey Creek which would be operated primarily for flood control. Releases from the reservoir would be controlled to the present channel capacity of Kelsey Creek. Smaller dams and reservoirs would also be constructed on Adobe and Highland Creeks so as to reduce the estimated peak flood flows on these streams to the present channel capacity of Adobe Creek. Irrigation water would be stored in each of these reservoirs to partially supply the estimated ultimate supplemental water requirement of the Big Valley Unit. Cost of the structures with the expensive release appurtenances required proved excessive, and preliminary studies indicated that the unit cost of the conserved water would be greater than the corresponding unit cost of the third plan described in this section. For these reasons, the plan was given no further present consideration.

The third of the alternative plans considered for local construction would provide flood protection to all lands in Big Valley, supply supplemental water for percolation to the ground water basin, and meet water requirements under conditions of ultimate development. The plan would include increased operation of the ground water basin and construction of a dam and reservoir on Kelsey Creek about 3.5 miles upstream from Kelseyville. Flood flows of Kelsey Creek would be discharged through the reservoir spillway into Adobe Creek, and thence into a by-pass channel which would convey the combined flood flows from Kelsey, Adobe, and Highland Creeks along the western edge of Big Valley, discharging into Clear Lake. This plan differs from the second plan described above in two major respects; additional ground water storage capacity would be utilized, and only the reservoir capacity above the spillway lip would be dedicated to flood control purposes. This method of operation would permit use of the proposed Kelseyville Reservoir for water conservation. This plan is hereinafter referred to as the "Big Valley Project" and its principal features are delineated on Plate 15.

Big Valley Project. A portion of the indicated supplemental water requirement of the Big Valley Unit could be met by additional utilization of ground water storage. The additional ground water storage capacity would be created by increasing pumping lifts so as to dewater more of the water-producing aquifers and thus enable the capture of a portion of the surface outflow from the valley which presently wastes to Clear Lake each season.

Studies made in connection with the current investigation indicate that, under present conditions of utilization of ground water, the available ground water storage is filled by March of every year. Therefore, surface inflow to the unit after March passes undiminished to Clear Lake. Stream flow measure-

Site of proposed Kelseyville Dam on Kelsey Creek

ments made during the investigation indicated that the maximum monthly rate of percolation of streams in Big Valley approached 5,000 acre-feet. From estimates of monthly runoff of streams in Big Valley for the period 1921 through 1947, and by utilizing the maximum monthly rate of percolation of 5,000 acre-feet, the average amount of water which could be percolated after March, above that which presently percolates, would be about 7,500 acre-feet. In order to capture this 7,500 acre-feet of water presently wasting from the valley, it would be necessary to create approximately 9,000 acre-feet of additional ground water storage. This could be accomplished by increasing pumping lifts about 7 feet by the end of the irrigation season.

Under this method of operation of the ground water basin, 7,500 acre-feet of the probable ultimate supplemental water requirement of Big Valley could be met. The balance of the supplemental water requirements, 9,500 acre-feet, could be obtained from upstream storage on Kelsey Creek. The proposed Kelseyville Reservoir would be operated for both flood control and water conservation purposes. The reservoir, with other required works, would give flood protection to virtually all lands in Big Valley and would yield firm supplies of water for use in the Big Valley Unit.

The proposed dam would be an earth- and rockfill structure with a chute spillway at the upper end of the reservoir, and two small dams in saddles on the west side of the reservoir. The main dam would be located on Kelsey Creek in Section 34, Township 13 North, Range 9 West, M.D.B. & M., about 4 miles south of Kelseyville. Stream bed elevation at the site is about 1,465 feet. The floodwaters of Kelsey Creek would be regulated in this reservoir and released into Kelsey Creek for percolation to ground water and for diversion to areas where good wells are not generally obtained. Spill of peak floods to Adobe Creek would be through a spillway located at the upper end of the reservoir in Section 4, Township 12 North, Range 9 West, M.D.B. & M. The floodwaters of Kelsey Creek, together with the unregulated flood flows of Adobe and Highland Creeks, would be diverted from Adobe Creek at Bell Hill Road into a by-pass channel discharging into Clear Lake.

As a first step in determination of size of the project, estimates were made of yield of the proposed works for various storage capacities. It was estimated the mean seasonal runoff of Kelsey Creek, from the approximately 37 square miles of watershed above the dam site, was about 42,000 acre-feet. Yield studies, based upon estimates of runoff during the critical dry period which occurred in the Sacramento Valley from 1920-21 through 1934-35, were made for three sizes of reservoir at the Kelsey Creek site. A summary of results of the yield studies is presented in Table 31.

After consideration of the results of yield studies, and of the requirements for flood control, a reservoir of 36,000 acre-foot storage capacity, with estimated seasonal yield of 26,800 acre-feet, was chosen for purposes of cost estimates presented in this bulletin. Operation studies for the period 1920-21 through 1935-36 indicate a maximum deficiency of about 10 per cent for releases made from the reservoir. The yield study for this size of reservoir is included in Appendix M.

TABLE 31

ESTIMATED SAFE SEASONAL YIELD OF KELSEYVILLE RESERVOIR, BASED ON CRITICAL DRY PERIOD FROM 1920-21 THROUGH 1934-35

(In acre-feet)

Reservoir storage capacity	Safe seasonal yield
3,600	5,000
16,000	17,500
36,000	26,800

As mentioned previously, the ground water basin presently fills by March of each year, and by increasing usable ground water storage each season by about 9,000 acre-feet, an additional average of 7,500 acre-feet could be percolated from streams in the Big Valley Unit after March. Of the total of 7,500 acre-feet per season, it is estimated that Kelsey Creek would contribute about 5,800 acre-feet. Since Kelsey Creek presently contributes about 11,500 acre-feet per season to ground water storage, the total percolation from Kelsey Creek, with greater utilization of ground water storage, would be 17,300 acre-feet. The difference between the total percolation from Kelsey

Creek, 17,300 acre-feet per season, and the estimated safe seasonal yield of 26,800 acre-feet from Kelseyville Reservoir indicates an estimated new yield of water of about 9,500 acre-feet creditable to the reservoir. The total new yield creditable to the Big Valley Project would be the sum of total seasonal percolation from streams in Big Valley resulting from greater utilization of ground water storage, or 7,500 acre-feet, and the new seasonal yield creditable to Kelseyville Reservoir, or 9,500 acre-feet giving a total of 17,000 acre-feet, seasonally.

The proposed Kelseyville Reservoir was operated to supply the amount of water presently contributed to ground water by Kelsey Creek and to replace increased irrigation draft from the ground water basin thereafter. A maximum percolation rate of 50 second-feet was assumed, although studies of measurements of stream flow indicated this rate might be as high as 80 second-feet. Under this method of operation of the surface reservoir and the ground water basin, it was assumed there would be a 7-foot lowering of ground water levels under conditions of increased ground water draft by the end of the irrigation season. The monthly rates of release used in the operation studies are listed in Table 32. Although the reservoir was operated to provide increased percolation to Kelsey Creek, it would be possible with only a slight change in schedule of releases to furnish a portion of the yield of the Kelseyville Reservoir to canals for conveyance to areas where good wells are not generally obtained.

Topographic maps of the Kelseyville dam site, with a scale of 1 inch equals 50 feet, and of the reservoir site, with a scale of 1 inch equals 40 feet, both with contour intervals of 10 feet, were furnished by the Bureau of Reclamation, United States Department of the Interior. The maps were prepared by photogrammetric methods. Topography of the proposed spillway site, at the upper end of the reservoir, was extended by a survey conducted by the Department of Water Resources. Storage capacities of Kelseyville Reservoir at various stages of water surface elevation are given in Table 33.

Based upon preliminary geological reconnaissance, the Kelseyville dam site is considered suitable for a concrete arch, earthfill, or a rockfill dam up to heights in excess of 200 feet. Foundation rock at the site consists of volcanic rocks, chiefly of Quaternary age. The formation of the left abutment differs from that of the right abutment. The left abutment rock stands nearly vertical and strikes across the channel and downstream into the left abutment, while rock on the right abutment is essentially horizontal. The possibility exists that this variation in attitude may be the result of a major fault passing down the channel section. Minor folds occur in the rocks on both abutments. Flow planes are prominent and blocky joints cutting steeply across these planes are common.

TABLE 32

MONTHLY OPERATION SCHEDULE FOR KELSEYVILLE RESERVOIR

(In acre-feet)

Month	Irrigation demand, in per cent of seasonal total	Ground water draft in portion of Big Valley influenced by Kelsey Creek	Demand on reservoir for percolation	Ground water storage space available, first day of month
January	0	0	3,000	14,300
February	0	0	3,000	11,300
March	0	0	3,000	8,300
April	2	530	3,000	5,300
May	10	2,680	3,000	2,836
June	21	5,620	3,000	2,516
July	33	8,850	3,000	5,136
August	15	4,020	2,800	10,986
September	14	3,760	0	12,206
October	4	1,072	0	15,966
November	1	268	0	17,038
December	0	0	3,000	*17,300
Totals	100	26,800	26,800	

* Maximum ground water storage space available in portion of Big Valley Unit influenced by Kelsey Creek under proposed ultimate pumping demand.

TABLE 33

AREAS AND CAPACITIES OF KELSEYVILLE RESERVOIR

Depth of water at dam, in feet	Water surface elevation, U.S.G.S. datum, in feet	Water surface area, in acres	Storage capacity, in acre-feet
0	1,465	0	0
15	1,480	10	300
35	1,500	25	900
55	1,520	160	1,800
75	1,540	340	6,800
95	1,560	490	15,000
115	1,580	610	26,000
130	1,595	690	36,000
135	1,600	720	40,000
155	1,620	840	56,000

The flow layers range from several feet to less than 1 inch in thickness. The rock is extremely hard where fresh and unjointed. Heavy to very heavy grout may be required at this site along both joint and flow planes. Many minor shears, represented only by thin line breaks, are apparent. The rock is essentially a highly porphyritic, coarse, pinkish rhyolite with much sanidine and some whitish glass shards. Some grey-pink or greenish andesite may also be associated with the rhyolite. The stream channel is approximately 60 feet in width, with abutment slopes averaging between 80 and 100 per cent. Stripping of the foundation for an earth- and rockfill structure should consist of about 10 feet on the right abutment, 15 feet on the left abutment, and 8 feet in the channel section.

A satisfactory location for a spillway to permit diversion of flood flows to Adobe Creek exists at the upper end of the reservoir through a saddle occupied by an existing county road. About half of the material from such excavation should prove recoverable for fill in the pervious section of the dam. There is also an adequate supply of earth, which could be obtained in limited quantities within the reservoir area and in large quantities from orchard lands about 1 mile downstream.

As a result of yield studies, geologic reconnaissance, and preliminary cost estimates, an earth- and rockfill dam 130 feet in height from stream bed to spillway lip, and with a crest elevation of 1,615 feet, was selected to illustrate estimates of cost of the Big Valley Project. The dam would have a crest length of about 390 feet, a crest width of 30 feet, and 2.5:1 upstream and downstream slopes. The central impervious core would have a top width of 10 feet and 0.8:1 slopes, and would be blanketed with sand and gravel filters. The outer pervious zones would consist of dumped quarried rock and rock excavated in the construction of the spillway. The volume of the fill would be an estimated 440,000 cubic yards. In addition, two saddle dams would be constructed in saddles on the west side of the reservoir. Saddle dam No. 1 would be an earth- and rockfill structure 35 feet in height, with a crest length of 800 feet, a crest width of 30 feet, and 2.5:1 upstream and downstream slopes. The central impervious core would have a top width of 10 feet, with 0.8:1 side slopes, and would be blanketed with sand and gravel filters graded to dumped rock in the outer pervious zones. The volume of fill would be an estimated 6,500 cubic yards. Saddle dam No. 2 would be 12 feet in height, and would have a crest length of 200 feet, a crest width of 20 feet, 3.0:1 side slopes upstream, and 2.0:1 side slopes downstream. Construction would be of rolled earth, and the volume would be an estimated 2,500 cubic yards.

The maximum depth of water above the spillway lip would be 13 feet, and an additional 7 feet of freeboard would be provided. The spillway would be of the chute type, excavated in rock, through a saddle at the upper end of the reservoir, and would be unlined, except for an entrance section about 25 feet in length. The spillway would have a maximum discharge capacity of 20,000 second-feet, required for an assumed discharge into the reservoir of 975 second-feet per square mile of drainage area. The flood flows would be regulated in surcharge storage and would discharge into Adobe Creek.

Outlet works would consist of a 42-inch diameter steel pipe placed in a trench excavated in rock beneath the dam, and encased in concrete. Releases from the dam would be controlled by two 42-inch butterfly valves located at a submerged inlet upstream from the dam, and operated by hydraulic controls from the crest of the dam. The outlet would be controlled at the downstream end by a hollow jet valve. Releases would be made to the channel of Kelsey Creek for percolation, as previously described.

Spill from the reservoir, which would occur infrequently, would enter Adobe Creek in Section 4, Township 12 North, Range 9 West, M.D.B. & M., and would flow in the natural channel to a leveed by-pass channel at Bell Hill Road below the confluence with Highland Creek. The by-pass channel chosen for cost estimating purposes would have a capacity of 18,000 second-feet, which is one-half the sum of the estimated once-in-1,000-year flood spill from Kelseyville Reservoir, plus the unregulated once-in-1,000-year flood of Adobe and Highland Creeks. The by-pass would extend in a northerly direction along the base of the foothills for a distance of 5 miles to Clear Lake. Diversion of flows of Adobe Creek to the by-pass would be accomplished by tying in the levees of the proposed channel to the existing banks of Adobe Creek. The levee crest would be about 10 feet above the bottom of the by-pass and about 7 feet above natural ground level on the land side, and would have a width of 20 feet. The levee embankment slopes would be 3:1. The by-pass channel, with an inlet elevation of 1,400 feet, would be about 300 feet in width between levee toes, and would have a slope of 12.4 feet to the mile. The maximum water depth would be 7 feet, with 3 feet of freeboard. Appurtenant structures would consist of the following: three bridges or trestles spanning the channel, one at Highway 29, and the other two at secondary road crossings; a stub channel with levees to intercept Manning Creek; and an outlet pipe through the levee near the proposed by-pass inlet to permit a maximum release of about 200 second-feet for percolation in Adobe Creek.

Cost estimates for the by-pass and appurtenant structures were based on designs utilizing data obtained by field location surveys. No provisions were made for distribution systems since the project does not provide for serving surface water although water could be served in this manner, as mentioned previously.

Pertinent data with respect to the general features of the Big Valley Project as designed for cost estimating purposes are presented in Table 34.

Assuming that the annual cost resulting from increased pumping lifts to create additional ground water storage capacity approximates \$0.08 per acre-foot per foot of lift of additional average lift for present pumpage, plus \$0.08 per acre-foot per foot of total lift for new ground water pumped, the increase in annual cost per acre-foot of water presently pumped would be about \$0.30, and annual cost per acre-foot of new ground water pumped would be about \$3.50. Total annual costs in the Big Valley Unit resulting from increased costs to present pump users and pumpage of new ground water would be about \$45,000.

Example of intensive use of valley areas in Lake County

TABLE 34

GENERAL FEATURES OF KELSEYVILLE PROJECT

Main Earth- and Rockfill Dam	
Type of dam	earth- and rockfill
Crest elevation, in feet	1,615
Crest length, in feet	390
Crest width, in feet	30
Height, spillway lip above stream bed, in feet	130
Side slopes	2.5:1
Freeboard above spillway lip, in feet	7
Elevation of stream bed, in feet	1,465
Volume of fill, in cubic yards	440,000
Saddle Dam No. 1	
Type of dam	earth- and rockfill
Crest elevation, in feet	1,615
Crest length, in feet	800
Crest width, in feet	30
Height, crest above saddle, in feet	35
Side slopes	2.5:1
Volume of fill, in cubic yards	6,500
Saddle Dam No. 2	
Type of dam	earthfill
Crest elevation, in feet	1,615
Crest length, in feet	200
Crest width, in feet	20
Height, crest above saddle, in feet	12
Side slopes, upstream	3.0:1
downstream	2.0:1
Volume of fill, in cubic yards	2,500
Reservoir	
Surface area at spillway lip, in acres	690
Storage capacity at spillway lip, in acre-feet	36,000
Drainage area of Kelsey Creek, in square miles	37
Estimated mean seasonal runoff of Kelsey Creek, in acre-feet	42,000
Estimated safe seasonal yield, in acre-feet	26,800
Type of spillway	chute
Spillway discharge capacity, in second-feet	20,000
Type of outlet—42-inch diameter steel pipe placed in trench excavated in rock beneath dam and encased in concrete	
By-pass Channel	
Length, in miles	5.0
Channel width, in feet	300
Capacity, in second-feet	18,000
Levees, height above natural ground, in feet	7
top width, in feet	20
side slopes	3:1
Maximum depth of water, in feet	7
Freeboard, in feet	3

The capital cost of the Big Valley Project, based on prices prevailing in November, 1954, was estimated to be about $2,421,000, exclusive of new pumpage costs. Corresponding annual costs were estimated to be about $170,000, including new pumpage costs. Average annual direct flood damages on Kelsey and Adobe Creeks were estimated by the Department of Water Resources to be about $35,000, based on data obtained from the Corps of Engineers, U. S. Army. The Big Valley Project would control all floods in Big Valley to nondamaging flows. Therefore, it may be assumed that the annual direct flood control benefits creditable to the project would be about $35,000. If a contribution of $35,000 annually were made by the Federal Government in the interests of flood control, the resultant estimated average unit cost of the 17,000 acre-feet per season of new water conserved by the Big Valley Project would be about $7.90 per acre-foot.

Estimated capital and annual costs of the Big Valley Project, exclusive of new pumpage costs, are summarized in the following tabulation. Detailed cost estimates are presented in Appendix N.

	Estimated costs	
	Capital	*Annual*
Kelseyville Dam and Reservoir	$1,788,000	$89,300
Big Valley by-pass channel	633,000	35,900
Totals	$2,421,000	$125,200

Scott Valley Unit

It was shown in Chapter III that there is no present requirement for supplemental water in the Scott Valley Unit, but that irrigable lands not presently irrigated will require the development of a supplemental water supply. For the Scott Valley Unit, the ultimate supplemental water requirement was estimated to be about 1,500 acre-feet per season. It was also shown that there are lands adjacent to Scott Creek, within and below Scott Valley, which are subject to flood damage during periods of high runoff. In addition, it was pointed out that irrigation water is presently obtained in Scott Valley by pumping from the ground water basin underlying the valley floor. The present draft on the ground water basin is replenished by percolation from Scott Creek and by rainfall.

For reasons hereinafter discussed, it was considered desirable to also supply supplemental water from the Scott Creek watershed to lands in Bachelor Valley, and in the Tule Lake, Helms, and Edmands Reclamation Districts, all situated in the Upper Lake Unit. Flood control measures were also considered to be essential in the design of plans for these lands. Three possible plans of works to provide for both flood protection and the ultimate supplemental water requirement of Scott Valley and portions of the Upper Lake Unit were considered. For reasons hereinafter mentioned, after preliminary investigation and study, the first two plans were given no further consideration for present cost estimating purposes, but may warrant future study. The third plan is described in some detail later in this section.

Alternative Plans Considered. The first of the alternative plans considered included construction of a dam and reservoir on Scott Creek at a site about 2 miles west of Lakeport. The proposed reservoir would have a storage capacity of about 18,000 acre-feet, and, although operated primarily for flood control, would yield about 8,000 acre-feet per season for irrigation and other purposes. Maximum flood flows below the dam would be reduced to about 2,000 second-feet. Because of the excessive cost of the comparatively large dam and appurtenant structures which would be required for flood releases, and the fact that the flood releases would continue to create ponding along lower Scott Creek, this plan was given no further present consideration.

The second of the alternative plans considered would involve the construction of dams and reservoirs on Scott and Middle Creeks, increase of the draft on the ground water basin in Scott Valley to yield additional ground water, and construction of levees to afford protection against floods. The amount of water in excess of the new yield of the ground water basin, and which would be required to meet the ultimate demand in Scott Valley and other lands in Bachelor Valley, would be furnished by a small storage reservoir on Scott Creek and by a supply canal about 12 miles in length from the proposed Hunter Point Dam and Reservoir located on Middle Creek in the Upper Lake Unit. Flood protection would be provided on the lower reaches of Scott Creek by a single levee extending along the left bank of Dayle Creek from high ground near Witter Springs to Scott Creek in the southwest corner of Bachelor Valley, and thence along the left bank of Scott Creek to its confluence with Middle Creek south of Upper Lake.

Additional development of the ground water basin by increasing the draft on ground water storage would supply the ultimate water requirement of Scott Valley. However, increased pumping lifts would increase the costs of pumping, as well as requiring deepening of existing wells and, in many cases, new pump installations. The small dam and reservoir on Scott Creek, which would be required to supply water to lands outside of Scott Valley that might be served by the project, would have a low cost for the dam, but costs for the spillway would be excessive. Flood protection would be confined to the lower reaches of Scott Creek, and the levees necessary for flood protection would be comparatively high. The supply canal to Bachelor Valley, which would be brought from the proposed Hunter Point Dam on Middle Creek, would have an over-all length of 12 miles, and would not reach irrigable lands of higher elevations in Bachelor Valley. Conveyance losses and maintenance costs would be high. Because of the excessive costs of many of the features of this plan, it was given no further consideration for cost estimating purposes, but may warrant future study.

The third of the alternative plans considered for initial construction would include a dam and reservoir on Scott Creek to supply the ultimate requirement for irrigation water in both Scott and Bachelor Valleys and a portion of the ultimate requirement in the Tule Lake, Helms, and Edmands Reclamation Districts, and to control flood flows on Scott Creek. This plan is hereinafter referred to as the ''Lakeport Project'' and its principal features are delineated on Plate 16.

Lakeport Project. Under present conditions of utilization of ground water in Scott Valley, about 2,300 acre-feet of water is withdrawn each season from ground water storage. However, this withdrawal is replaced during the runoff season by percolation of a portion of the natural flows of Scott Creek and deep percolation from precipitation on the valley floor. Under this project the natural flows of Scott Creek would be conserved in the proposed Lakeport Reservoir located on Scott Creek upstream from Scott Valley. In the operation of the reservoir, releases would be made to replace water which presently percolates from Scott Creek to ground water storage in Scott Valley, and to supply water to meet the ultimate supplemental water requirements of Scott and Bachelor Valleys and a portion of such requirements in the Tule Lake, Helms, and Edmands Reclamation Districts.

The proposed Lakeport Dam would be an earth- and rock-fill structure with chute spillway, located on Scott Creek in the southwest quarter of Section 22, Township 14 North, Range 10 West, M. D. B. & M., some 2 miles west of Lakeport. Stream bed elevation at the dam site is about 1,457 feet. The floodwaters of Scott Creek would be regulated behind the dam and released to Scott Creek for percolation to ground water in Scott Valley, and for use in the Tule Lake, Helms, and Edmands Reclamation Districts. Spill of peak flood flows would be discharged through the spillway located about 2,300 feet southeast of the dam site and would be conveyed easterly directly to Clear Lake.

As a first step in determination of size of the project, estimates were made of yield of water from the proposed works for different storage capacities. It was estimated that the mean seasonal runoff of Scott Creek, from the approximately 5 square miles of watershed above the dam site, was about 42,000 acre-feet. Yield studies were made for two sizes of reservoirs at the Lakeport site, based upon estimates of runoff during the critical dry period which occurred in the Sacramento Valley from 1920-21 through 1934-35. Monthly demands for water on the Lakeport Project were assumed to be proportional to the estimated distribution of irrigation demands in the Clear Lake Area, as presented in Table 29. However, the Lakeport Reservoir was operated to supply water for percolation from Scott Creek in Scott Valley, and to furnish a surface supply to Bachelor Valley and the Tule Lake, Helms, and Edmands Reclamation Districts in the Upper Lake Unit. Monthly releases from Lakeport Reservoir were made equal to the sum of the surface supply required by the aforementioned lands in the Upper Lake Unit and the supply required for percolation in Scott Creek, the latter amount being equal to the available space in ground water storage in Scott Valley, or 500 acre-feet, whichever was the lesser amount. The value of 500 acre-feet per month represents the maximum rate of percolation of waters from Scott Creek in Scott Valley. A summary of the results of the yield studies is presented in Table 35.

After consideration of the results of yield studies, together with topography of the dam site, flood con-

TABLE 35

ESTIMATED SEASONAL IRRIGATION YIELD OF LAKEPORT RESERVOIR, BASED ON CRITICAL DRY PERIOD FROM 1920-21 THROUGH 1934-35

(In acre-feet)

Reservoir storage capacity	Seasonal irrigation yield
6,000	5,000
12,800	9,300

trol requirements, and cost analysis, hereinafter discussed, a reservoir of 12,800 acre-foot storage capacity, with estimated seasonal irrigation yield of 9,300 acre-feet, when operated on the monthly schedule presented in Table 36, was chosen for purposes of cost estimates to be presented in this bulletin. The yield study for this size of reservoir is included in Appendix M.

For cost estimating purposes a tentative distribution was made of the 9,300 acre-feet of yield of the proposed Lakeport Reservoir. Of this total yield, 3,500 acre-feet was allocated to Scott Valley and the remainder of 5,800 acre-feet was allocated to Bachelor Valley, and to the Tule Lake, Helms, and Edmands Reclamation Districts. Of the 3,500 acre-feet allocated to Scott Valley, 2,000 acre-feet would replace that water which presently flows past the dam site and percolates to the ground water basin, and the remaining 1,500 acre-feet would furnish all but 300 acre-feet of the probable ultimate supplemental water requirement. The additional 300 acre-feet required to meet the ultimate requirement of 3,800 acre-feet would be derived from additional deep percolation of direct precipitation on the valley floor of Scott Valley.

It was assumed that the unconsumed portion of water applied to lands in the pressure zone of Scott Valley would be available in the natural channel of Scott Creek for diversion and use on those lands scattered along Scott Creek between Scott Valley and Bachelor Valley which were not included in either the Scott Valley or the Upper Lake Units. It was also assumed that of the 5,800 acre-feet of new water supply allocated to Bachelor Valley, and to the Tule Lake, Helms, and Edmands Reclamation Districts, about 4,100 acre-feet would be assigned to Bachelor Valley to supply its total seasonal ultimate requirement of applied water, plus conveyance losses estimated at 25 per cent. The average seasonal application of water in Bachelor Valley is about 3 acre-feet per acre. On this basis, it was estimated that the new water supply would be applied to some 1,000 acres.

The remainder of the new water supply from the Lakeport Project, 1,700 acre-feet, was allocated to the Tule Lake, Helms, and Edmands Reclamation Districts. This amount is somewhat less than the ultimate supplemental water requirement for this area. However, the unconsumed portion of water applied to lands in the pressure zones of Bachelor Valley and the Upper Lake Unit would also be available to this area. It was assumed that the new water supply would be used largely on irrigated pasture, and that the average seasonal application of new water would be 3 acre-feet per acre. On this basis it was estimated that the new water supply would be applied to some 600 acres.

A topographic map of the Lakeport reservoir site up to an elevation of 1,560 feet was prepared by the United States Geological Survey, using photogrammetric methods. Field control for the map was estab-

TABLE 36

MONTHLY OPERATION SCHEDULE FOR LAKEPORT PROJECT

(In acre-feet)

Month	1 Irrigation demand, in per cent of seasonal total	2 Ground water draft in Scott Valley	3 Demand on reservoir for portion of Upper Lake Unit	4 Demand on reservoir for percolation in Scott Valley	5 Replenishment to ground water in Scott Valley from direct precipitation	6 Ground water storage available in Scott Valley	7 Total draft on Reservoir (3 + 4)
January	0	0	0	0	*	0	0
February	0	0	0	0	*	0	0
March	0	0	0	0	*	0	0
April	2	100	120	100		0	220
May	10	400	580	400		0	980
June	21	800	1,220	500		300	1,720
July	33	1,250	1,910	500		1,050	2,410
August	15	570	870	500		1,120	1,370
September	14	530	810	500		1,150	1,310
October	4	150	230	500		800	730
November	1	40	60	500	*	340	560
December	0	0	0	0	*	0	0
Totals	100	3,840	5,800	3,500	*340		9,300

* Minimum replenishment during period November through March totals 340 acre-feet.

shed by the Corps of Engineers. The map was drawn) a scale of 1 inch equals 1,000 feet, with a contour iterval of 10 feet. Storage capacities of the Lakeport eservoir at various stages of water surface elevation re given in Table 37.

TABLE 37

AREAS AND CAPACITIES OF LAKEPORT RESERVOIR

Depth of water at dam, in feet	Water surface elevation, U.S.G.S. datum, in feet	Water surface area, in acres	Storage capacity, in acre-feet
)	1,457	0	0
3	1,460	3	30
3	1,480	95	800
3	1,500	255	4,400
3	1,520	390	10,700
3	1,525	415	12,800
)	1,537	475	18,200
3	1,540	495	19,700

Based upon preliminary geological reconnaissance, ie Lakeport dam site is considered suitable for an irthfill or rockfill dam of any height up to a maxi-ium of about 80 feet. Bedrock in the vicinity of the ain dam consists of a mixed series of Franciscan eta-sedimentary and meta-volcanic rocks. Outcrops re common on both abutments and in the channel rea, and meta-volcanic greenstone seems to predomi-ite. Some soil creep and landsliding occur on the ownstream side of both abutments. The greenstone aphanitic, green-black in color, contains a few ienocrysts and vesicles, and show some slight effects serpentinization. Many random joints occur on the irface with minor separation along these joints. Nar-w shears and cross shears are in great abundance it gouge zones are seldom more than 1 inch in ickness. The metasedimentary rock was formerly a edium-grained sandstone in which metamorphism is proceeded further than in most of the other meta-ndstones of the Franciscan formation. Distinct foli-ion lines now appear in the old standstone due to a alignment of mineral grains.

Abutment slopes average 65 to 75 per cent to a ight of about 100 feet. The width of the channel, cluding a terrace on the right side, is about 350 feet. ripping of a 4-foot soil and rock mantle, 3 feet of drock from the abutments, and 10 feet of fill and feet of bedrock from the channel section should pro-de a foundation suitable for the impervious section an earthfill dam. A maximum of 6 feet of soil uld be recovered from flats both upstream and down-ream from the dam site, but much of this would be lty and mixed with layers of gravel which would be asted during stripping of the borrow area. Rock and avel could be obtained in large quantities in the cinity of the site.

The saddle chosen for the spillway site is located oout 2,300 feet southeast of the dam site, and is underlain by unconsolidated to partly consolidated sands, clays, and clayey gravels, apparently the terrace of the Cache formation. Hard consolidated Franciscan bedrock outcrops on the hill to the south of the saddle, and underlies the whole area at unknown and probably extremely variable depths which could only be accurately determined by additional exploration. Franciscan rock is probably nearest the surface on the south side of the saddle, and might be reached by excavation of 15 feet or more. Common excavation would be necessary in the sands, clays, and clayey gravels overlying the Franciscan formation, and the materials should not become significantly more consolidated with depth until Franciscan rocks are reached. The unconsildated rocks extend east of the saddle. A spillway here should be lined and probably channelized to reduce erosion for some distance from the lip, possibly to the point of entering the main stream about 1,200 feet downstream.

A second saddle located about 1,300 feet northwest of the Lakeport site is thin, falling away rapidly both to the north and the south. The necessary depth of stripping for an auxiliary saddle dike at this location would probably be at least 15 feet in the saddle, and somewhat less on the higher slopes. Rock at the site consists of meta-volcanics and other hard Franciscan rocks.

Bedrock at a third saddle, about 3,500 feet south of the dam site, is all hard Franciscan rock, being mostly sandstone with some chert and jasper. An auxiliary saddle dike at this location would involve stripping of overburden and weathered and fractured bedrock, and would amount to about 10 feet on the hillsides and 12 feet in the depressions along the axis of the saddle.

Considerable areas underlain by sand and gravel occur along the stream channel and in terraces both upstream and downstream from the Lakeport dam site. In places these deposits contain a high percentage of gravel; in others they are mostly sand. Use of these deposits as aggregate is somewhat questionable, due to the probable presence of reactive minerals. The deposits should, however, be generally suitable for pervious fill. The total amount of this material within a distance of one-half mile upstream and downstream from the site is roughly estimated to be 400,000 cubic yards.

As a result of yield studies, geologic reconnaissance, and preliminary cost analysis, an earth- and rockfill dam, 68 feet in height from stream bed to spillway lip, and with a crest elevation of 1,537 feet, was selected to illustrate estimates of costs of the Lakeport Project. The dam would have a crest length of 610 feet, a crest width of 30 feet, and 2.5:1 upstream and downstream slopes. The central impervious core would have a top width of 10 feet and 1:1 slopes. The outer pervious zones of the dam would consist of stream bed gravels, and salvaged and quarried rock graded to larger rock at the face for bank protection. The volume of fill in the main dam would be about 220,000 cubic yards. In addition to the main dam, there would be two smaller saddle dams having the same type of construction as the main dam. Saddle dam No. 1, 1,300 feet northwest of the main dam, would be 50 feet in height. The dam would have a crest length of 390 feet and the volume of fill would be about 73,000 cubic yards. Saddle dam No. 2, 3,500 feet south of the main dam, would be 48 feet in height. This dam would have a crest length of 1,210 feet and the volume of fill would be about 172,000 cubic yards. The total volume of fill of the dam and the two saddle dams would be about 465,000 cubic yards.

The spillway would be of the chute type with an ogee weir and concrete-lined, and would be located in a saddle about 2,300 feet southeast of the main dam. The maximum depth of water above the spillway lip would be 6¼ feet, and an additional 5¾ feet of freeboard would be provided. The spillway would have a capacity of 21,000 second-feet, required for an assumed discharge of 410 second-feet per square mile of drainage area, regulated in surcharge storage. The spillway would discharge into a natural draw which is about 1 mile in length and which emerges onto the gently sloping open land immediately southwest of the City of Lakeport. The spillway channel from the mouth of the draw to Clear Lake would be along the alignment of a present meandering ditch, and would be concrete-lined. The channel with a capacity of 21,000 second-feet, would be 1.5 miles in length, and would terminate in Clear Lake, at about the east quarter corner of Section 25, Township 14 North, Range 10 West, M.D.B. & M.

The outlet works would consist of a steel pipe 36 inches in diameter, laid in a trench excavated in the right abutment, and encased in concrete. Releases would be controlled at the upstream end by two 36-inch diameter butterfly valves, hydraulically operated from a control house on the right abutment. The maximum release through the outlet would be about 100 second-feet, which would be discharged into the natural channel of Scott Creek through a 36-inch hollow jet valve.

The water for export to Bachelor Valley would flow, after discharge from the reservoir, in the natural channel of Scott Creek for a distance of about 12 miles to a diversion structure located near the east quarter corner of Section 9, Township 15 North, Range 10 West, M.D.B. & M., adjacent to Highway 20. From this point, a maximum flow of 23 second-feet would be conveyed northerly a distance of 0.8 mile in an unlined ditch to a pump sump, where two pumps would raise the water about 42 feet to a proposed regulating reservoir. From this reservoir about one-half the water would be released through an outlet at an elevation of 1,362 feet to a head ditch which would irrigate lands in Bachelor Valley belo the 1,350-foot contour by gravity. The remainin water in the regulating reservoir would be pumpe up an additional 98 feet to an elevation of about 1,46 feet to a second ditch which would supply the high lands of Bachelor Valley.

The proposed diversion structure on Scott Cree would consist of a flashboard dam with concrete abu ments and apron, 10 feet in height above stream be and some 50 feet in length. About 25 feet upstrea from the left abutment, a ditch with an inlet elev tion of 1,330 feet would convey the water a distan of 0.8 mile in a northerly direction to the pump sum on Dayle Creek in Bachelor Valley. The unlined dit would be of trapezoidal section with 1.5:1 side slope bottom width of 6 feet, depth of 2.0 feet, and fre board of 1 foot. The canal slope would be about 3 feet per mile, and the velocity would be about 1 feet per second. The capacity of the ditch would b about 23 second-feet. The crossing of Highway 2 would be accomplished by a pipe jacked through th present fill.

The pump sump would be formed by a small chec dam on Dayle Creek. The height of the check da would be about 2.5 feet from stream bed to crest, ar 16 feet in length. The check dam would create a po approximately 600 feet long, with water surface el vation at 1,328 feet. At the upper end of the pool, ju upstream from the Bachelor Valley Road brid crossing Dayle Creek, a pumping plant would be i stalled, consisting of two 5,000-gallon-per-minut double suction, centrifugal pumps, each with a 10 horsepower motor, housed in a pump house. The wat discharged from the pumps would be convey through a welded steel pipe 2,400 feet in length ar 30 inches in diameter to a regulating reservoir. Th regulating reservoir would be located in a small na ural draw having a drainage area of approximate 75 acres in the southeast quarter of Section 4, Tow ship 15 North, Range 10 West, M. D. B. & M.

Because of the desirability of providing overnig storage, and because of local topography and ava able construction materials, an earthfill dam 10 fe in height from natural ground to spillway, with crest elevation of 1,375 feet, was selected to illustra the estimates of cost of the regulating reservoir. T dam would have a crest length of 310 feet, a cre width of 10 feet, and 3:1 upstream and 2:1 dow stream slopes. The volume of fill would be an es mated 6,400 cubic yards. The spillway would be the chute type, located on the right abutment a concrete-lined. The maximum depth of water abo the spillway lip would be 3 feet, with an addition 2 feet of freeboard. The spillway would have a c pacity of 200 second-feet required for an assum discharge of 1.5 second-feet per acre of drainage ar The spillway would discharge into a natural dr tributary to Dayle Creek. The outlet works would ıde a welded steel pipe laid in a trench excavated the left abutment, and encased in concrete. The pe outlet would have a diameter of 24 inches, a pacity of 20 second-feet, and its length would be 0 feet. Releases would be controlled at the upstream d by a 24-inch slide gate operated from the dam est. The outlet pipe would terminate at the inlet the proposed Lower Bachelor Valley Ditch.

The Lower Bachelor Valley Ditch would be of apezoidal section, with 1.5:1 side slopes, bottom dth of 6 feet, depth of 2.0 feet, and freeboard of 1 ot. Its slope would be about 3 feet per mile, mean locity about 1.4 feet per second, and capacity about second-feet. The ditch would extend for a distance about 1 mile in an easterly direction across Bachor Valley just above the 1,350-foot contour, and uld supply water for lands below this elevation.

To supply water to the upper portion of the valley, second pumping plant would be constructed, consting of two 4,000-gallon-per-minute, double suction, ntrifugal pumps, each with a 200-horsepower motor, used in a pump house. This pumping plant would ise the water from the regulating reservoir to an evation of 1,460 feet through a welded steel pipe e 18 inches in diameter and 500 feet in length. The pe would terminate at the inlet to the proposed pper Bachelor Valley Ditch. This ditch would be of apezoidal section, with 1.5:1 side slopes, bottom dth of 4.0 feet, depth of 1.8 feet, and freeboard of foot. Its slope would be about 6.0 feet per mile, ean velocity about 1.7 feet per second, and capacity out 20 second-feet. The ditch would extend around e upper limits of Bachelor Valley for a distance of miles.

Detailed designs of a conveyance system to supply ter to the Tule Lake, Edmands, and Helms Reclaation Districts were not made. Water is presently pplied to these districts from Scott Creek and from ear Lake. It was considered that the existing work ould be satisfactory, with minor improvement and largement, to supply these districts with their alated new water supply.

Cost estimates for ditches and regulation and dirsion structures to convey water to Bachelor Valley re based on designs utilizing data obtained by field rveys. Cost estimates for distribution of water from e major ditch systems were based on known costs similar irrigation works elsewhere in California, justed to correspond with conditions prevailing in ke County.

Pertinent data with respect to general features of e Lakeport Project, as designed for cost estimating rposes, are presented in Table 38.

The capital costs of the Lakeport Dam Project, sed on prices prevailing in November, 1954, were imated to be about $2,145,900. The corresponding nual costs of the Lakeport Project were estimated to be about $121,700. Average annual direct flood damages on Scott Creek were estimated by the Division of Water Resources to be about $42,000, based on data obtained from the Corps of Engineers, U. S. Army. The Lakeport Project would control all floods resulting from high flows of Scott Creek to nondamaging flows. Therefore, it may be assumed that the annual direct flood control benefits creditable to the project would be about $42,000. If a contribution of $42,000 annually were made by the Federal Government in the interest of flood control, the resultant estimated unit cost of the 7,300 acre-feet of new water conserved by the Lakeport Dam would be about $7.90 per acre-foot released to Scott Valley. The estimated

TABLE 38

GENERAL FEATURES OF LAKEPORT PROJECT

	Main dam	Saddle dam No. 1	Saddle dam No. 2
Earth- and Rockfill Dam			
Type	earth and rockfill		
Crest elevation, in feet, U.S.G.S. datum	1,537	1,537	1,537
Crest length, in feet	610	390	1,210
Crest width, in feet	30	30	30
Height, spillway lip above stream bed, in feet	68	--	--
Crest above saddle, in feet	--	50	48
Side slopes, upstream and downstream	2.5:1	2.5:1	2.5:1
Elevation of stream bed or saddle, in feet, U.S.G.S. datum	1,457	1,487	1,489
Volume of fill, in cubic yards	220,000	73,000	172,000

Reservoir	
Surface area at spillway lip, in acres	415
Capacity at spillway lip, in acre-feet	12,800
Drainage area, in square miles	54
Estimated mean seasonal runoff, in acre-feet	42,000
Estimated safe seasonal yield, in acre-feet	9,300
Type of spillway	chute, concrete-lined
Spillway capacity, in second-feet	21,000
Type of outlet—36-inch diameter steel pipe through right abutment, encased in concrete	
Spillway Channel to Clear Lake	
Type	concrete-lined trapezoidal section
Length, in miles	1.5
Side slopes	1.5:1
Bottom width, in feet	28.0
Depth, in feet	12.0
Freeboard, in feet	4.0
Slope, in feet per mile	45
Velocity, in feet per second	38.2
Capacity, in second-feet	21,000

	Main ditch, Scott Creek to pump sump	Lower ditch	Upper ditch
Conveyance Ditches, Bachelor Valley			
Type	unlined, trapezoidal sections		
Length, in miles	0.8	1.0	3.0
Side slopes	1.5:1	1.5:1	1.5:1
Bottom width, in feet	6.0	6.0	4.0
Depth, in feet	2.0	2.0	1.8
Freeboard, in feet	1.0	1.0	1.0
Slope, in feet per mile	3.0	3.0	6.0
Velocity, in feet per second	1.4	1.4	1.7
Capacity, in second-feet	23.0	23.0	20.0

TABLE 38—Continued

GENERAL FEATURES OF LAKEPORT PROJECT

	Pumps	
	2 double suction centrifugal	2 double suction centrifugal
Pumping Plants, Bachelor Valley		
Estimated minimum water surface elevation, in feet	1,328	1,362
Discharge elevation, in feet	1,373	1,460
Estimated maximum pumping head, in feet	50	104
Installed pumping capacity, in gallons per minute	10,000	10,000
Estimated maximum monthly demand, in acre-feet	1,350	590
Estimated gross seasonal diversion, in acre-feet	4,100	1,780
Motors, horsepower	100	200
Pump support	concrete base	concrete base
Pump sump	check dam	regulating reservoir
Discharge lines	30-inch welded steel pipe, 2,400 feet in length	18-inch welded steel pipe, 500 feet in length

Dayle Creek Regulating Dam and Reservoir	
Earthfill dam	
Crest elevation, in feet	1,375
Crest length, in feet	310
Crest width, in feet	10
Height, spillway lip above stream bed, in feet	10
Side slopes, upstream	3:1
downstream	2:1
Freeboard above spillway lip, in feet	5
Elevation of stream bed, in feet	1,360
Volume of fill in cubic yards	6,400
Reservoir	
Surface area at spillway lip, in acres	2.5
Surface area with 3.0-foot flashboards, in acres	3.1
Capacity at spillway lip, in acre-feet	15
Capacity with 3.0-foot flashboards, in acre-feet	23.5
Drainage area, in acres	135
Type of spillway	chute type
Spillway capacity, in second-feet	200
Type of outlet	18-inch welded steel pipe

unit cost of water applied for irrigation in Bachelor Valley would be about $12.70 per acre-foot, and the estimated unit cost of water applied for irrigation in the Tule Lake, Edmands, and Helms Reclamation Districts would be about $9.20 per acre-foot.

Estimated capital and annual costs of the Lakeport Project are summarized in the following tabulation. Detailed cost estimates are presented in Appendix N.

	Estimated costs	
	Capital	*Annual*
Lakeport Dam and Reservoir	$1,472,700	$72,200
Spillway channel to Clear Lake	531,700	27,400
Bachelor Valley conveyance pumping system	101,100	15,100
Bachelor Valley distribution system	25,400	4,700
Tule Lake, Helms, and Edmands Reclamation Districts' distribution system	15,000	2,300
Totals	$2,145,900	$121,700

Upper Lake Unit

It was shown in Chapter III that there is no pres ent requirement for supplemental water in the Uppe Lake Unit, but that the irrigation of irrigable land not presently irrigated will require the developmen of a supplemental water supply. For the Upper Lak Unit, the ultimate supplemental water requiremen was estimated to be about 14,000 acre-feet per seaso However, since about 5,800 acre-feet of water pe season would be furnished to portions of the Uppe Lake Unit from the previously described Lakepo Project, it was only necessary to design addition works to provide the remaining 8,200 acre-feet. It wa also pointed out in Chapter III that there exists need for flood protection for lands adjacent to Clove and Middle Creeks. Therefore, it was considered d sirable to provide works to insure a water supply i the amount of the estimated ultimate supplement water requirement and to control floods.

Two possible plans to effect flood control and t supply the ultimate demand for supplemental wate in the Upper Lake Unit were considered. For reaso hereinafter mentioned, after preliminary investig tion and study, the first plan was given no furth consideration for cost estimating purposes, but ma warrant future study. The second plan is describe in some detail later in this section.

Alternative Plans Considered. The first of t alternative plans considered included the constru tion of a reservoir having a storage capacity of 30,0 acre-feet at the Hunter Point site on Middle Cree The reservoir would be operated for water conserv tion and to regulate flood flows of Middle Creek. T yield of water developed by the project would mo than meet the ultimate supplemental water requir ment of the Upper Lake Unit. Since only a porti of the yield of the project could be readily utiliz at the present time, the costs of developed wat would be excessive until such time as the major po tion of the yield could be put to beneficial use other areas. Under this plan certain flood cont benefits would be realized. However, maximum r leases from the reservoir would exceed the chann capacity of Middle Creek. In addition, flows in Clov Creek would not be controlled. For these reasons t plan was given no further present consideration.

The second of the alternative plans would inclu the construction of a dam on Middle Creek at t Pitney Ridge site, and the increased use of grou water storage in the Upper Lake Unit, to supp sufficient water to meet the ultimate supplement water requirement in the unit. Flood protection f lands in the unit would be provided by channel alignment and construction of levees along Clover a Middle Creeks. This plan is hereinafter referred as the "Upper Lake Project," and its principal f tures are delineated on Plate 17.

Upper Lake Project. Under present conditions of tilization of water in the Upper Lake Unit, ground ater storage is filled by January, and surface out-ow after this time passes undiminished out of the nit. From stream flow measurements made during he investigation, it was estimated that the maximum onthly rate of percolation in the Upper Lake Unit pproaches 2,000 acre-feet. By utilizing the maximum ercolation rate of 2,000 acre-feet per month, it was stimated that the average additional amount of wa-er that could be retained by increased use of ground ater storage would be about 4,000 acre-feet per eason, 4,200 acre-feet less than that required to meet he ultimate requirement in the Upper Lake Unit. 'herefore, in order to meet the remainder of the ltimate supplemental requirement in this unit, it ill be necessary to develop water from a source or ources other than ground water. Surveys and studies ndicate that the most feasible source of supply would e that resulting from the construction of a dam and eservoir at the Pitney Ridge site on Middle Creek.

The proposed Pitney Ridge Dam would be an arth- and rockfill structure with a chute spillway, ocated in Section 15, Township 16 North, Range 10 Vest, M.D.B. & M., some 8 miles upstream from Upper Lake. Stream bed elevation at the dam site s about 1,475 feet. Flood waters of Middle Creek onserved by the Pitney Ridge Reservoir would be eleased to the channel of Middle Creek and diverted ownstream at an elevation of approximately 1,410 eet to an unlined canal to serve lands in the Upper Lake Unit lying below an elevation of about 1,400 eet.

As a first step in determination of size of the proj-ct, estimates were made of yield of the proposed vorks for two storage capacities. It was estimated hat the mean seasonal runoff of Middle Creek, from he approximately 40 square miles of drainage area bove the dam site, was 22,600 acre-feet. Yield studies vere made for two sizes of reservoir at the Pitney Ridge site, based upon records and estimates of run-ff during the critical dry period which occurred in he Sacramento Valley from 1920-21 through 1934-35. t was assumed that a seasonal irrigation deficiency p to 35 per cent could be endured in one season of he period. A summary of results of the yield studies s presented in Table 39.

TABLE 39

STIMATED SEASONAL IRRIGATION YIELD OF PITNEY RIDGE RESERVOIR, BASED ON CRITICAL DRY PERIOD FROM 1920-21 THROUGH 1934-35

(In acre-feet)

Reservoir storage capacity	Seasonal irrigation yield
5,400	5,400
12,700	10,000

Flood in Upper Lake and flood damage in rural area—some 15 inches of silt deposited in young orchard

After consideration of results of the yield studies, together with topography of the dam site and cost analysis, hereinafter discussed, a reservoir of 5,400 acre-foot capacity, with estimated seasonal irrigation yield of 5,400 acre-feet, was chosen for purposes of cost estimates to be presented in this bulletin. The yield study for this size of reservoir is included in Appendix M.

Since the Upper Lake Unit overlies both a free and a confined ground water area, the water losses in the proposed canal and ditch system to supply lands overlying the free ground water area would percolate to the ground water. For this reason it was considered that the new water supply from the Pitney Ridge Dam would be limited to lands overlying the free ground water area, so far as is practicable, and that canal and ditch losses plus the unconsumed portion of the applied new water would be available for reuse. It was estimated that losses in conveyance and distribution of the 5,400 acre-feet of seasonal irrigation yield would be about 25 per cent, leaving some 4,000 acre-feet per season for surface application to irrigation of lands. It was also assumed that the water would be used largely on lands having the same pattern of crops as are presently grown, and that the average seasonal application of new water would be 2.4 acre-feet per acre. On this basis it was assumed that the new water supply would be applied directly to some 1,700 acres in a service area lying generally north and east of Upper Lake. The quantity of water lost in conveyance and distribution, some 1,400 acre-feet, would be repumped as ground water and applied to some 600 acres in the Upper Lake Unit.

An estimate of the monthly distribution of demand for irrigation water in the Clear Lake Area was presented in Table 29. Based on these data, monthly demands on the Pitney Ridge Project would be as shown in Table 40.

TABLE 40

ESTIMATED MONTHLY DISTRIBUTION OF DEMAND FOR WATER FROM PITNEY RIDGE RESERVOIR

Month	Per cent of seasonal total	Gross release to Upper Lake Unit, in acre-feet
April	2	100
May	10	500
June	21	1,100
July	33	1,800
August	15	800
September	14	800
October	4	200
November	1	100
Totals	100	5,400

A topographic map covering the area of the Pitney Ridge dam and reservoir sites, at a scale of 1 inch equals 1,000 feet, with contour interval of 10 feet, was prepared by the United States Geological Survey in 1949, using photogrammetric methods. Field control was by the Corps of Engineers, and photography by the United States Bureau of Reclamation. Storage capacities of Pitney Ridge Reservoir at various stages of water surface elevation are given in Table 41.

Based upon preliminary geological reconnaissance, the Pitney Ridge dam site is considered suitable for an earthfill dam of any height up to a maximum of about 65 feet. Bedrock at the site is buried at an undeterminate depth. However, the bedrock is probably the Franciscan formation, and may be principally sandstone. The channel section at the dam site is about 375 feet wide and filled with sand and gravel

TABLE 41

AREAS AND CAPACITIES OF PITNEY RIDGE RESERVOI

Depth of water at dam, in feet	Water surface elevation, U.S.G.S. datum, in feet	Water surface area, in acres	Storage capacity, in acre-feet
0	1,478	0	0
22	1,500	83	650
32	1,510	100	1,550
42	1,520	110	2,600
52	1,530	122	3,750
62	1,540	148	5,100
64	1,542	157	5,400
72	1,550	197	6,850
82	1,560	233	9,000
92	1,570	260	11,400
102	1,580	292	14,100
112	1,590	325	17,200
122	1,600	365	20,600

through which a cutoff would have to be constructe to bedrock.

The left abutment consists of a knoll, behind whic is located a saddle, about 65 feet above the stream be The height of a dam utilizing this knoll for an abut ment, without constructing a saddle dam farther t the east, is thus limited to somewhat less than 65 feet The knoll is composed of fractured, weathered Fran ciscan rock, consisting of dolerite, some serpentin and probably some sandstone and chert. The saddl to the east of the knoll is underlain by less resistan Franciscan shale. The rock of the knoll is highly fra tured, with many breaks in various directions. Ave age slope of the abutment is about 55 per cent. Ther is some scrubby brush but little soil on the abutmen

Two possible locations for the right abutment exi at the Pitney Ridge dam site, the axis of one trendin about south 80° west and the other about south 60 west from the left abutment knoll previously de scribed. For either axis, the right abutment would b a sloping terrace composed of a jumble of colluvia and alluvial fragments under which bedrock is burie at an undetermined depth. On first examination, th axis trending about north 60° west appears to be th better. Average slope of this abutment is about 2 per cent.

Without exploration, the depth of the unconsol dated, unsorted rock fragments and fines of the righ abutment can only be estimated, but it may averag 20 feet or more before bedrock is reached. It woul be necessary to excavate a cutoff to bedrock beneat the impervious section of a fill type of dam, and add tional stripping of 2 to 3 feet of fractured bedroc should be sufficient to reach sound material. Furthe study should be made to check the possibility tha this colluvial material would slough into the reservoi when saturated, and to determine whether it would b necessary to stabilize this slope with a rockfill toe.

Depth of stripping for the impervious section of a earthfill dam would probably average about 25 fee plus 5 feet of fractured rock. The condition of the foundation probably would not improve materially with additional stripping beyond this depth. Excavated material here and elsewhere at the site could be utilized generally in the pervious section of the dam. Leakage through the left abutment knoll is a possibility unless the foundation is thoroughly grouted.

A spillway for an earthfill dam at this site could probably be cut through the left abutment saddle. It would have to be lined, and the estimated depth of stripping before lining would be about 8 feet of soil and weathered shale.

Little material suitable for impervious earthfill was found upstream from the Pitney Ridge site, although some pervious material occurs near the junction of the east and west forks of Middle Creek just upstream from the site. Much greater quantities of fill occur downstream within 3 miles of the site. Extensive low terraces in this reach appear to contain material of satisfactory quality for use as impervious earthfill. Stream gravels here should be satisfactory for use as pervious fill.

As a result of yield studies, geologic reconnaissance, and preliminary cost analysis, an earth- and rockfill dam, 64 feet in height from stream bed to spillway lip, and with a crest elevation of 1,555 feet, was selected to illustrate estimates of cost of the Pitney Ridge Dam. The dam would have a crest length of about 875 feet, a crest width of 30 feet, and 2.5:1 upstream and downstream slopes. The central impervious core would have a top width of 10 feet and 0.8:1 slopes. The outer pervious zones of the dam would consist of stream bed gravels, salvaged material from stripping and excavation, and quarried rock. The pervious sections would be graded to coarse rock at the face for bank protection. The volume of fill would be an estimated 399,000 cubic yards.

The spillway would be of the chute type, located in a saddle on the left abutment, and concrete-lined. The maximum depth of water above the spillway lip would be 8 feet, and an additional 5 feet of freeboard would be provided. The spillway would have a capacity of 20,800 second-feet, required for an assumed discharge of 520 second-feet per square mile of drainage area. The spillway would discharge directly into Middle Creek below the dam.

The outlet works would consist of a 30-inch welded steel pipe placed in a trench and backfilled with concrete. Release of water through the dam would be controlled at the upstream end by two 30-inch, hydraulically controlled, high-pressure slide valves located at a submerged inlet upstream from the dam, and operated by hydraulic controls from the crest of the dam. The outlet would be controlled at the downstream end by a hollow jet valve.

After release through the outlet, the water would be conveyed in the natural channel of Middle Creek for a distance of about 3.5 miles to a point about 1,000 feet below the existing county road bridge at Hunter Point. At this point there is a rock outcrop, and a flashboard dam would be constructed to divert the flow into the proposed main supply canal in the Upper Lake Unit. The diversion dam would be 5 feet in height and 100 feet in length, and would divert reservoir releases into the canal cut in the left bank. The inlet elevation of the bottom of the proposed main supply canal would be 1,408 feet. The capacity of the canal would be about 30 second-feet, and would extend for a distance of about 4 miles along the toe of the hills on the east side of Middle Valley, crossing Clover Valley in a north-south direction through the center of Section 5, Township 15 North, Range 9 West, M.D.B. & M., terminating in the southwest quarter of Section 5. The canal would be unlined and of trapezoidal section, with 1.5:1 side slopes, bottom width of 6 feet, depth of 1.75 feet, and a gradient of about 8 feet to the mile.

Cost estimates of the canal were based on designs utilizing data obtained by a reconnaissance field survey. Detailed design of the distribution system, however, was considered to be outside the scope of the current investigation. Cost estimates for the distribution system were based on known costs of similar irrigation works elsewhere in California, adjusted to correspond with conditions prevailing in the Lake County Area. Pertinent data with respect to general features of the Pitney Ridge Dam and Reservoir and the Middle Creek Diversion and Canal, as designed for cost estimating purposes, are presented in Table 42.

As previously stated, 4,000 acre-feet of new ground water yield could be obtained by increasing the draft on ground water, thereby creating additional ground water storage in the free ground water zone of the Upper Lake Unit. This additional storage would be filled at the rate of 2,000 acre-feet per month from surface outflows to Clear Lake that presently occur between January and April of each year. Therefore, the remaining 2,800 acre-feet, the portion of the indicated ultimate supplemental water requirement of 8,200 acre-feet in the Upper Lake Unit not furnished by Pitney Ridge Reservoir, could be met from this increased storage. Maximum pumping lifts, under conditions required to utilize this additional storage, would be increased by about 25 feet. It is probable that in order to obtain the additional ground water storage capacity, many wells would have to be deepened, and well casings and pump columns lowered. If it is assumed that costs resulting from increased pumping lifts, to create additional ground water storage capacity, would approximate $0.08 per acre-foot of additional average lift for present pumpage, and $0.08 per acre-foot per foot of total lift for new

TABLE 42

GENERAL FEATURES OF PITNEY RIDGE DAM AND RESERVOIR, AND MIDDLE CREEK DIVERSION AND CANAL

Earth- and Rockfill Dam	
Crest elevation, in feet	1,555
Crest length, in feet	875
Crest width, in feet	30
Height, spillway lip above stream bed, in feet	64
Side slopes	2.5:1
Freeboard, above spillway, in feet	13
Elevation of stream bed, in feet	1,478
Volume of fill, in cubic yards	399,000
Reservoir	
Surface area at spillway lip, in acres	158
Capacity at spillway lip, in acre-feet	5,400
Drainage area, Middle Creek, in square miles	40
Estimated mean seasonal runoff, Middle Creek, in acre-feet	22,600
Estimated safe seasonal new yield, in acre-feet	5,400
Type of spillway—chute type, concrete-lined	
Spillway capacity, in second-feet	20,800
Type of outlet—30-inch welded steel pipe encased in concrete	
Middle Creek Diversion and Canal	
Diversion—flashboard dam with concrete base and abutment, 100 feet in length, 5 feet high, with ditch intake immediately upstream on left bank.	
Canal	
Type—unlined earth ditch, trapezoidal section	
Length, in miles	4
Side slopes	1.5:1
Bottom width, in feet	6
Depth, in feet	1.75
Freeboard, in feet	1.0
Slope, in feet per mile	8
Velocity, in feet per second	2
Capacity, in second-feet	31

ground water pumped, the resultant increase in annual cost per acre-foot of water presently pumped would be about $1.00, and the resultant annual cost per acre-foot of new ground water pumped would approach $3.80. Total increase in annual cost to present pump users would approximate $12,000. Total annual costs chargeable to pumping of new ground water would be about $18,000. Total increased annual cost in the portion of the Upper Lake Unit, excluding Bachelor Valley and the Tule Lake, Helms, and Edmands Reclamation Districts, to present pump users and for pumping new ground water, would be about $30,000.

The capital costs of the features of the project designed to supply the ultimate supplemental water requirement of the Upper Lake Unit were estimated to be $839,000. The corresponding annual costs of these features, including increased cost to present pump users and for pumping new ground water, was estimated to be $78,000. The resultant estimated unit cost of the 8,200 acre-feet per season of new yield conserved by the project would be about $9.50 per acre-foot. The resultant estimated average unit cost of the 5,400 acre-feet per season conserved by Pitney Ridge Reservoir would be about $8.30 per acre-foot.

Estimated capital and annual costs of the Upper Lake Project, excluding flood control features, on a 3.5 per cent interest basis, are summarized in the following tabulation. Detailed cost estimates are presented in Appendix N.

	Estimated costs	
	Capital	*Annua*
Pitney Ridge Dam and Reservoir	$765,000	$36,60
Middle Creek Diversion and Canal	23,000	1,40
Distribution system	51,000	6,70
Increased pumping cost of present ground water supply	--	12,00
Pumping cost of new ground water supply	--	18,00
Pumping cost of salvaged conveyance losses	--	3,30
Totals	$839,000	$78,00

The foregoing works would provide sufficient water to meet the estimated ultimate requirement for supplemental water in the portions of the Upper Lake Unit, excluding Bachelor Valley and the Tule Lake, Helms, and Edmands Reclamation Districts. However, additional works would be required to give needed protection against floods in the Upper Lake Unit. The plan for flood control in the Upper Lake Unit is the same as that proposed by the Corps of Engineers, U. S. Army, in its "Review Report on Cache Creek Basin," dated July 1, 1950, and authorized by the Congress in H. R. 9859, 83rd Congress, second session. This plan contemplates the diversion of flood flows of Clover Creek, just below the confluence of Clover Creek with Alley Creek, by means of the proposed Clover Creek Diversion Channel, a leveed by-pass canal diverting flows westerly into Middle Creek. In addition, the present capacity of the channel of Middle Creek would be increased. In the

TABLE 43

PRINCIPAL FEATURES OF FLOOD CONTROL WORKS OF UPPER LAKE PROJECT

Item	Clover Creek Diversion Channel	Middle Creek				Scott Creek
		Clear Lake to Scott Creek	Scott Creek to Clover Creek	Clover Creek to Clover Creek Diversion Channel	Above Clover Creek Diversion Channel	
Length, in miles	0.76	1.32	0.76	1.30	1.57	1.37
Slope, in feet per mile	5.3	*6.1	12.5	12.5	15.0	3.5
Present channel capacity, in second-feet	0.0	7,500	4,500	4,000	3,500	4,000
Proposed channel capacity, in second-feet	6,500	27,000	19,000	17,500	14,000	12,000
Bottom width of channel, in feet	250	varies	varies	varies	varies	varies
Top width of levees, in feet	12	12	12	12	12	12
Average height of levees, in feet (stripped surfaces to crest)	6	10	10	10	6	4
Maximum height of levees, in feet	0	14	14	10	7	5
Freeboard on levees, in feet	3	3	3	3	3	3
Side slopes						
Water side	3:1	3:1	3:1	3:1	3:1	3:1
Land side	2:1	2:1	2:1	2:1	2:1	2:1
Approximate width of right of way, in feet	400	500	500	500	500	500

* From mouth of Scott Creek to Clear Lake with water level 8.0 feet on Rumsey gage.

reach of Middle Creek between the bridge near Nice upstream to the mouth of Scott Creek the height of the existing levee would be increased and 0.2 mile of new levee would be constructed. These levee improvements would be limited to the left bank of the stream since protection of the limited areas at the base of the hills adjacent to the right bank was deemed not feasible. From the mouth of Scott Creek upstream to the mouth of Clover Creek the capacity of the existing channel of Middle Creek would be increased by deepening and by building levees on both the left and right banks. Above the outlet of Clover Creek to near the intersection with the proposed Clover Creek Diversion Channel outlet, the capacity of the existing channel of Middle Creek would be increased by deepening and by building levees on both the left and right banks. Above the outlet of the proposed Clover Creek Diversion Channel a levee would extend along the left bank of Middle Creek to tie in to high ground. The adjacent hills on the right bank would contain the flood flows in this reach except for a distance of about 0.5 mile where a right bank levee would be constructed, tying in at both ends to high ground and protecting a pocket of alluvial land. A levee would also be constructed along the left bank of Scott Creek from its junction with Middle Creek upstream for a distance of about 8,000 feet to high ground. Appurtenant works necessary for completion of the project would consist of replacing seven bridges, relocating 0.5 mile of state highway and 0.4 mile of county road, and the acquisition of about 430 acres of land. Principal features of the existing and proposed flood channels and levees are tabulated in Table 43 and delineated on Plate 14.

Cost estimates for the flood control works of the Upper Lake Project were made by the Corps of Engineers and were reported in the Omnibus Flood Control Bill of 1954. The estimates were based on prices prevailing in 1954. The cost estimates made by the Corps of Engineers were considered satisfactory for use in connection with the Upper Lake Project.

Capital costs of the flood control features of the Upper Lake Project were estimated by the Corps of Engineers to be $1,900,000. Corresponding annual costs of the flood control features were estimated at $75,600. Average annual direct flood benefits were estimated by the Department of Water Resources to be about $116,000, based on data obtained from the Corps of Engineers, U. S. Army.

CHAPTER V

SUMMARY OF CONCLUSIONS, AND RECOMMENDATIONS

As a result of field investigation and analysis of available data on the water resources and water problems of the Clear Lake Area, and on the basis of estimates and assumptions discussed hereinbefore, the following conclusions and recommendations are made.

SUMMARY OF CONCLUSIONS

1. The present water problems in the Clear Lake Area are twofold in nature, and are manifested by:

a. The need for supplemental water to meet requirements of irrigable lands presently not supplied with water.

b. The need for flood control on Kelsey, Adobe, Scott, Middle, and Clover Creeks.

2. There is no present requirement for supplemental water in the Clear Lake Area, since mean seasonal extraction of water from the free ground water areas of the Big Valley, Scott Valley, and Upper Lake Units has not exceeded average base period replenishment.

3. Under forecast ultimate conditions of development in the Clear Lake Area, the mean seasonal requirement for supplemental water will be about 32,500 acre-feet, distributed as follows: Big Valley Unit, 17,000 acre-feet; Scott Valley Unit, 1,500 acre-feet; and Upper Lake Unit, 14,000 acre-feet.

4. The surface water supplies of the Clear Lake Area are generally of excellent mineral quality and well suited from that standpoint for irrigation and other beneficial uses. Ground water of good mineral quality occurs generally in the area, except in certain locations in which the ground water contains excessive concentrations of boron.

5. Studies which have been described heretofore indicate that the flows of streams tributary to Clear Lake, if properly regulated and controlled, could more than meet probable ultimate water requirements of the Clear Lake Area, and that the flood hazard would be eliminated.

6. Major features of The California Water Plan which would be pertinent to the operation of Clear Lake, and which could provide supplemental water to the Clear Lake Area, involve a diversion from the Eel River through Clear Lake to the Sacramento Valley. Works on the Eel River would include a series of major conservation reservoirs. Pumping plants would transport the surplus conserved water from reservoir to reservoir up the Eel River to a tunnel beneath the southerly divide between the Eel River and the Cache Creek watershed. The tunnel would convey water for export to the Sacramento River Basin by way of Clear Lake and Putah Creek. Surplus waters of the Eel River conveyed through Clear Lake could more than meet the probable ultimate supplemental water requirements of the Clear Lake Area.

7. Tentative plans for local development provide for control of floods and the conservation of waters of the Clear Lake Area by greater utilization of ground water storage in the area, and the construction of dams and reservoirs on certain streams tributary to Clear Lake.

8. The Big Valley Project, considered for local development in the Big Valley Unit, would provide flood protection to all lands in Big Valley, supply supplemental water for percolation to the ground water basin, and meet water requirements under conditions of ultimate development. The plan would include increased operation of the ground water basin, and the construction of the Kelseyville Dam and Reservoir on Kelsey Creek about 4 miles upstream from Kelseyville. Flood flows of Kelsey Creek would be discharged through the reservoir spillway into Adobe Creek, and thence into a by-pass channel which would convey the combined flood flows of Kelsey, Adobe, and Highland Creeks along the western edge of Big Valley to discharge into Clear Lake. The capital cost of the Big Valley Project, based on prices prevailing in November, 1954, was estimated to be about $2,421,000, exclusive of new pumpage cost. The corresponding annual cost was estimated to be about $170,000, including new pumpage cost. If a contribution of $35,000 annually were made by the Federal Government in the interest of flood control, the resultant estimated average unit cost of the 17,000 acre-feet per season of new water conserved by the Big Valley Project would be about $7.90 per acre-foot.

9. The Lakeport Project, considered for initial local construction in the Scott Valley Unit, would include the Lakeport Dam and Reservoir on Scott Creek to supply the ultimate supplemental water requirement in both Scott and Bachelor Valleys, and a portion of such requirement in the Tule Lake, Helms, and Edmands Reclamation Districts, and to control flood flows on Scott Creek. The flood waters of Scott Creek would be regulated in the proposed reservoir and released to Scott Creek for percolation to ground water in Scott Valley and for use in Bachelor Valley and in the Tule Lake, Helms, and Edmands Reclamation Districts. Reservoir spill of flood flows would be dis-

charged through a spillway located a short distance southeast of the dam site and would be conveyed easterly and directly to Clear Lake. Of the total new seasonal yield of 7,300 acre-feet developed by the Lakeport Project, 1,500 acre-feet would be allocated to Scott Valley, 4,100 acre-feet to Bachelor Valley, and the remainder, 1,700 acre-feet, to the Tule Lake, Helms, and Edmands Reclamation Districts. The capital cost of the Lakeport Project, based on prices prevailing in November, 1954, was estimated to be about $2,146,000. The corresponding annual cost of the project was estimated to be about $122,000. If a contribution of $42,000 annually were made by the Federal Government in the interest of flood control, the resultant estimated unit cost of new water conserved by the Lakeport Project would be $7.90 per acre-foot in Scott Valley, $12.70 per acre-foot in Bachelor Valley, and $9.20 per acre-foot in the Tule Lake, Helms, and Edmands Reclamation Districts.

10. The Upper Lake Project, considered for initial local construction in the Upper Lake Unit, would include the construction of the Pitney Ridge Dam and Reservoir on Middle Creek, and the increased use of ground water storage in the Upper Lake Unit, to supply sufficient water to meet the ultimate supplemental water requirement in the unit. Flood protection for the lands in the unit would be provided by channel realignment and construction of levees along Clover and Middle Creeks. The total capital cost of the Upper Lake Project, not including flood control features, and based on prices prevailing in November, 1954, was estimated to be $839,000. The corresponding annual cost of the project was estimated to be about $78,000. The resultant estimated unit cost of the 8,200 acre-feet of new water conserved by the project would be about $9.50 per acre-foot. Capital and annual costs of the flood control features of the Upper Lake Project were estimated by the Corps of Engineers, U. S. Army, to be $1,900,000 and $75,600, respectively. Average annual direct flood control benefits were estimated by the Department of Water Resources to be about $116,000.

RECOMMENDATIONS

It is recommended that:

1. A public district endowed with appropriate powers be created as required for the purposes of proceeding with further study of local water problems of the Clear Lake Area, and with financing, constructing, and operating projects found to be feasible.

2. Local development of water resources be accomplished by an orderly progression of phases of development and in accordance with The California Water Plan. Successive steps of the proposed plans should first develop those projects with indicated lowest capital cost and unit cost of water, and then proceed in order of expense to phases of greater unit cost as needs develop.

3. Additional engineering investigation and study be made as required, for the design, financing, and constructing of the more favorable of the local projects for initial development, when the financial feasibility of these projects has been determined.

4. Stream gaging station be constructed and continuous records of stream flow be obtained at strategic points on those streams for which future construction of water conservation works is probable, in order to permit more reliable determination of yield of the projects and their most economic design and construction.

5. A program be initiated for the acquisition of lands, easements, and rights of way necessary for construction of the required local water conservation works.

6. Continuous support be given to the investigation and study of major multipurpose water resource development works under The California Water Plan.

APPENDIX A

AGREEMENTS BETWEEN THE STATE WATER RESOURCES BOARD, THE COUNTY OF LAKE, AND THE DEPARTMENT OF PUBLIC WORKS

TABLE OF CONTENTS

AGREEMENT BETWEEN THE STATE WATER RESOURCES BOARD, THE COUNTY OF LAKE, AND THE DEPARTMENT OF PUBLIC WORKS

This Agreement, executed in quintuplicate, entered into by the State Water Resources Board, hereinafter referred to as the "Board"; the County of Lake, hereinafter referred to as the "County"; and the Department of Public Works, State of California, acting through the agency of the State Engineer, hereinafter referred to as the "State Engineer":

WITNESSETH:

Whereas, by the State Water Resources Act of 1945, as amended, the Board is authorized to make investigations, studies, surveys, hold hearings, prepare plans and estimates, and make recommendations to the Legislature in regard to water development projects including flood control plans and projects; and

Whereas, by said act, the State Engineer is authorized to cooperate with any county, city, state agency or public district on flood control and other water problems and when requested by any thereof may enter into a cooperative agreement to expend money in behalf of any thereof to accomplish the purposes of said act; and

Whereas, the County desires and hereby requests the Board to enter into a cooperative agreement for the making of an investigation and report on underground water supplies as more particularly set forth hereinafter in Article I; and

Whereas, the Board hereby requests the State Engineer to cooperate in making said investigation and report;

Now therefore, in consideration of the premises and the several promises to be faithfully performed by each as hereinafter set forth, the Board, the County and the State Engineer do hereby mutually agree as follows:

ARTICLE I—WORK TO BE PERFORMED:

The work to be performed under this agreement shall consist of an investigation and report on the underground water supplies of Big Valley within the Big Valley Soil Conservation District and of Scotts Valley-Upper Lake Area within the Scotts Valley-Upper Lake Soil Conservation District, all in the county of Lake, including quality, replenishment and utilization thereof, and, if possible, a method or methods of solving the water problems involved.

The Board by this agreement authorizes and directs the State Engineer to cooperate by making said investigation and report and by otherwise advising and assisting in making an evaluation of the present and ultimate underground water problems in said areas, and in formulating a plan for the solution or solutions thereof.

During the progress of said investigation and report all maps, plans, information, data and records pertaining thereto which are in the possession of any party hereto shall be made fully available to any other party for the due and proper accomplishment of the purposes and objectives hereof.

The work under this agreement shall be diligently prosecuted with the objective of completion of the investigation and report on or before October 1, 1950, or as nearly thereafter as possible.

ARTICLE II—FUNDS:

The County, upon execution by it of this agreement, shall transmit to the State Engineer the sum of Three Thousand Dollars ($3,000) for deposit, subject to the approval of the Director of Finance, into the Water Resources Revolving Fund in the State Treasury, for expenditure by the State Engineer in performance of the work provided for in this agreement. Also, upon execution of this agreement by the Board, the Director of Finance will be requested to approve the transfer of the sum of Three Thousand Dollars ($3,000) from funds appropriated to the Board by Item 335 of the Budget Act of 1948, for expenditure by the State Engineer in performance of the work provided for in this agreement and the State Controller will be requested to make such transfer.

If the Director of Finance, within thirty (30) days after receipt by the State Engineer of said Three Thousand Dollars ($3,000) from the County, shall not have approved the deposit thereof into said Water Resources Revolving Fund, together with the transfer of the sum of Three Thousand Dollars ($3,000) from funds appropriated to the Board by Item 335 of the Budget Act of 1948, for expenditure by the State Engineer in performance of the work provided for in this agreement, said sum contributed by the County shall be returned thereto by the State Engineer.

It is understood by and between the parties hereto that the sum of Six Thousand Dollars ($6,000) to be made available as hereinbefore provided is adequate to perform approximately half of the above specified work and it is the understanding that the County will make a further sum of Three Thousand Dollars ($3,000) available at the commencement of the second year of said investigation which will be subject to a matching or contribution in an equal sum by the Board for the completion of said investigation and report.

The Board and the State Engineer shall under no circumstances be obligated to expend for or on account of the work provided for under this agreement any amount in excess of the sum of Six Thousand Dollars ($6,000) as made available hereunder and when said sum is exhausted, the Board and the State Engineer may discontinue the work provided for in this agreement and shall not be liable or responsible for the resumption and completion thereof until further sums as specified in the preceding paragraph are made available.

Upon completion of and final payment for the work provided for in this agreement, the State Engineer shall furnish to the Board and to the County a statement of all expenditures made under this agreement. One-half of the total amount of all said expenditures shall be deducted from the sum advanced from funds appropriated to said Board, and one-half of the total amount of all said expenditures shall be deducted from the sum advanced by the County and any balance which may remain shall be returned to the Board, and to the County, in equal amount.

ARTICLE III—EFFECTIVE DATE:

This agreement shall become effective immediately upon its execution by all of the parties hereto.

IN WITNESS WHEREOF, the parties hereunto have affixed their signatures, the County on the 23rd day of November, 1948, the Board on the 9th day of December, 1948, and the State Engineer on the 17th day of December, 1948.

Approved as to Form:
/s/ LOVETT K. FRASER
District Attorney,
County of Lake
By /s/ FREDRIC S. CRUMP, Deputy

Approval Recommended:
/s/ HENRY HOLSINGER
Principal Attorney,
Division of Water Resources

Approved as to Legality:
/s/ C. C. CARLETON
Chief Attorney,
Department of Public Works

Approved:
/s/ JAMES S. DEAN
Director of Finance

COUNTY OF LAKE
By /s/ JAMES R. TOCHER
Chairman, Board of Supervisors
/s/ THOS. L. GARNER
Clerk, Board of Supervisors

STATE WATER RESOURCES BOARD
By /s/ C. A. GRIFFITH
Vice-Chairman

DEPARTMENT OF PUBLIC WORKS
STATE OF CALIFORNIA
By /s/ C. H. PURCELL
C. H. Purcell
Director of Public Works
/s/ EDWARD HYATT
Edward Hyatt
State Engineer

SUPPLEMENTAL AGREEMENT BETWEEN THE STATE WATER RESOURCES BOARD, THE COUNTY OF LAKE, AND THE DEPARTMENT OF PUBLIC WORKS

This Agreement, executed in quintuplicate, entered into by the State Water Resources Board, hereinafter referred to as the "Board"; the County of Lake, hereinafter referred to as the "County"; and the Department of Public Works of the State of California, acting through the agency of the State Engineer, hereinafter referred to as the "State Engineer."

WITNESSETH:

Whereas, by agreement heretofore entered into by and between the County of Lake, the Board and the State Engineer, executed by the County on the 23rd day of November, 1948, by the Board on the 9th day of December, 1948, and by the State Engineer on the 17th day of December, 1948, providing for the making by the State Engineer of an investigation and report on the underground water supplies of Big Valley within the Big Valley Soil Conservation District and of Scotts Valley-Upper Lake area within the Scotts Valley-Upper Lake Soil Conservation District, all in the County of Lake, including quality, replenishment and utilization thereof, and, if possible, a method or methods of solving the water problems involved; and

Whereas, by said prior agreement the sum of Six Thousand Dollars ($6,000) was made available for said investigation and report, the sum of Three Thousand Dollars ($3,000) thereof being made available by said County, and the sum of Three Thousand Dollars ($3,000) thereof being made available from funds appropriated to the Board by Item 335 of the Budget Act of 1948; and

Whereas, it was the expressed intention in said prior agreement that at the commencement of the second year of said investigation the County of Lake would make available a further sum of Three Thousand Dollars ($3,000) subject to the matching thereof or contribution in equal amount by the Board for the completion of said investigation and report and that not to exceed Twelve Thousand Dollars ($12,000) total shall be expended for said purpose; and

Whereas, additional funds are now required to complete said investigation and report, and it is the desire of the parties hereto by this supplemental agreement that in addition to the sum of Six Thousand Dollars ($6,000) already provided, the further sum of Six Thousand Dollars ($6,000) be provided, Three Thousand Dollars ($3,000) by the County, and Three Thousand Dollars ($3,000) by the Board;

Now Therefore, in consideration of the premises and of the several promises to be faithfully performed by each as hereinafter set forth, the Board, the County, and the State Engineer do hereby mutually agree as follows:

1. The County, upon execution by it of this agreement, shall transmit to the State Engineer the sum of Three Thousand Dollars ($3,000) for deposit, subject to the approval of the Director of Finance, into the Water Resources Revolving Fund in the State Treasury for expenditure by the State Engineer in continuing performance of the work provided for in said prior agreement to which this agreement is supplemental.

2. Upon execution of this agreement by the Board, the Director of Finance will be requested to approve the transfer of the sum of Three Thousand Dollars ($3,000) from funds appropriated to the Board by Item 259 of the Budget Act of 1949 for expenditure by the State Engineer in continuing performance of the work provided for in said prior agreement to which this agreement is supplemental, and the State Controller will be requested to make such transfer.

3. The Board and the State Engineer shall under no circumstances be obligated to expend for or on account of the work provided for in said prior agreement to which this agreement is supplemental any amount in excess of the sum of Twelve Thousand Dollars ($12,000) as made available under said prior agreement and this supplemental agreement and if funds are exhausted before completion of said work, the Board and the State Engineer may discontinue said work and shall not be liable or responsible for the completion thereof.

4. In so far as consistent herewith and to the extent adaptable hereto, all of the terms and provisions of said prior agreement to which this agreement is supplemental are hereby made applicable to this agreement and are hereby confirmed, ratified, and continued in effect.

In Witness Whereof, the parties hereunto have affixed their signatures, the County on the 3rd day of October, 1949, the Board on the 11th day of October, 1949, and the State Engineer on the 13th day of October, 1949.

Approved as to form:

/s/ Lovett K. Fraser
District Attorney
County of Lake

By /s/ Fredric S. Crump, Deputy

COUNTY OF LAKE

By /s/ J. H. Pearce
Chairman, Board of Supervisors

(SEAL) Board of Supervisors
Lake County

/s/ Thos. L. Garner
Clerk, Board of Supervisors

By /s/ Dorothy M. Butler,
Deputy Clerk

Approval Recommended:

/s/ Henry Holsinger
Principal Attorney
Division of Water Resources

STATE WATER RESOURCES BOARD

By /s/ C. A. Griffith
Chairman

Approval Recommended:

/s/ Robert E. Reed
Attorney
Department of Public Works

DEPARTMENT OF PUBLIC WORKS
STATE OF CALIFORNIA

C. H. Purcell
Director of Public Works

(SEAL)

By /s/ Frank B. Durkee
Deputy Director

/s/ Edward Hyatt
Edward Hyatt
State Engineer

Approved:

Director of Finance

L. D. K. Form	F. J. M. Budget	Value	Description
DEPARTMENT OF FINANCE APPROVED October 21, 1949 James S. Dean, Director By /s/ Louis J. Heinzer Administrative Adviser			

AGREEMENT BETWEEN THE STATE WATER RESOURCES BOARD, THE COUNTY OF LAKE, AND THE DEPARTMENT OF PUBLIC WORKS

This Agreement, executed in quintuplicate, entered into as of January 1, 1953, by the State Water Resources Board, hereinafter referred to as the "Board"; the County of Lake, hereinafter referred to as the "County"; and the Department of Public Works of the State of California, acting through the agency of the State Engineer, hereinafter referred to as the "State Engineer":

WITNESSETH:

Whereas, an investigation of Big Valley, Scott Valley, and the Upper Lake Area, all situated in Lake County, has been conducted by the Department of Public Works, acting by and through the agency of the State Engineer, between December 1948 and July 1952, and a report on the results of said investigation is being prepared pursuant to a cooperative arrangement between the Department and the County of Lake whereby the work accomplished, including the preparation of a report, was financed with funds contributed equally by the County of Lake and the State of California; and

Whereas, funds were appropriated to the Board by Item 269 of the Budget Act of 1952 for continuing work on ground water level and stream flow measurements, a quality of water check, and collection of crop survey records in the investigational area on a matching basis pending accomplishment of solution of the water problems in that area; and

Whereas, by The State Water Resources Act of 1945, as amended, the Board is authorized to make investigations, studies, surveys, prepare plans and estimates, and make recommendations to the Legislature in regard to water development projects; and

Whereas, by said act, the State Engineer is authorized to cooperate with any county, city, State agency or public district on flood control and other water problems and when requested by any thereof may enter into a cooperative agreement to expend money in behalf of any thereof to accomplish the purposes of said act; and

Whereas, the County desires and hereby requests the Board to enter into a cooperative agreement for the making of ground water level and stream flow measurements, a quality of water check, and crop surveys in Big Valley, Scott Valley, and the Upper Lake Area between January 1, 1953 and January 1, 1954.

Now Therefore, in consideration of the premises and of the several promises to be faithfully performed by each as hereinafter set forth, the Board, the County, and the State Engineer do hereby mutually agree as follows:

ARTICLE I—WORK TO BE PERFORMED:

The work to be performed under this agreement may include a series of ground water level measurements in the spring and fall of 1953, stream flow measurements from time to time, collection and analysis of samples of surface and ground waters, collection of crop survey records and compilation of results of such measurements, analysis and other data, and operation and maintenance of the stream gaging stations on Scott Creek near Lakeport, Clover Creek near Upper Lake, and Middle Creek near Hunter Point.

The Board by this agreement authorizes and directs the State Engineer to cooperate in performing said work and compiling the results thereof.

During the progress of said investigation, all maps, plans, information, data and records pertaining thereto which are in the possession of any party hereto shall be made fully available to any other party for the due and proper accomplishment of the purposes and objects hereof.

The work under this agreement shall be diligently prosecuted with the objective of completion of the investigation and compilation of data by January 1, 1954, or as nearly thereafter as possible.

ARTICLE II—FUNDS:

The County, upon execution by it of this agreement, shall transmit to the State Engineer the sum of Seven Hundred and Fifty Dollars ($750) for deposit, subject to the approval of the Director of Finance, into the Water Resources Revolving Fund in the State Treasury, for expenditures by the State Engineer in performance of the work provided for in this agreement. Also, upon execution of this agreement by the Board, the Director of Finance will be requested to approve the transfer of the sum of Seven Hundred and Fifty Dollars ($750) from funds made available to the Board by Item 269 of the Budget Act of 1952, as augmented, into the Water Resources Revolving Fund in the State Treasury, for expenditure by the State Engineer in performance of the work provided for in this agreement and the State Controller will be requested to make such transfer.

If the Director of Finance, within thirty (30) days after receipt by the State Engineer of said Seven Hundred and Fifty Dollars ($750) from the County, shall not have approved the deposit thereof into said Water Resources Revolving Fund, together with the sum of said Seven Hundred and Fifty Dollars ($750) transferred from funds made available to the Board, for expenditure by the State Engineer in performance of the work provided for in this agreement, such sum contributed by the County shall be returned thereto by the State Engineer.

The Board and the State Engineer shall under no circumstances be obligated to expend for or on account of the work provided for under this agreement any amount in excess of the sum of Fifteen Hundred Dollars ($1,500) as made available hereunder and when said sum is exhausted, the Board and the State Engineer may discontinue the work provided for in this agreement and shall not be liable or responsible for the resumption and completion thereof.

Upon completion of and final payment for the work provided for in this agreement, the State Engineer shall furnish to the Board and to the County a statement of all expenditures made under this agreement. One-half of the total amount of all said expenditures shall be deducted from the sum advanced from funds appropriated to said Board, and one-half of the total amount of all said expenditures shall be deducted from the sum advanced by the County and any balance which may remain shall be returned to the Board, and to the County, in equal amount.

In Witness Whereof, the parties hereto have executed this agreement to be effective as of the date hereinabove first written.

Approved as to Form and Procedure

/s/ Fredric S. Crump
County Counsel
County of Lake

Approved as to Form and Procedure

/s/ Henry Holsinger
Attorney for Division of Water Resources

Approved as to Form and Procedure

Attorney, Department of Public Works

Approved:

Director of Finance

COUNTY OF LAKE

By /s/ C. W. Lampson
Chairman, Board of Supervisors

STATE WATER RESOURCES BOARD

By /s/ C. A. Griffith
Chairman

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS

FRANK B. DURKEE
Director of Public Works
(SEAL)

By /s/ Russell S. Munro
Russell S. Munro
Acting Deputy Director of Public Works

/s/ A. D. Edmonston
A. D. Edmonston
State Engineer

LEZ Form	FJM Budget	Value	Descript.

DEPARTMENT OF FINANCE
APPROVED
SEP 2 1952
James S. Dean, Director
By /s/ Louis J. Heinzer
Administrative Adviser

CHAPTER 52, STATUTES OF 1956

An act to amend Section 22 and the title to Article 1 of Chapter 2 of Division 1 of, to repeal Sections 23, 200, 201, 202, 203, 1009, 1050.5, 1050.6, and 1060 of, and to add Sections 23, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 1009, 1256, and 13003 to, and Article 2 to Chapter 2 of Division 1, the title to Chapter 2.5 of Division 1, and the title to Article 1 of Chapter 2.5 of Division 1 of, the Water Code, relating to the water resources of the State, creating the Department of Water Resources and the State Water Rights Board, and providing for their powers and duties.

[Approved by Governor April 25, 1956. Filed with Secretary of State April 25, 1956.]

The people of the State of California do enact as follows:

SECTION 1. The Legislature hereby declares that the purpose of this act is to provide for the reorganiza of the Executive Branch of the State Government with respect to the administration of statutory and constitutional provisions relating to water or dams by the creation of a Department of Water Resources and a State Water Rights Board. It is the intent of the Legislature in providing for such reorganization to provide for the continuance of the existing laws, rights, powers, and duties pertaining to water and dams.

SEC. 2. Section 22 of the Water Code is amended to read:

22. "Department," unless otherwise specified, means the Department of Water Resources.

SEC. 3. Section 23 of said code is repealed.

SEC. 4. Section 23 is added to said code, to read:

23. "Director," unless otherwise specified, means the Director of Water Resources.

SEC. 5. The title to Article 1 of Chapter 2 of Division 1 of said code is amended to read:

Article 1. Department of Water Resources

SEC. 6. Sections 150 to 159, inclusive, are added to said code, immediately following the title to Article 1, Chapter 2, Division 1, to read:

150. There is in the State Government the Department of Water Resources, which is under the control of an executive officer known as the Director of Water Resources. The director is appointed by the Governor and holds office at the pleasure of the Governor. The appointment of the director is subject to confirmation by the Senate at the next regular or special session of the Legislature, and the refusal or failure of the Senate to confirm the appointment shall create a vacancy in the office. The annual salary of the director is eighteen thousand dollars ($18,000), and he is a member of the Governor's Council.

151. Before entering upon the duties of his office, the director shall execute an official bond to the State in the penal sum of twenty-five thousand dollars ($25,000) conditioned upon the faithful performance of his duties.

152. The director, in addition to being subject to removal from office by the Governor, may be removed from office by the Legislature, by concurrent resolution adopted by a majority vote of all members elected to each house, for dereliction of duty or corruption or incompetency.

153. Except as provided in Section 189, the department succeeds to and is vested with all of the powers, duties, purposes, responsibilities, and jurisdiction in matters pertaining to water or dams vested in the Department and Director of Public Works, the Division of Water Resources of the Department of Public Works, the State Engineer, the Water Project Authority of the State of California, or any officer or employee thereof. The department also succeeds to and is vested with all of the powers, duties, purposes, responsibilities, and jurisdiction of the Department of Finance under Part 2 (commencing at Section 10500) of Division 6. The department succeeds to and is vested with all of the powers, duties, purposes, responsibilities, and jurisdiction vested in the State Water Resources Board, except as provided in Section 154.

Any commission or other body heretofore or hereafter created by the Legislature to formulate a compact with a similar commission or body from another state relative to the distribution and use of the waters of any interstate streams or bodies of water, including but not limited to the California Klamath River Commission and the California-Nevada Interstate Compact Commission, shall, in formulating a provision in any such compact for the administration of the terms of the compact, provide that the Department of Water Resources shall be the representative of the State of California for the purpose of such administration.

154. The Division of Water Resources of the Department of Public Works, the Water Project Authority of the State of California, the Office of State Engineer, and the offices of the executive directors created by Section 39105 of the Water Code are each abolished.

The State Water Resources Board, hereafter to be known as the State Water Board, is continued in existence within the department, but the board shall hereafter have only the powers and duties provided in this section. The board shall confer with, advise, and make recommendations to the director with respect to any matters and subjects under his jurisdiction. The rule-making power of the department shall be exercised in the following manner. All rules and regulations of the department, other than those relating exclusively to the internal administration and management of the department, shall be first presented by the director to the board and shall become effective only upon approval thereof by the board.

It is the intention of the Legislature that in the making of all major departmental determinations, policies and procedures, such as departmental recommendations to the Legislature, the director and the board shall be in agreement whenever possible; but for the purpose of fixing responsibility to the Governor and to the Legislature, in the event of disagreement between the director and the board upon such matters, the views of the director shall prevail. In such situations a written report upon such disagreement shall be made immediately to the Governor and to the President pro Tempore of the Senate and the Speaker of the Assembly by the board and by the director.

The provisions of existing law relating to the appointment, qualifications, and tenure of the members of the board are continued in effect except that board members may be removed from office by the Legislature, by concurrent resolution adopted by a majority vote of all members elected to each house, for dereliction of duty or corruption or incompetency.

The Reclamation Board is continued in existence within the department and the provisions of law relating to the appointment, qualifications, and tenure of its members are continued in effect, but said board shall continue to exercise and have all of its powers, duties, purposes, responsibilities, and jurisdiction. It is the intent of the Legislature that the Reclamation Board shall cooperate with the department in all matters of mutual concern to the fullest extent practicable.

All meetings and hearings held by any board continued in existence within the department shall be open and public.

155. For the purpose of administration, the director shall organize the department with the approval of the Governor in the manner he deems necessary to segregate and conduct the work of the department properly. With the approval of the Governor, the director may create such divisions and subdivisions as may be necessary and change or abolish them from time to time.

The director with the approval of the Governor may establish branch offices in hydrographic or other regions of the State in order to assure the expeditious conduct of the work of the department in such region, and to assure free and rapid communication of local problems and recommendations to the department and may change or abolish any such branch offices from time to time. Any branch office so established shall be under the control of a branch office manager who, subject to the direction and control of the director, shall represent the department in all matters under the department's jurisdiction in the region.

156. There shall be one Deputy Director of Water Resources who shall be a civil executive officer and shall be appointed by the Governor and serve at the pleasure of the Governor. The compensation of the deputy director shall be fixed by the director pursuant to law. The deputy director shall have such duties as shall be assigned, from time to time, by the director, and he shall be responsible to the director for the performance thereof.

157. The department is authorized to employ legal counsel who shall advise the director, represent the department in connection with legal matters before other boards and agencies of the State, and may, when authorized by the Attorney General, represent the department and the State in litigation concerning affairs of the department. In any event, the legal counsel of the department may, with the approval of the director and with the consent of the court before which the action is pending, present to the court the views of the department with respect to the action. Section 11416 of this code and Sections 11041, 11042, 11043, and subdivision (b) of Section 16048 of the Government Code are not applicable to the Department of Water Resources.

158. In times of extraordinary stress and of disaster, resulting from storms and floods, the director may declare the existence of an emergency and designate the location, nature, cause, area, and extent of the emergency if in his opinion:

(a) The emergency is a matter affecting the waters or dams of the State and is of general public and state concern; and

(b) Work and remedial measures are required to immediately avert, alleviate, repair, or restore damage or destruction to property having a general public and state interest and to protect the health, safety, convenience, and welfare of the general public of the State.

The department may perform any work required or take any remedial measures necessary to avert, alleviate, repair, or restore damage or destruction to property as provided in this section. In carrying out such work the department may perform the work itself or through or in cooperation with any other state department or agency, the Federal Government, or any political subdivision, city, or district.

The director shall transmit any declaration made under this section to the Governor with a recommendation and request that money be allocated from any available money appropriated for that purpose or to meet state emergencies within the meaning of that term as employed in this section, in order to carry out the work and remedial measures required to meet the emergency.

The Governor shall forthwith determine if a state emergency exists, and if money is available in any appropriation or emergency fund for the work and remedial measures. Upon an affirmative finding upon these matters he shall direct the Department of Finance to allocate to the department such amount as in his opinion will be required to meet the emergency.

159. With respect to any project the planning, construction, operation, or maintenance of which is specifically under the jurisdiction of the Department of Water Resources, as used in the State Contract Act or any other law relating to work by the State, references to the Department of Public Works mean the Department of Water Resources and references to the Director of Public Works or the State Engineer mean the Director of Water Resources.

SEC. 7. Article 2 is added to Chapter 2 of Division 1 of said code, to read:

Article 2. State Water Rights Board

185. There is in the State Government the State Water Rights Board consisting of three members appointed by the Governor. One of the members appointed shall be an attorney admitted to practice law in this State and one shall be a registered civil engineer under the laws of this State. Each member shall represent the State at large and not any particular portion thereof. The appointments so made by the Governor shall be subject to confirmation by the Senate at the next regular or special session of the Legislature, and the refusal or failure of the Senate to confirm an appointment shall create a vacancy in the office to which the appointment was made.

186. Each member of the board shall receive an annual salary of fifteen thousand dollars ($15,000) and shall receive the necessary traveling and other expenses incurred by him in the performance of his official duties out of appropriations made for the support of the board. When necessary the members of the board may travel within or without the State.

187. The terms of the members first appointed shall expire as follows: one member on January 15, 1957, one member on January 15, 1958, and one member on January 15, 1959. Thereafter all members of the board shall be appointed for terms of four years. Vacancies shall be immediately filled by the Governor for the unexpired portion of the terms in which they occur.

188. The members of the board may be removed from office by the Legislature, by concurrent resolution adopted by a majority vote of all members elected to each house, for dereliction of duty or corruption or incompetency.

189. The board succeeds to and is vested with all of the powers, duties, purposes, responsibilities, and jurisdiction vested in the Department and Director of Public Works, the Division of Water Resources of the Department of Public Works, and the State Engineer, or any officer or employee thereof, under Parts 1 (commencing at Section 1000), 2 (commencing at Section 1200), 3 (commencing at Section 2000), and 5 (commencing at Section 4999) of Division 2 of this code, or any other law under which permits or licenses to appropriate water are issued, denied, or revoked.

190. Before entering upon the duties of his office, each member of the board shall execute an official bond to the State in the penal sum of twenty-five thousand dollars ($25,000) conditioned upon the faithful performance of his duties.

191. The board shall maintain its headquarters at Sacramento and shall hold meetings at such times and at such places as shall be determined by it. The Governor shall designate the time and place for the first meeting of the board. All meetings of the board shall be open and public.

192. The Governor shall designate the chairman of the board from the membership of the board. The person so designated shall hold the office of chairman at the pleasure of the Governor.

193. The board may hold any hearings and conduct any investigations in any part of the State necessary to carry out the powers vested in it, and for such purposes has the powers conferred upon heads of departments of the State by Article 2 (commencing at Section 11180), Chapter 2, Part 1, Division 3, Title 2 of the Government Code.

Any hearing or investigation by the board may be conducted by any member upon authorization of the board, and he shall have the powers granted to the board by this section, but any final action of the board shall be taken by the board as a whole.

All hearings held by the board or by any member thereof shall be open and public.

194. The Department of Water Resources shall have an interest and may appear as a party in any hearing held by the board and may commence or appear in any judicial proceeding brought to inquire into the validity of any action, order, or decision of the board.

195. The board shall adopt rules for the conduct of its affairs in conformity, as nearly as practicable, with the provisions of Chapter 4 (commencing at Section 11370), Part 1, Division 3, Title 2 of the Government Code.

196. The board shall have such powers, and may employ such legal counsel and other personnel and assistance, as may be necessary or convenient for the exercise of its duties under Division 2 (commencing at Section 1000). The Attorney General shall represent the board and the State in litigation concerning affairs of the board unless the Department of Water Resources is a party to the action. In such case the legal counsel of the board shall represent the board. Sections 11041, 11042, and 11043 of the Government Code are not applicable to the State Water Rights Board.

197. The board and the Department of Water Resources shall, to the fullest extent possible, ex-

change records, reports, material, and any other information relating to water or water rights, to the end that unnecessary duplication of effort may be avoided; however, no such exchange shall be made when, in the opinion of the agency possessing the records, reports, material, or other information, such exchange would be detrimental to the public interest.

SEC. 8. Sections 200, 201, 202, and 203 of said code are repealed.

SEC. 9. The title to Chapter 2.5 of Division 1 is added to said code, immediately following Section 197, to read:

CHAPTER 2.5. MISCELLANEOUS POWERS OF DEPARTMENT

SEC. 10. The title to Article 1 of Chapter 2.5 of Division 1 is added to said code, immediately preceding Section 205, to read:

Article 1. Participation in Associations

SEC. 11. Section 1009 of said code is repealed.

SEC. 12. Section 1009 is added to said code, to read:

1009. As used in Parts 1 (commencing at Section 1000), 2 (commencing at Section 1200), 3 (commencing at Section 2000), and 5 (commencing at Section 4999) of this division, "department" means the State Water Rights Board.

SEC. 13. Sections 1050.5, 1050.6, and 1060 of said code are repealed.

SEC. 14. Section 1256 is added to said code, to read:

1256. In determining public interest under Sections 1253 and 1255, the State Water Rights Board shall give consideration to any general or coordinated plan prepared and published by the Department of Water Resources or any predecessor thereof, looking toward the development, utilization, or conservation of the water resources of the State.

SEC. 15. Section 13003 is added to said code, to read:

13003. It is the intent of the Legislature that the State Water Pollution Control Board and each regional water pollution control board shall cooperate with the department in all matters of mutual concern to the fullest extent practicable.

SEC. 16. All persons, other than temporary employees, serving in the state civil service and engaged in the performance of a function transferred to the Department of Water Resources or the State Water Rights Board or engaged in the administration of a law, the administration of which is transferred to the department or board, shall remain in the state civil service and are hereby transferred to the Department of Water Resources or the State Water Rights Board, as the case may be, on the effective date of this act. The status, positions, and rights of such persons shall not be affected by their transfer and shall continue to be retained by them pursuant to the State Civil Service Act, except as to positions the duties of which are vested in a position that is exempt from civil service.

All public property, real or personal, of any state agency or officer used principally or primarily in carrying out of any function, or acquired in connection with the exercise of any function, which function is transferred to the Department of Water Resources or the State Water Rights Board, is transferred to the department or the board, as the case may be.

The Governor shall make the final determination as to the proper division of personnel and property between the Department of Water Resources and the State Water Rights Board.

APPENDIX B

RECORDS OF MONTHLY PRECIPITATION IN CLEAR LAKE AREA
NOT PREVIOUSLY PUBLISHED

TABLE OF CONTENTS

RECORD OF MONTHLY PRECIPITATION AT KELSEYVILLE 2N, CALIFORNIA

County: Lake
Date established: 1935
Type of gage: non-recording
Elevation: 1,355 feet, U.S.G.S. datum

Station No. 5-101A on Plate 3
Location: NW¼ SW¼, S 2, T 13 N, R 9 W, M.D.B.&M.
Record obtained from: Mr. H. W. Benson

(In inches)

Season	July	Aug.	Se t.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	Total
1934-35	----	----	----	----	----	----	8.83	2.38	4.32	2.70	0	0	----
35-36	0	0.12	0	1.74	2.13	2.96	5.98	7.92	1.18	1.21	0.88	2.20	26.32
36-37	0.06	0	0	0.25	0	1.92	3.04	7.84	4.62	0.88	0	1.32	19.93
37-38	0	0	0	1.71	6.40	7.90	4.76	10.49	5.45	1.75	0	0	38.46
38-39	0	0	0.72	1.62	1.65	1.70	3.16	1.35	1.63	0.21	1.15	0	13.18
1939-40	0	0	0	0.54	0.42	3.82	4.92	2.07	0.18	0.33	0.84	0	13.12
40-41	0	0	0.88	1.14	2.18	10.79	8.72	8.08	5.29	3.38	0.94	0	41.44
41-42	0	0	0	1.10	2.54	8.92	5.43	6.18	1.97	5.05	1.57	0	32.76
42-43	0	0	0	1.18	3.58	5.57	8.74	1.81	2.89	2.53	0	0.32	26.62
43-44	0	0	0	0.87	1.14	2.56	4.92	2.96	2.10	1.61	0.71	1.96	18.83
1944-45	0	0	0	1.53	5.74	3.46	2.00	3.69	3.88	0	1.54	0	21.84
45-46	0	0	0	4.11	3.86	8.06	2.01	2.07	1.02	0.11	0.70	0	21.94
46-47	0.40	0	0.10	0.36	3.37	3.66	0.89	3.91	3.68	0.61	0.23	0.73	17.94
47-48	0	0	0	3.61	1.05	0.86	2.00	2.10	4.45	6.08	0.80	1.18	22.13
48-49	0	0	0.20	0.71	0.90	4.05	0.96	2.14	6.44	0.06	0.66	0	16.12
1949-50	0.08	0	0	0.04	2.03	1.34	5.52	3.54	2.71	1.28	0.60	0	17.14
50-51	0	0	0.08	4.11	6.00	6.81	5.18	3.15	1.59	1.08	1.74	0	29.74
51-52	0	0	0	2.14	4.61	7.98	7.20	3.38	3.67	0.50	0.29	1.09	30.86
52-53	0.07	0	0	0.29	1.69	11.83	6.41	0.24	2.51	2.31	1.11	0.65	27.11
53-54	0	0.38	0	0.84	----	----	----	----	----	----	----	----	----

RECORD OF MONTHLY PRECIPITATION AT LOWER LAKE 1W, CALIFORNIA

County: Lake
Date established: 1934
Type of gage: non-recording
Elevation: 1,500 feet, U.S.G.S. datum

Station No. 5-101B on Plate 3
Location: SW¼ SE¼, S 4, T 12 N, R 7 W, M.D.B.&M.
Record obtained from: Mr. Walter Reichert

(In inches)

Season	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	Total
1934-35	----	----	----	----	----	----	----	---	----	----	----	----	29.50
35-36	----	----	0	0.56	1.19	2.88	6.00	11.31	1.25	1.56	0	1.25	26.00
36-37	----	----	0	0.25	0	2.00	3.00	11.13	1.00	0.25	0	0	17.63
37-38	----	----	0	0.62	7.25	10.00	5.50	12.38	9.87	1.00	0	0	46.62
38-39	----	----	1.50	1.37	1.63	1.50	2.37	0.50	2.26	0	0	0	11.13
1939-40	----	----	0	0	0.12	5.25	12.25	14.75	3.50	0.50	1.00	0	37.37
40-41	----	----	0.37	1.63	2.25	18.87	11.50	10.63	8.10	5.37	0.88	0	59.60
41-42	----	----	0	1.37	2.75	13.63	8.25	7.00	2.75	6.37	0.50	0	42.62
42-43	----	----	0	0.50	2.12	5.25	10.38	2.25	4.24	1.75	0	0	26.49
43-44	----	----	0	0.75	1.25	3.00	6.50	5.12	2.38	2.50	0.87	0	22.37
1944-45	----	----	0	1.98	5.18	4.85	2.52	4.13	4.47	0.22	1.50	0	24.85
45-46	----	----	0	6.07	3.16	10.98	1.26	2.12	1.78	0	0	0	24.37
46-47	----	----	0	0.18	5.79	3.30	0.93	4.37	5.07	0.62	0	1.05	21.29
47-48	----	----	0	3.88	0.74	1.65	1.22	1.59	4.33	8.53	0.99	0.59	23.52
48-49	----	----	0.30	0.12	0.45	5.38	1.20	3.36	10.59	0	0	0	21.40
1949-50	----	----	0.65	0	1.61	2.20	7.39	6.10	1.73	1.33	0.41	0	21.42
50-51	----	----	0	5.59	5.58	6.66	4.13	2.72	1.22	1.09	2.43	0	29.42
51-52	----	----	0	1.50	5.01	9.66	10.73	2.97	4.54	0	0	1.12	35.53
52-53	----	----	0	0.26	2.18	15.19	6.97	0	2.73	2.26	0.90	0.54	31.03
53-54	----	----	0	0.37	----	----	----	----	----	----	----	----	----

RECORD OF MONTHLY PRECIPITATION AT MIDDLETOWN, CALIFORNIA

County: Lake
Date established: 1940
Type of gage: non-recording
Elevation: 1,105 feet, U.S.G.S. datum

Station No. 5-101C on Plate 3
Location: S3, T 10 N, R 7 W, M.D.B.&M.
Record obtained from: United States Weather Bureau

(In inches)

Season	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	Total
1939–40						----	17.94	20.13	8.86	1.94	2.12	0.09	----
40–41	0	0	0.66	2.46	4.24	22.09	15.07	13.34	8.70	6.97	1.86	0.65	76.04
41–42	0	0.05	0.02	1.90	4.05	17.48	10.63	12.79	3.82	8.06	2.81	0	61.61
42–43	0	0	Tr	0.92	7.39	6.64	16.30	2.54	4.32	3.62	0.07	0.15	41.95
43–44	0	0	0	0.83	2.15	3.61	7.88	8.22	6.19	3.80	1.57	0.69	34.94
1944–45	0	0	0	3.19	7.80	5.76	2.11	6.19	5.08	0.91	2.21	0	36.03
45–46	0	0	0	5.87	6.81	15.93	1.41	3.99	2.50	0.39	0.65	0	37.55
46–47	0.18	0	0.15	0.03	9.02	4.68	0.78	4.95	8.60	0.73	1.21	2.09	32.42
47–48	0	0	0	e6.38	1.20	1.98	4.69	1.90	6.20	12.83	1.14	0.38	36.70
48–49	0	0	0.34	0.54	2.89	10.87	e3.50	7.90	11.80	0.03	0.28	0	38.15
1949–50	0.02	Tr	0.09	0	3.80	5.03	12.75	8.47	4.40	2.45	1.19	0.05	38.25
50–51	0	0	0.10	8.06	9.61	12.09	7.60	3.83	3.15	1.55	2.50	0	48.49
51–52	0	0	0	3.93	10.25	15.91	17.07	6.15	6.13	0.94	0.92	1.78	63.08
52–53	0.01	0	0	0.07	3.52	22.60	15.38	0.02	7.47	3.66	1.19	0.04	54.32
53–54	0	0.27	0	1.70	----	----	----	----	----	----	----	----	----

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RECORD OF MONTHLY PRECIPITATION AT SCOTT VALLEY, CALIFORNIA

County: Lake
Date established: 1929
Type of gage: non-recording
Elevation: 1,450 feet, U.S.G.S. datum

Station No. 5-94A on Plate 3
Location: SW¼ SE¼ S 14, T 14 N, R 10 W, M.D.B.&M.
Record obtained from: Mr. A. S. Riggs

(In inches)

Season	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	Total
1929–30	----	----	----	----	----	11.32	4.79	4.43	2.63	2.26	0.70	0	----
30–31	0	0	0	1.16	1.68	0.50	5.83	1.55	0	0.41	2.01	1.25	14.39
31–32	0	0	0	2.75	1.22	11.55	2.74	1.18	1.04	1.57	1.20	0	23.25
32–33	0	0	0	0	2.03	4.32	6.95	1.10	3.23	0	1.60	0	19.23
33–34	0	0	0	2.73	0	8.69	1.78	5.26	1.38	1.02	1.02	0.81	22.69
34–35	---	---	---	*3.73	8.80	3.14	9.60	2.71	5.19	3.92	0	0	37.09
1935–36	0	0	0	1.70	2.55	3.67	8.88	11.86	1.47	2.02	0.86	2.63	35.64
36–37	0	0	0	0	0.15	3.01	3.70	10.40	6.08	1.54	0	1.73	26.61
37–38	0	0	0	1.90	9.37	8.46	5.11	12.17	9.86	2.32	0	0	49.19
38–39	0	0	0.93	2.99	2.51	2.72	4.72	2.62	2.64	0.23	1.70	0	21.06
39–40	0	0	0	0	0.66	4.77	12.45	14.40	6.49	1.44	1.32	0	41.53
1940–41	0	0	0.58	3.02	2.19	14.93	12.28	11.18	6.23	4.79	1.29	0.15	56.64
41–42	0	0	0	1.76	3.63	12.83	5.96	7.86	2.79	5.33	2.04	---	42.20
42–43	0	0	0	1.56	5.99	8.29	9.91	1.63	2.58	3.24	0	0	33.20
43–44	0	0	0	1.44	0.50	2.65	7.04	4.17	4.00	2.89	0.76	0.42	23.87
44–45	0	0	0	2.20	6.22	3.99	2.98	4.45	5.34	0.62	1.72	0	27.52
1945–46	0	0	0	5.48	5.99	12.55	2.47	3.12	1.63	0.42	0.30	0	31.96
46–47	0	0	0.10	0.73	4.56	3.61	1.19	3.31	6.57	0.38	0.33	1.26	22.04
47–48	0	0	0	5.48	0.65	1.32	3.55	2.40	5.50	8.28	1.50	0.62	29.30
48–49	0	0	0.30	0.96	1.67	5.33	1.56	4.26	9.09	0	0.40	0	23.57
49–50	0	0	0	0	2.54	2.00	10.12	4.20	4.29	1.53	1.40	0	26.08
1950–51	0	0	0	5.86	6.30	9.01	7.68	4.20	1.75	1.27	2.05	0	38.12
51–52	0	0	0	2.36	6.31	10.98	11.22	4.39	4.25	0.48	0.25	1.56	41.80
52–53	0	0	0	0.13	3.10	14.86	9.83	0.23	4.14	2.75	1.37	0.73	37.14
53–54	0	0.50	0	-	----	----	-	----	-	----	----	----	----

* Total to date.

RECORD OF MONTHLY PRECIPITATION AT UPPER SCOTT VALLEY, CALIFORNIA

County: Lake
Date established: 1932
Type of gage: non-recording
Elevation: 1,375 feet, U.S.G.S. datum

Station No. 5-94B on Plate 3
Location: SW¼ S 22, T 14 N, R 10 W, M.D.B.&M.
Record obtained from: Mr. D. E. Riggs

(In inches)

Season	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	Total
1932-33	0	0	0	0	1.46	4.47	7.68	1.35	3.55	0.58	1.97	0	21.06
33-34	0	0	0	3.32	0	9.80	2.11	5.13	1.62	1.06	1.19	0.16	24.39
34-35	0	0	0	2.52	6.03	3.63	9.60	3.01	5.65	4.49	0	0	34.93
1935-36	0	0	0	1.76	3.03	4.34	10.40	13.27	1.68	2.28	0.74	2.88	40.38
36-37	0	0	0	0	0	3.66	4.32	10.86	6.02	1.35	0	1.79	28.00
37-38	0	0	0	1.86	11.36	10.86	5.07	13.63	10.57	2.00	0	0	55.35
38-39	0	0	0.68	3.08	2.14	3.52	4.13	2.97	2.34	0.26	1.81	0	20.93
39-40	0	0	0	0	0.84	5.06	12.24	14.83	6.53	1.23	1.51	0	42.24
1940-41	0	0	0.65	2.60	2.58	14.80	13.03	11.82	5.48	5.23	1.39	0.30	57.88
41-42	0	0	0	1.67	3.54	14.53	7.09	8.40	3.14	5.39	2.62	0	46.38
42-43	---		---	-	--	*16.02	10.96	2.32	4.02	3.80	0.16	0.14	37.42
43-44	0	0	0	1.20	1.24	2.86	8.96	4.90	4.89	2.97	0	0	27.02
44-45	0	0	0	1.52	6.47	5.68	2.46	5.17	5.09	0.38	1.42	0	28.19
1945-46	0	0	0.10	5.77	6.83	13.81	3.25	3.57	2.05	0.29	0.18	0	35.85
46-47	0.46	0	0.14	0.58	4.66	4.14	1.53	3.94	9.37	0.49	0.32	1.55	27.18
47-48	0	0	0	5.74	1.05	1.46	3.72	2.81	5.94	9.92	1.37	0.38	32.39
48-49	0	0	0.34	1.05	1.77	5.44	0.52	4.60	9.93	0.04	0.20	0	23.89
49-50	0.15	0	0.15	0.12	2.70	2.50	10.08	5.30	4.86	9.76	1.42	0	36.89
1950-51	0	0	Tr	6.15	6.70	9.74	10.07	5.53	2.30	1.50	1.80	0	43.79
51-52	0	0	0	2.88	7.32	12.53	12.10	5.56	5.24	0.66	0.64	1.34	48.17
52-53	0	0	0	0.16	3.66	17.17	12.78	0.50	4.78	3.14	1.92	0.90	45.01
53-54	0	0.70	0	1.70	----	----	----	----	-	----	----	--	----

* Total to date.
Tr—Trace

APPENDIX C

RECORDED AND ESTIMATED DAILY RUNOFF IN CLEAR LAKE AREA NOT PREVIOUSLY PUBLISHED

TABLE OF CONTENTS

Abbreviations used:

D.W.R.—Division of Water Resources
U.S.E.D.—Corps of Engineers, U.S. Army

BLE 1

RUNOFF OF ADOBE CREEK AT BELL HILL ROAD, 1948-49

(Daily mean flow, in second-feet)

tation No. L-1 on Plate 3 — Record from D.W.R.

Date	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
			0	60	4	16	7	3				
			0	34	4	178	6	3				
			0	18	5	275	6	3				
			0	9	25	210	6	2				
			0	6	40	158	6	2				
			0	5	125	137	5	2				
			0	5	146	76	5	2				
			0	5	47	48	5	2				
			0	5	32	60	5	2				
			0	3	38	365	5	2				
			0	2	161	445	5	1.5				
			0	2	49	300	4	1.5				
			0	2	29	131	4	1.5				
			5	1	22	78	4	1				
			2	1	18	76	4	1				
	NO FLOW	NO FLOW	1	1	17	147	4	1	NO FLOW	NO FLOW	NO FLOW	NO FLOW
			1	1	16	200	4	1				
			2	1	14	212	4	1				
			1	1	13	316	4	1				
			1	2	18	188	4	1				
			0.5	3	20	96	4	1				
			0.5	8	63	144	4	1				
			0	8	68	72	4	1				
			0	5	50	40	3	1				
			0	4	33	30	8	0.5				
			0	3	27	24	3	0.3				
			3	3	22	20	3	0.1				
			5	3	19	17	3	0.1				
			5	3		11	3	0				
			20	4		9	3	0				
			25	4		8		0				
noff, in acre-feet			144.8	41.8	2,231	8,105	258	78				

sonal runoff, in acre-feet: 11,235

BLE 1—Continued

RUNOFF OF ADOBE CREEK AT BELL HILL ROAD, 1949-50

(Daily mean flow, in second-feet)

ation No. L-1 on Plate 3 — Record from D.W.R.

Date	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
					12	7	9	4				
					10	7	8	3				
					45	6	7	3				
					868	6	6	3				
					535	6	6	3				
					768	6	5	3				
					188	6	55	3				
				100	60	6	120	3				
				14	43	6	52	2				
				160	64	5	32	2				
				62	43	5	19	2				
				18	30	5	15	2				
				100	21	5	12	2				
				175	18	5	10	2				
				75	16	5	9	2				
	NO FLOW	NO FLOW	NO FLOW	210	17	6	9	2	NO FLOW	NO FLOW	NO FLOW	NO FLOW
				250	17	8	8	2				
				150	15	8	7	2				
				50	11	12	7	2				
				20	9	10	6	2				
				100	9	10	6	2				
				77	9	22	6	1.5				
				35	8	88	5	1.5				
				31	8	308	5	1.5				
				17	8	100	5	1				
				13	8	48	5	1				
				20	7	32	4	1				
				76	7	23	4	1				
				36		14	4	1				
				22		11	4	1				
				16		10						
noff, in acre-feet				3,620	5,660	1,578	892	124				

sonal runoff, in acre-feet: 11,874

TABLE 1—Continued

RUNOFF OF ADOBE CREEK AT SODA BAY ROAD, 1948-49

(Daily mean flow, in second-feet)

Station No. L-2 on Plate 3 Record from D.W.R

Date	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1			0	15	0	18	29	2				
2			0	10	0	200	27	1				
3			0	0	0	350	24	1				
4			0	0	10	250	22	1				
5			0	0	25	185	19	1				
6			0	0	100	165	16	1				
7			0	0	125	100	13	1				
8			0	0	47	55	12	0.5				
9			0	0	27	70	11	0.5				
10			0	0	33	485	9	0.5				
11			0	0	125	500	8	0.5				
12			0	0	45	370	6	0.5				
13			0	0	30	160	5	0.5				
14	NO FLOW	NO FLOW	0	0	25	100	5	0.3	NO FLOW	NO FLOW	NO FLOW	NO FLOW
15			0	0	22	270	5	0.3				
16			0	0	22	325	5	0.3				
17			0	0	20	435	5	0.1				
18			0	0	20	460	5	0.1				
19			0	0	20	600	5	0.1				
20			0	0	22	400	5	0				
21			0	0	24	125	4	0				
22			0	0	60	107	4	0				
23			0	0	65	82	4	0				
24			0	0	50	57	3	0				
25			0	0	37	55	3	0				
26			0	0	30	48	3	0				
27			0	0	25	41	2	0				
28			0	0	20	36	2	0				
29			0	0		34	2	0				
30			0	0		32		0				
31			5	0		30		0				
Runoff, in acre-feet			9.9	49.6	2,041	12,186	525	24				

Seasonal runoff, in acre-feet: 14,836

TABLE 1—Continued

RUNOFF OF ADOBE CREEK AT SODA BAY ROAD, 1949-50

(Daily mean flow, in second-feet)

Station No. L-2 on Plate 3 Record from D.W.R

Date	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1					20	5	19	5				
2					15	5	18	5				
3					20	4	18	4				
4					750	4	17	4				
5					500	7	17	4				
6					600	6	15	4				
7					200	5	150	3				
8					75	5	109	3				
9					60	4	60	3				
10				75	84	4	46	3				
11				60	60	4	40	2				
12				30	45	4	35	2				
13				0	37	4	30	2				
14	NO FLOW	NO FLOW	NO FLOW	176	34	3	25	2	NO FLOW	NO FLOW	NO FLOW	NO FLOW
15				100	31	3	20	2				
16				176	29	3	18	1				
17				225	30	3	17	1				
18				100	30	7	15	1				
19				40	25	41	12	1				
20				29	14	30	10	1				
21				190	12	17	9	1				
22				75	10	41	8	1				
23				46	9	33	7	0				
24				38	9	282	6	0				
25				29	9	95	5	0				
26				25	7	60	5	0				
27				30	6	46	5	0				
28				80	5	37	5	0				
29				50		30	5	0				
30				37		20	5	0				
31				29		19		0				
Runoff, in acre-feet				3,074	5,400	1,648	1,489	109				

Seasonal runoff, in acre-feet: 11,726

BLE 1—Continued

RUNOFF OF ADOBE CREEK AT HIGHLAND CUTOFF, 1949-50

(Daily mean flow, in second-feet)

ation No. L-3 on Plate 3 — Record from D.W.R.

Date	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
		0	0.3	1	2	3	4					
		0	0.3	1	1	2	4					
		0	0.3	0.5	15	2	3					
		0	0.3	0.5	250	2	3					
		0.	0.3	0.5	175	2	3					
		0	0.3	0.5	175	1	3					
		0	1	0.5	75	1	30					
		0	1	15	40	1	60					
		2	1	10	30	1	30					
		2	1	100	40	1	15					
		1	1	20	30	1	12					
		0.2	1	10	27	1	10					
		0.2	1	100	24	1	8					
		0.2	1	50	20	1	6					
	NO FLOW	0.2	1	50	17	1	6	NO FLOW	NO FLOW	NO FLOW	NO FLOW	NO FLOW
		0.2	1	50	15	1	6					
		0.2	1	25	12	1	5					
		0.2	1	25	10	2	5					
		0.2	1	25	8	3	5					
		0.2	1	20	7	2	5					
		0.2	1.5	30	7	3	4					
		0.3	1	30	6	10	4					
		0.3	1	20	5	25	4					
		0.3	1	15	5	120	4					
		0.3	1	7	4	75	4					
		0.3	1	2	2	20	3					
		0.3	1	10	3	15	3					
		0.3	1	35	3	10	3					
		0.3	1	12		6	3					
		0.3	1	10		5	3					
		0.3	1	6		4						
noff, in acre-feet		19.8	53.5	1,353	1,999	640	512					

sonal runoff, in acre-feet: 4,577

BLE 1—Continued

RUNOFF OF COLD CREEK AT KONOCTI ROAD, 1948-49

(Daily mean flow, in second-feet)

ation No. L-4 on Plate 3 — Record from D.W.R.

Date	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
				0	1.0	1.5	3	0.5				
				0	1.0	9	3	0.5				
				0	1.0	8	3	0.5				
				0	1.5	7.	3	0.5				
				0	3	6	3	0.5				
				0	1.6	6	3	0.5				
				0	3.5	4	3	0.5				
				0	3	3	3	0.5				
				0	2	3	3	0.3				
1				0	2	30	3	0.3				
1,				0	4	40	3	0.3				
1				0	3	25	3	0.3				
1				0	2	20	3	0.3				
1				0	2	15	3	0.3				
1	NO FLOW	NO FLOW	NO FLOW	0	2	22	3	0.3	NO FLOW	NO FLOW	NO FLOW	NO FLOW
1,				0	2	25	3	0.3				
1				0	1.5	20	2	0.2				
1				0	1.5	15	2	0.2				
1				0	2	25	2	0.2				
2				0	2	15	2	0.2				
2				0	2	10	2	0.2				
2				0	2	8	1	0.2				
2				0	4	7	1	0.2				
2				0.5	4	6	1	0.2				
2				0.5	3	5	1	0.2				
2				0.5	2	4	1	0.1				
2				0.5	2	4	1	0				
2				0.5	1.5	3	1	0				
2				0.5		3	1	0				
3				0.5		3	1	0				
3				0.5		3		0				
noff, in acre-feet				8	123	695	133	18				

sonal runoff, in acre-feet: 977

TABLE 1—Continued

RUNOFF OF COLD CREEK AT KONOCTI ROAD, 1949-50

(Daily mean flow, in second-feet)

Station No. L-4 on Plate 3 | Record from D.W.R

Date	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1				0	2	1	1	0.3				
2				0	2	1	1	.3				
3				0	2	1	1	.3				
4				0	10	1	1	.3				
5				0	15	1	1	.3				
6				0	12	1	1	.3				
7				0	5	1	2	.3				
8				0	5	1	3	.3				
9				0	5	1	2	.2				
10				0	10	1	2	.2				
11				3	5	1	2	.2				
12				1	4	1	2	.2				
13				0.5	3	1	2	.2				
14	NO FLOW	NO FLOW	NO FLOW	15	3	1	2	.2	NO FLOW	NO FLOW	NO FLOW	NO FLOW
15				10	3	1	2	.2				
16				10	3	1	1	.1				
17				15	3	1.5	1	.1				
18				12	3	1.5	1	.1				
19				10	3	1.5	1	.1				
20				2	2	1	0.5	.1				
21				10	2	1	0.5	.1				
22				8	2	1.5	0.5	.1				
23				3	2	2	0.5	.1				
24				3	2	4	0.3	.1				
25				2	2	3	0.3	.1				
26				2	2	2	0.3	.1				
27				2	2	2	0.3	.1				
28				5	1.5	2	0.3	.1				
29				4		1	0.3	.1				
30				3		1	0.3	.1				
31				3		1		.1				
Runoff, in acre-feet				245	229	83	65	12				

Seasonal runoff, in acre-feet: 634

TABLE 1—Continued

RUNOFF OF COLD CREEK AT SODA BAY ROAD, 1949-50

(Daily mean flow, in second-feet)

Station No. L-5 on Plate 3 | Record from D.W.R

Date	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1				0	0	0.5	0.5					
2				0	0	0.5	0.5					
3				0	0	0.5	0.5					
4				0	50	0.5	0.5					
5				0	40	0.5	0.5					
6				0	30	0.5	0.5					
7				0	20	0.5	1					
8				0	5	0.5	3					
9				0	2	0.5	2					
10				0	5	0.5	2					
11				0	3	0.5	2					
12				0	2	0.3	2					
13				0	2	0.3	1					
14	NO FLOW	NO FLOW	NO FLOW	2	2	0.2	1	NO FLOW	NO FLOW	NO FLOW	NO FLOW	NO FLOW
15				3	2	0.2	1					
16				5	2	0	1					
17				5	1	0	1					
18				5	1	1	0.5					
19				2	1	1	0.5					
20				0	1	0.5	0.5					
21				1	1	0.5	0.5					
22				2	1	1	0.3					
23				1	1	1	0.3					
24				0	0.5	3	0.2					
25				0	0.5	2	0.2					
26				0	0.5	2	0					
27				0	0.5	1	0					
28				1	0.5	1	0					
29				1		1	0					
30				1		0.5	0					
31				0		0.5						
Runoff, in acre-feet				58	346	45	45					

Seasonal runoff, in acre-feet: 494

TABLE 1—Continued

RUNOFF OF HIGHLAND CREEK AT BRIDGE ABOVE ADOBE CREEK, 1948-49

(Daily mean flow, in second-feet)

Station No. L-6 on Plate 3 Record from D.W.R.

Date	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1				45	3	10	7	1				
2				25	3	110	7	1				
3				15	4	200	11	1				
4				7	15	140	11	1				
5				5	26	100	11	1				
6				4	100	80	10	1				
7				4	120	56	10	1				
8				4	28	35	9	1				
9				3	20	45	9	1				
10				2	26	150	9	1				
11				1	75	100	9	1				
12				1	30	200	8	1				
13			17	1	25	90	8	0.5				
14			8	1	18	50	8	0.5				
15	NO FLOW	NO FLOW	8	1	10	50	8	0.5	NO FLOW	NO FLOW	NO FLOW	NO FLOW
16			8	1	10	100	7	0.5				
17			7	1	10	140	6	0.5				
18			7	1	9	145	5	0.5				
19			6	1	8	215	4	0.5				
20			5	1	11	185	4	0.5				
21			4	2	13	115	4	0.3				
22			3	6	40	75	3	0.3				
23			1	6	50	60	3	0.2				
24			1	4	35	45	3	0.2				
25			1	3	21	32	2	0.1				
26			1	2.4	17	25	2	0.1				
27			1	2	14	20	2	0.1				
28			1	2	11	15	1	0				
29			1	2		10	1	0				
30			1	3		9	1	0				
31			1	3		8		0				
Runoff, in acre-feet			161	315	1,492	5,186	363	36				

Seasonal runoff, in acre-feet: 7,553

TABLE 1—Continued

RUNOFF OF HIGHLAND CREEK AT BRIDGE ABOVE ADOBE CREEK, 1949-50

(Daily mean flow, in second-feet)

Station No. L-6 on Plate 3 Record from D.W.R.

Date	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1		0	0	0.5	4	3	8					
2		0	0	0.3	2	3	6					
3		0	0	0.2	10	3	5					
4		0	0	0	500	5	4					
5		0	0	0	300	6	3					
6		0	0	0	200	5	3					
7		0	0	0	85	4	140					
8		0	1	0	45	3	105					
9		2	0	10	40	3	75					
10		1	0	75	85	3	50					
11		0	0	31	45	3	40					
12		0	0	10	30	3	30					
13		0	0	10	20	2	20					
14		0	0	10	20	2	12					
15	NO FLOW	0	0	75	20	2	10	NO FLOW	NO FLOW	NO FLOW	NO FLOW	NO FLOW
16		0	0	100	20	1.5	8					
17		0	0	75	17	6	6					
18		0	0	75	13	6	5					
19		0	0	75	10	21	5					
20		0	0	10	6	15	4					
21		0	2	50	6	8	4					
22		0	1	50	6	21	4					
23		0	1	27	6	50	3					
24		0	1	20	6	180	3					
25		0	1	10	5	90	3					
26		0	1	5	5	35	3					
27		0	0.5	15	4	30	3					
28		0	0.5	50	3	20	3					
29		0	0.5	20		14	3					
30		0	0.5	10		12	3					
31			0.5	10		10						
Runoff, in acre-feet		6	21	1,634	3,000	1,130	1,132					

Seasonal runoff, in acre-feet: 6,923

TABLE 1—Continued

RUNOFF OF HILL CREEK AT BELL HILL ROAD, 1949-50

(Daily mean flow, in second-feet)

Station No. L-7 on Plate 3 — Record from D.W.R.

Date	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1				0	0	0	0					
2				0	0	0	0					
3				0	0	0	0					
4				0	10	0	0					
5				0	15	0	0					
6				0	10	0	0					
7				0	5	0	0					
8				0	1	0	1					
9				0	1	0	0					
10				0	3	0	0					
11				0	1	0	0					
12				0	1	0	0					
13				0	0	0	0					
14	NO FLOW	NO FLOW	NO FLOW	0	0	0	0	NO FLOW	NO FLOW	NO FLOW	NO FLOW	NO FLOW
15				0	0	0	0					
16				12	0	0	0					
17				15	0	0	0					
18				5	0	0	0					
19				0	0	0	0					
20				0	0	0	0					
21				0	0	0	0					
22				0	0	0	0					
23				0	0	0	0					
24				0	0	2	0					
25				0	0	1	0					
26				0	0	0	0					
27				0	0	0	0					
28				0	0	0	0					
29				0		0	0					
30				0		0	0					
31				0		0						
Runoff, in acre-feet				63	93	6	2					

Seasonal runoff, in acre-feet: 164

TABLE 1—Continued

RUNOFF OF HIILL CREEK AT SODA BAY ROAD, 1949-50

(Daily mean flow, in second-feet)

Station No. L-8 on Plate 3 — Record from D.W.R.

Date	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1				0	1	1	1					
2				0	0	1	1					
3				0	0	1	1					
4				0	10	1	1					
5				0	15	1	1					
6				0	10	1	1					
7				0	5	0.5	3					
8				0	2	0.5	2					
9				0	1	0.5	2					
10				0	4	0.5	2					
11				0	2	0.5	2					
12				0	2	0.5	2					
13				0	1	0.5	2					
14	NO FLOW	NO FLOW	NO FLOW	0	1	0.5	2	NO FLOW	NO FLOW	NO FLOW	NO FLOW	NO FLOW
15				0	1	0.5	1					
16				0	1	0.5	1					
17				2	1	0.5	1					
18				1	1	1	1					
19				0	1	2	1					
20				0	1	1	1					
21				3	1	1	1					
22				2	1	2	1					
23				0	1	2	1					
24				0	1	10	1					
25				0	1	4	1					
26				0	1	2	1					
27				0	1	2	0.5					
28				0	1	2	0.5					
29				0		1	0.5					
30				2		1	0.5					
31				1		1						
Runoff, in acre-feet				22	135	86	73					

Seasonal runoff, in acre-feet: 316

TABLE 1—Continued

RUNOFF OF HILL CREEK AT STATE HIGHWAY 29, 1949-50

(Daily mean flow, in second-feet)

Station No. L-9 on Plate 3 — Record from D.W.R.

Date	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1				0	0	0.2	0.5					
2				0	0	0.2	0.3					
3				0	0	0.2	0.2					
4				0	10	0.2	0.2					
5				0	15	0.3	0.3					
6				0	5	0.3	0.5					
7				0	2	0.3	1					
8				0	1	0.3	2					
9				0	1	0.3	1					
10				0	4	0.3	1					
11				0	2	0.2	1					
12				0	2	0.2	1					
13				0	2	0.2	1					
14	NO FLOW	NO FLOW	NO FLOW	0	11	0.2	1	NO FLOW	NO FLOW	NO FLOW	NO FLOW	NO FLOW
15				0	1	0.2	0.5					
16				15	1	0.1	0.5					
17				20	1	1	0.5					
18				15	1	1	0.5					
19				5	1	1	0.3					
20				0	0.5	0.5	0.3					
21				2	0.5	0.5	0.3					
22				0	0.5	1	0.2					
23				0	0.3	1	0.2					
24				0	0.3	2	0.2					
25				0	0.3	1	0.2					
26				0	0.2	1	0					
27				0	0.2	1	0					
28				0	0.2	0.5	0					
29				0		0.5	0					
30				0		0.5	0					
31				0		0.5						
Runoff, in acre-feet				113	105	34	30					

Seasonal runoff, in acre-feet: 282

TABLE 1—Continued

RUNOFF OF KELSEY CREEK AT SODA BAY ROAD, 1948-49

(Daily mean flow, in second-feet)

Station No. L-11 on Plate 3 — Record from D.W.R.

Date	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1			0	30	2	15	36	6				
2			0	50	2	200	35	6				
3			0	35	3	220	33	6				
4			0	20	4	200	32	6				
5			0	6	60	180	31	5				
6			0	6	28	145	30	6				
7			0	7	145	120	29	6				
8			0	8	65	100	29	5				
9			0	5	47	80	28	5				
10			0	3	38	400	28	5				
11			0	0	150	480	28	4				
12			0	0	90	275	27	3				
13			0	0	45	200	27	3				
14	NO FLOW	NO FLOW	0	0	35	150	27	3	NO FLOW	NO FLOW	NO FLOW	NO FLOW
15			0	0	28	105	26	2				
16			0	0	25	200	26	2				
17			0	0	20	250	25	2				
18			0	0	20	210	25	2				
19			0	0	28	275	24	1				
20			0	0	30	200	23	1				
21			0	0	35	139	22	1				
22			0	0	80	132	20	0.5				
23			0	0.5	80	110	18	0.5				
24			0	0.5	60	93	10	0.3				
25			0	0	45	80	8	0.2				
26			0	0	35	65	7	0.1				
27			0	0	30	55	6	0				
28			0	0	20	45	6	0				
29			0	0		42	6	0				
30			0	0		40	6	0				
31			25	1		38		0				
Runoff, in acre-feet			50	341	2,479	9,606	1,344	165				

Seasonal runoff, in acre-feet: 13,985

TABLE 1—Continued

RUNOFF OF KELSEY CREEK AT SODA BAY ROAD, 1949-50

(Daily meon flow, in second-feet)

Station No. L-11 on Plate 3 — Record from D.W.R.

Date	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1					20	20	36	20				
2					18	20	33	27				
3					20	20	30	24				
4					400	20	27	20				
5					500	20	25	18				
6					300	18	50	15				
7					200	16	420	15				
8					130	14	320	14				
9					100	14	225	14				
10				250	120	14	155	13				
11				65	95	14	100	13				
12				40	85	14	80	13				
13				14	75	14	75	12				
14				150	68	14	56	11				
15	NO FLOW	NO FLOW	NO FLOW	100	62	14	50	11	NO FLOW	NO FLOW	NO FLOW	NO FLOW
16				175	56	14	44	10				
17				300	48	20	39	9				
18				200	40	50	35	8				
19				100	32	115	32	7				
20				32	27	38	29	6				
21				100	27	38	27	5				
22				80	27	85	25	4				
23				39	27	56	23	3				
24				35	27	512	21	2				
25				30	27	220	20	2				
26				28	25	140	19	2				
27				35	22	100	19	1				
28				50	20	75	19	1				
29				40		55	18	1				
30				29		45	17	1				
31				27		39		1				
Runoff, in acre-feet				3,805	5,152	3,665	4,103	599				

Seasonal runoff, in acre-feet: 17,324

TABLE 1—Continued

RUNOFF OF MANNING CREEK NEAR HOPLAND HIGHWAY, 1949-50

(Daily meon flow, in second-feet)

Station No. L-12 on Plate 3 — Record from D.W.R.

Date	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1				0	5	1	2					
2				0	3	1	2					
3				0	10	1	2					
4				0	30	1	2					
5				0	50	2	1.5					
6				0	30	1	1.5					
7				0	15	1	5					
8				0	10	1	8					
9				0	8	1	6					
10				5	30	0.5	5					
11				3	20	0.5	4					
12				3	15	0.5	3					
13				3	8	0.5	3					
14				3	8	0.5	2					
15	NO FLOW	NO FLOW	NO FLOW	3	8	0.5	2	NO FLOW	NO FLOW	NO FLOW	NO FLOW	NO FLOW
16				15	7	0.2	2					
17				8	7	2	2					
18				5	7	2	1					
19				5	6	8	1					
20				5	5	4	1					
21				5	5	4	1					
22				5	4	4	1					
23				10	3	8	1					
24				5	3	30	1					
25				5	2	20	1					
26				5	2	12	0.5					
27				5	2	8	0.5					
28				15	2	6	0.5					
29				10		4	0.5					
30				8		3	0.5					
31				5		3						
Runoff, in acre-feet				270	605	260	126					

Seasonal runoff, in acre-feet: 1,261

TABLE 1—Continued

RUNOFF OF MANNING CREEK AT STATE HIGHWAY 29, 1948-49

(Daily mean flow, in second-feet)

Station No. L-13 on Plate 3 — Record from D.W.R.

Date	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	NO FLOW	NO FLOW	NO FLOW	5	0.5	2	6	1	NO FLOW	NO FLOW	NO FLOW	NO FLOW
2				4	0.5	30	5	1				
3				2	1	40	4	1				
4				1	6	35	4	1				
5				0.5	8	30	4	1				
6				0.5	3	25	4	1				
7				0	10	20	3	1				
8				0	6	15	3	1				
9				0	4	10	3	1				
10				0	5	70	3	1				
11				0	12	80	3	0.5				
12				0	6	35	3	0.5				
13				0	5	20	2	0.5				
14				0	4	15	2	0.5				
15				0	4	10	2	0.5				
16				0	3	25	2	0.5				
17				0	2	30	2	0.5				
18				0	2	35	2	0.3				
19				0	2	45	2	0.3				
20				0	3	30	2	0.3				
21				0.5	4	20	2	0.3				
22				1	7	20	2	0.2				
23				2	8	18	1.5	0.2				
24				1	6	15	1.5	0.2				
25				0.5	5	12	1.5	0.2				
26				0.5	3	10	1.5	0.1				
27				0.5	3	9	1.5	0.1				
28				1	2	8	1	0.1				
29				0.5		7	1	0				
30				0.5		7	1	0				
31				0.5		6		0				
Runoff, in acre-feet				43	248	1,456	149.7	32				

Seasonal runoff, in acre-feet: 1,929

TABLE 1—Continued

RUNOFF OF MANNING CREEK AT STATE HIGHWAY 29, 1949-50

(Daily mean flow, in second-feet)

Station No. L-13 on Plate 3 — Record from D.W.R.

Date	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	NO FLOW	NO FLOW	NO FLOW	0	10	4	6	2	NO FLOW	NO FLOW	NO FLOW	NO FLOW
2				0	8	4	5	1				
3				0	10	3	5	1				
4				0	75	3	4	1				
5				0	125	4	4	1				
6				0	75	3	4	1.5				
7				0	30	2	12	1.5				
8				0	25	2	30	1.5				
9				0	20	2	25	1.5				
10				0	50	2	20	1.5				
11				10	30	2	15	1.3				
12				5	20	2	13	1.3				
13				1	12	2	10	1.2				
14				50	12	2	8	1.2				
15				40	12	2	8	1.2				
16				40	12	1.5	7	0				
17				20	12	5	7	0				
18				20	11	5	6	0				
19				20	11	8	5	0				
20				12	10	8	5	0				
21				10	9	8	5	0				
22				10	8	8	4	0				
23				15	7	10	4	0				
24				15	7	50	4	0				
25				20	6	25	3	0				
26				15	6	20	3	0				
27				15	5	15	3	0				
28				15	5	10	2	0				
29				15		8	2	0				
30				15		6	2	0				
31				15		6		0				
Runoff, in acre-feet				750	1,235	462	458	24				

Seasonal runoff, in acre-feet: 2,929

TABLE 2 RUNOFF OF HENDRICKS CREEK NEAR JUNCTION WITH SCOTT VALLEY ROAD, 1949-50

(Daily mean flow, in second-feet)

Station No. L-14 on Plate 3 — Record from D.W.R.

Date	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1				0	5	2	3					
2				0	5	2	3					
3				0	20	2	3					
4				0	125	2	2					
5				0	100	2	2					
6				0	75	2	2					
7				0	15	2	2					
8				0	12	2	4					
9				0	10	2	3					
10				0	50	2	3					
11				0	15	2	3					
12				0	10	2	3					
13				0	8	2	3					
14				10	7	2	3					
15	NO FLOW	NO FLOW	NO FLOW	15	7	2	3	NO FLOW	NO FLOW	NO FLOW	NO FLOW	NO FLOW
16				20	6	4	2					
17				30	6	6	2					
18				20	5	8	2					
19				15	5	10	2					
20				6	4	6	2					
21				8	4	4	2					
22				8	4	6	2					
23				8	3	12	2					
24				8	3	40	1					
25				6	3	20	1					
26				5	3	10	1					
27				8	2	8	1					
28				15	2	6	1					
29				10		4	1					
30				10		4	1					
31				8		4						
Runoff, in acre-feet				416	1,019	361	129					

Seasonal runoff, in acre-feet: 1 925

TABLE 2—Continued RUNOFF OF SCOTT CREEK AT BRIDGE SOUTH OF BACHELOR VALLEY, 1949-50

(Daily mean flow, in second-feet)

Station No. L-15 on Plate 3 — Record from D.W.R.

Date	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1					85	47	150					
2					80	45	120					
3					75	42	95					
4					1,500	42	85					
5					1,500	47	80					
6					1,000	66	85					
7					700	60	90					
8					500	55	365					
9					400	47	300					
10				90	550	45	250					
11				100	450	43	175					
12				50	400	41	150					
13				32	350	40	130					
14				400	275	39	115					
15	NO FLOW	NO FLOW	NO FLOW	75	213	38	100	NO FLOW	NO FLOW	NO FLOW	NO FLOW	NO FLOW
16				125	194	50	85					
17				600	160	60	70					
18				300	140	66	65					
19				200	120	400	60					
20				150	100	310	55					
21				300	90	212	50					
22				250	80	400	48					
23				400	70	290	46					
24				250	66	1,060	44					
25				150	62	925	42					
26				100	58	700	40					
27				150	54	570	36					
28				300	50	450	32					
29				250		350	30					
30				150		275	28					
31				100		200						
Runoff, in acre-feet				8,969	18,489	13,914	5,992					

Seasonal runoff, in acre-feet: 47,364

TABLE 2—Continued

RUNOFF OF SCOTT CREEK NEAR LAKEPORT, 1948-49

(Daily mean flow, in second-feet)

Station No. L-16 on Plate 3 Record from U.S.E.D.

Date	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1		0	0.5	264	18	25	34	5.1	1.0	0.1	0	
2		0	0.5	156	17	386	30	5.1	0.8	0.1	0	
3		0	0.5	64	18	701	26	5.1	0.6	0.1	0	
4		0	0.5	32	59	658	23	4.2	0.5	0.1	0	
5		0	0.5	3.1	132	503	21	3.8	0.4	0.2	0	
6		0	0.5	2.4	197	409	20	3.6	0.5	0.2	0.1	
7		0	0.5	4.0	332	267	17	3.5	0.4	0.1	0.1	
8		0	0.5	5.9	124	164	15	3.5	0.4			
9		0	0.5	2.7	84	202	14	3.5	0.3	0.1	0.1	
10		0.4	0.4	1.1	160	1,220	13	3.5	0.4	0.1	0.1	
										0.1	0.1	
11		0.4	0.4	1.0	542	1,260	12	3.3	0.4	0.1	0.1	
12		0.4	0.4	13	186	834	11	3.3	0.4	0	0.1	
13		0.4	0.4	13	90	510	9.8	3.1	0.4	0	0.1	
14		0.4	14	11	56	318	9.5	3.1	0.4	0	0.1	
15	NO FLOW	0.5	10	10	40	288	9.2	3.1	0.4	0	0.1	NO FLOW
16		0.6	5.4	8.2	48	398	8.8	2.9	0.4	0	0.1	
17		0.5	3.8	8.2	53	510	8.8	2.9	0.3	0	0.1	
18		0.5	3.3	8.2	52	588	8.2	2.7	0.3	0	0.1	
19		0.5	2.4	10	51	739	7.9	2.7	0.3	0	0.1	
20		0.5	2.4	11	85	542	7.2	2.7	0.3	0	0.1	
21		0.5	2.4	15	101	362	6.9	2.7	0.3	0	0.1	
22		0.5	2.3	19	264	285	6.7	2.6	0.2	0	0.1	
23		0.5	1.8	17	231	204	6.4	2.4	0.2	0	0.1	
24		0.5	1.2	14	147	149	6.2	2.3	0.2	0	0.1	
25		0.5	1.7	14	89	117	5.9	2.0	0.2	0	0.1	
26		0.5	1.5	15	63	90	5.9	1.7	0.2	0	0.1	
27		0.5	4.0	15	45	74	5.6	1.2	0.2	0	0.1	
28		0.5	9.5	17	32	62	5.6	1.2	0.2	0	0.1	
29		0.5	18	18		53	5.6	0.9	0.1	0	0	
30		0.5	36	18		45	5.4	0.9	0.1	0	0.1	
31			56	18		40		1.0		0	0.1	
Runoff, in acre-feet		20	360	1,605	6,577	23,810	726	178	21	3	5	

Seasonal runoff, in acre-feet: 33,305

Flows above approximately 900 second-feet were estimated from extension of log log rating curve.

TABLE 2—Continued

RUNOFF OF SCOTT CREEK NEAR LAKEPORT, 1949-50

(Daily mean flow, in second-feet)

Station No. L-16 on Plate 3 Record from U.S.E.D.

Date	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1			0.0	0.1	51	11	36	15	2.4	1.2		
2			0.0	0.1	36	10	31	26	2.4	1.2		
3			0.1	0.1	96	9.8	26	24	2.3	1.2		
4			0.1	0.1	1,170	9.5	23	17	2.0	0.9		
5			0.1	0.1	769	17	23	12	2.0	0.9		
6			0.1	0.1	906	22	23	11	1.9	0.6		
7			0.1	0.1	394	15	73	10	1.9	0.4		
8			0.1	0.1	90	13	182	9.8	1.9	0.1		
9			0.1	0.1	51	13	117	9.5	2.7	0.1		
10			0.1	68	218	12	77	8.8	2.3	0.8		
11			0.1	77	160	14	57	8.2	1.9	0.6		
12			0.1	35	114	12	55	7.9	1.8	0.4		
13			0.1	60	95	11	44	7.2	1.8			
14			0.1	471	63	10	36	6.9	1.5			
15	NO FLOW	NO FLOW	0.1	64	51	9.5	27	6.7	1.4		NO RECORD	NO RECORD
16			0.1	139	54	9.2	26	6.2	1.5			
17			0.1	674	42	29	22	5.6	1.7			
18			0.1	369	34	28	21	5.4	1.7			
19			0.1	137	29	19	19	4.6	1.8			
20			0.1	71	25	7.5	17	4.6	1.4			
21			0.1	236	22	73	16	4.2	1.3			
22			0.1	215	20	156	14	4.0	1.4			
23			0.1	167	18	270	14	3.8	1.3	NO RECORD		
24			0.1	137	17	747	13	3.6	1.2			
25			0.1	84	16	444	12	3.6	1.4			
26			0.1	56	15	231	11	3.6	1.7			
27			0.1	80	14	145	11	3.3	1.5			
28			0.1	178	13	93	10	3.3	1.5			
29			0.1	114		72	9.5	3.1	1.4			
30			0.1	84		56	9.2	2.6	1.2			
31			0.1	61		43		2.6				
Runoff, in acre-feet	0	0	6	7,090	9,090	5,180	2,090	484	104	17		

Seasonal runoff, in acre-feet: 24,061

Flows above approximately 900 second-feet were estimated from extension of log log rating curve.

TABLE 2—Continued

RUNOFF OF SCOTT CREEK NEAR LAKEPORT, 1950-51

(Daily mean flow, in second-feet)

Station No. L-16 on Plate 3 — Record from U.S.E.D.

Date	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1		12	17	14	36	36	11	4.6	4.2	0.7	0.1	1.3
2		9.8	108	13	32	35	10	4.6	4.2	0.8	0.0	1.2
3			2,110	33	40	32	9.5	69	4.2	0.8	0.1	1.2
4			2,900	24	332	152	9.2	282	4.0	0.8	0.1	1.3
5			204	19	650	209	8.5	95	3.8	0.8	0.1	1.3
6			366	17	362	255	7.9	50	3.6	0.7	0.1	1.3
7			452	18	215	258	7.5	34	3.5	0.8	0.0	1.4
8			386	17	145	207	7.2	25	3.1	0.8	0.1	1.3
9		NO RECORD	288	18	106	282	6.9	21	3.1	1.0	0.1	1.2
10			167	132	93	187	6.7	18	2.7	0.8	0.2	1.2
11			218	276	730	139	6.2	18	2.3	0.6	0.7	1.1
12			137	231	593	204	5.1	17	2.3	0.6	1.2	0.9
13			122	132	352	86	4.6	16	1.9	0.6	1.2	0.7
14	NO RECORD		621	100	218	71	4.4	15	1.8	0.7	1.1	0.5
15			335	186	160	59	4.2	13	1.7	0.8	1.2	0.8
16			193	186	109	50	4.0	12	1.5	0.7	1.0	0.8
17			126	466	92	42	4.2	11	1.5	0.4	0.8	0.8
18		515	90	950	82	32	4.4	11	1.5	0.4	0.6	0.6
19		223	71	590	62	33	4.0	10	1.2	0.5	1.1	0.4
20		294	53	433	65	30	3.8	9.5	1.2	0.8	1.2	0.3
21		276	42	1,140	61	28	3.6	8.8	1.2	0.8	1.2	0.1
22		116	34	1,003	53	23	3.6	7.9	1.2	0.8	1.2	0.1
23		64	28	582	48	20	3.5	7.5	1.1	0.8	1.2	0.5
24		40	24	352	39	18	3.5	7.2	1.2	0.6	1.2	0.3
25		28	22	218	36	17	3.8	6.4	0.9	0.4	1.2	0.2
26		21	19	149	34	16	3.6	6.2	1.1	0.4	1.2	0.2
27		20	17	106	32	15	3.6	5.9	1.0	0.2	1.2	0.1
28		16	16	80	32	14	16.0	5.6	1.0	0.5	1.2	0.2
29		14	16	64		14	8.2	5.4	0.7	0.5	1.2	0.3
30		18	16	52		12	6.4	5.1	0.6	0.4	1.2	0.3
31			16	42		11		4.4		0.2	1.3	
Runoff, in acre-feet	0	3,299	18,280	15 160	9,536	5,131	367	1,599	126	39	53	43

Seasonal runoff, in acre-feet: 53,633

Flows above approximately 900 second-feet were estimated from extension of log log rating curve.

TABLE 2—Continued

RUNOFF OF SCOTT CREEK NEAR LAKEPORT, 1951-52

(Daily mean flow, in second-feet)

Station No. L-16 on Plate 3 — Record from U.S.E.D.

Date	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	0.5	1.2	1,110	242	1,070	86		13	1.8	1.9	0	0.4
2	0.6	1.1	452	152	953	72		11	1.7	1.7	0.1	.6
3	0.5	1.1	758	111	614	84		11	1.5	1.4	0.1	.7
4	0.7	1.0	674	86	433	71		9.5	1.2	1.3	0.2	.8
5	0.7	1	568	73	300	62		9.8	1.2	1.3	0.1	.8
6	0.8	1	234	160	218	117		14	1.2	1.3	0.1	.8
7	0.8	1	109	128	167	164		14	1.5	1.2	0.2	.8
8	0.8	1	63	114	132	175	NO RECORD	11	1.4	1.1	0.2	.8
9	0.8	1.1	42	101	109	156		9.5	1.7	0.9	0.3	.8
10	0.8	1.2	34	372	92	150		8.5	2.0	0.9	0.4	.8
11	0.8	1.2	26	722	294	124		7.9	1.7	0.9	0.4	.9
12	1.0	1.2	22	915	250	139		7.5	1.3	0.9	0.4	.9
13	0.9	1.2	17	1,040	171	128		7.2	1.2	0.8	0.4	.9
14	0.9	1.4	13	1,800	141	145		6.7	1.2	0.9	0.4	.9
15	0.9	1.3	11	1,070	132	200		6.2	1.2	0.9	0.5	.8
16	0.9	1.3	9.8	663	244	318	20	5.6	1.2	0.6	0.4	.8
17	1.0	1.3	16	441	173	522	19	5.1	0.8	0.5	0.5	.8
18	1.0	1.3	28	338	178	1,030	18	4.4	0.8	0.5	0.4	.8
19	1.1	1.8	28	318	184	772	17	4.6	0.8	0.5	0.4	.8
20	1.0	1.8	3.1	783	236	552	16	4.6	0.6	0.5	0.4	.8
21	1.2	1.7	2.3	603	187	429	15	4.2	0.6	0.5	0.2	.8
22	1.2	1.7	2.0	503	218	309	15	3.8	0.7	0.3	0	.8
23	1.2	1.7	2.2	386	318	258	14	3.6	0.8	0.2	0	.7
24	1.3	1.9	2.7	938	258	234	14	3.3	0.8	0.2	0.1	.7
25	1.2	2.0	2.7	869	209	193	15	3.1	0.8	0.1	0.3	.6
26	1.2	51	872	755	171	154	14	2.4	0.8	0.1	0.3	.6
27	1.2	5.4	1,360	535	126	126	12	2.3	0.8	0.1	0.2	.6
28	1.2	111	1,050	383	114		11	2.3	0.9	0.2	0.4	.6
29	1.2	59	892	276	98		17	2.0	1.7	0.2	0.4	.5
30	1.2	87	550	234			19	1.9	2.4	0.1	0.3	.5
31	1.2		433	279				1.8		0.1	0.5	
Runoff, in acre-feet	59	688	18,620	30,520	15,450	13,430	468	400	72	44	17	44

Seasonal runoff, in acre-feet: 79,812

Flows above approximately 900 second-feet were estimated from extension of log log rating curve.

TABLE 2—Continued

RUNOFF OF SCOTT CREEK NEAR LAKEPORT, 1952-53

(Daily mean flow, in second-feet)

Station No. L-16 on Plate 3 — Record from U.S.E.D.

Date	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	0.3	0.4	----------	459	62	15	49	53	12	0	0	0
2	.1	.5	----------	374	56	15	46	46	12	0	0	0
3	.1	.5	----------	230	52	13	42	40	11	0	0	0
4	.1	.5	----------	158	49	12	38	35	9.6	0	0	0
5	.1	.5	249	117	52	15	35	33	8.8	0	0	0
6	.1	.5	986	512	49	20	33	33	30	0	0	0
7	.4	.5	1,090	973	45	18	34	34	18	0	0	0
8	.3	.5	249	521	41	18	34	31	12	0	0	*0.1
9	.3	.5	306	49	38	19	34	29	11	0	0	*0.1
10	.3	.6	439	641	34	36	39	25	12	0	0	0
11	.2	.5	260	382	33	34	30	22	10	0	0	0
12	.2	.6	131	387	31	69	27	20	10	0	0	0
13	.4	.8	85	503	29	44	25	18	12	0	0	0
14	.4	.8	61	805	27	32	24	17	9.6	0	0	0
15	.4	.9	45	476	26	26	23	17	8.8	0	0	0
16	.2		36	283	26	26	26	16	7.4	0	0	0
17	0		30	568	24	29	31	15	6.2	0	0	0
18	.1		26	909	24	43	24	13	5.5	0	0	0
19	.3		129	721	23	682	23	18	4.5	0	0	0
20	.4		213	824	*22	543	25	17	3.4	0	0	0
21	.4		117	597	21	473	23	44	2.9	0	0	----------
22	.2		86	126	21	290	20	18	2.2	0	0	----------
23	.2		67	272	20	199	18	16	1.7	0	0	----------
24	.2	NO RECORD	56	209	19	156	18	17	0.7	0	0	----------
25	.2		56	161	17	123	17	31	0.8	0	0	----------
26	.4		167	129	16	102	22	34	0.5	0	0	----------
27	.4		783	108	16	84	217	30	0.4	0	0	----------
28	.4		267	94	16	77	109	20	0.4	0	0	----------
29	.4		179	84	----------	67	81	17	0.1	0	0	----------
30	.4		587	75	----------	59	65	16	0.0	0	0	----------
31	.4		292	68	----------	53	----------	13	0	0	0	----------
Runoff, in acre-feet	17	----------	13,844	23,430	1,763	6,728	2,444	1,563	443	0	0	----------

Seasonal runoff, in acre-feet: 49,658

* Estimated
Flows above approximately 900 second-feet were estimated from extension of log log rating curve.

TABLE 2—Continued

RUNOFF OF SCOTT CREEK AT BRIDGE TO HIDDEN LAKES, 1948-49

(Daily mean flow, in second-feet)

Station No. L-17 on Plate 3 — Record from D.W.R.

Date	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	----------	----------	----------	200	17	45	60	8	0.5	----------	----------	----------
2	----------	----------	----------	150	17	350	50	7	0.3	----------	----------	----------
3	----------	----------	----------	65	17	770	45	6	0.3	----------	----------	----------
4	----------	----------	----------	35	32	600	40	5	0.2	----------	----------	----------
5	----------	----------	----------	23	48	490	36	4	0.2	----------	----------	----------
6	----------	----------	----------	21	62	350	32	3.5	0.1	----------	----------	----------
7	----------	----------	----------	28	200	205	30	3.5	0.1	----------	----------	----------
8	----------	----------	----------	30	119	150	28	3.5	0	----------	----------	----------
9	----------	----------	----------	20	98	100	26	3.5	0	----------	----------	----------
10	----------	----------	----------	17	90	1,700	24	3.5	0			
11			----------	17	700	2,000	22	3.5	0			
12			----------	17	250	800	20	3	0			
13			----------	17	100	500	19	3	0			
14			35	14	55	360	18	3	0			
15			20	12	46	300	18	3	0	NO FLOW	NO FLOW	NO FLOW
16	NO FLOW	NO FLOW	10	10	55	375	17	3	0			
17			0	10	62	400	17	2	0			
18			0	11	60	550	16	2	0			
19			0	11	55	650	16	2	0			
20			0	11	100	600	15	2	0			
21			0	12	110	500	15	2	0			
22			0	12	195	360	14	1	0			
23			0	12	265	300	14	1	0			
24			0	11	150	250	13	1	0			
25			0	11	100	200	12	1	0			
26			0	12	90	140	11	1	0			
27			0	15	70	125	10	1	0			
28			20	15	51	110	10	0.5	0			
29			25	15	----------	90	9	0.5	0			
30			45	16	----------	70	9	0.5				
31			50	17	----------	50	----------	0.5	----------			
Runoff, in acre-feet	----------	----------	407	1,720	6,373	26,750	1,341	167	4	----------	----------	----------

Seasonal runoff, in acre-feet: 36,762

TABLE 2—Continued

RUNOFF OF SCOTT CREEK AT BRIDGE TO HIDDEN LAKES, 1949-50

(Daily mean flow, in second-feet)

Station No. L-17 on Plate 3 — Record from D.W.R.

Date	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1					60	25	75					
2					36	25	60					
3					53	25	50					
4					900	25	45					
5					650	27	42					
6					600	26	60					
7					300	25	100					
8					200	24	320					
9					150	23	250					
10				80	325	22	155					
11				35	275	21	120					
12				15	200	20	100					
13				10	125	19	75					
14				300	80	18	57					
15	NO FLOW	NO FLOW	NO FLOW	75	70	17	54	NO FLOW	NO FLOW	NO FLOW	NO FLOW	NO FLOW
16				120	60	17	50					
17				300	50	34	46					
18				300	42	100	42					
19				150	40	300	40					
20				90	34	174	38					
21				250	29	97	36					
22				200	29	260	34					
23				150	29	300	32					
24				125	28	1,038	30					
25				90	28	580	29					
26				50	27	300	28					
27				75	27	225	26					
28				175	26	175	24					
29				115		140	22					
30				80		110	20					
31				60		90						
Runoff, in acre-feet				5,643	8,872	8,493	4,086					

Seasonal runoff, in acre-feet: 27,094

TABLE 3

RUNOFF OF ALLEY CREEK ABOVE JUNCTION WITH CLOVER CREEK, 1948-49

(Daily mean flow, in second-feet)

Station No. L-18 on Plate 3 — Record from D.W.R.

Date	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1				8	0.5	20	20	3	0.1			
2				12	0.5	100	18	3	0.1			
3				9	0.5	80	15	2	0.1			
4				7	1	62	13	2	0.1			
5				5	2	60	13	1.5	0.1			
6				33	7	50	14	1.5	0			
7			4	2	11	40	14	1.5	0			
8			6	1	7	30	14	1.5	0			
9			6	0.5	15	27	13	1	0			
10			4	0.5	40	125	12	1	0			
11			2	0.5	62	150	11	1	0			
12			2	1	30	130	10	1	0			
13			4	2	20	100	10	1	0			
14			10	2	20	45	9	1	0			
15	NO FLOW	NO FLOW	8	1	21	40	9	0.5	0	NO FLOW	NO FLOW	NO FLOW
16			8	0.5	24	100	8	0.5	0			
17			6	0.5	25	130	8	0.5	0			
18			4	0.5	30	140	7	0.5	0			
19			3	0.5	35	150	7	0.5	0			
20			2	0.5	35	75	6	0.5	0			
21			1	0.5	35	50	6	0.3	0			
22			1	0.5	75	75	5	0.3	0			
23			0.5	0.5	65	63	5	0.2	0			
24			0.5	0.5	45	51	5	0.2	0			
25			2	0.5	35	40	5	0.2	0			
26			1	0.5	30	30	5	0.2	0			
27			0.5	0.5	25	28	4.5	0.1	0			
28			0.5	0.5	20	26	4	0.1	0			
29			1	0.5		24	4	0.1	0			
30			5	0.5		22	3	0.1				
31			5	0.5		21		0.1				
Runoff, in acre-feet			172	124	1,421	4,133	550	54	2			

Seasonal runoff, in acre-feet: 6,456

TABLE 3—Continued

RUNOFF OF ALLEY CREEK ABOVE JUNCTION WITH CLOVER CREEK, 1949-50

(Daily mean flow, in second-feet)

Station No. L-18 on Plate 3 — Record from D.W.R.

Date	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1					18	8	13					
2					17	7	13					
3					19	6	12					
4					200	6	12					
5					175	11	11					
6					225	8	12					
7					97	7	14					
8					75	7	20					
9		12			65	6	17					
10		3			82	6	16					
11		3			75	5	16					
12		2			50	5	15					
13					16	4	15					
14	NO FLOW		NO FLOW	40	16	4	14	NO FLOW	NO FLOW	NO FLOW	NO FLOW	NO FLOW
15				10	15	4	14					
16				36	15	4	13					
17				180	14	16	13					
18				97	14	11	12					
19				45	13	36	12					
20				29	13	16	11					
21				140	12	14	11					
22				110	12	18	10					
23				97	11	16	9					
24				45	11	181	8					
25				36	10	52	7					
26				20	10	25	6					
27				25	10	19	6					
28				35	9	17	6					
29				30		16	5					
30				18		15	5					
31				18		14						
Runoff, in acre-feet		40		2,005	2,576	1,119	690					

Seasonal runoff, in acre-feet: 6,430

TABLE 3—Continued

RUNOFF OF CLOVER CREEK NEAR UPPER LAKE, 1948-49

(Daily mean flow, in second-feet)

Station No. L-19 on Plate 3 — Record from U.S.E.D.

Date	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1			0	31	3	18	6	2	0.5	0.3		
2			0	25	4	63	5	2	.5	.3		
3			0	15	5	62	9	2	.5	.3		
4			0	9	7	49	8	2	.5	.3		
5			6	7	12	48	8	2	.5	.3		
6			5	10	17	43	8	2	.5	.3		
7			4	14	22	34	7	2	.5	.3		
8			3	14	17	25	7	1.5	.5	.3		
9			3	10	25	36	7	1.5	.5	.3		
10			3	9	43	95	7	1	.5	.3		
11			3	8	61	97	7	1	.5	.3		
12			3	7	27	69	7	1	.5	.2		
13			10	7	16	88	6	0.5	.5	.2		
14	NO FLOW	NO FLOW	5	6	14	80	6	1	.5	.2	NO FLOW	NO FLOW
15			5	6	12	75	6	1	.5	.2		
16			4	15	15	120	6	0.5	.5	.2		
17			4	5	17	124	6	0.5	.5	.2		
18			4	5	20	114	6	1	.5	.2		
19			4	6	24	182	6	1	.5	.2		
20			4	6	28	104	6	0.5	.5	.2		
21			4	6	31	62	4	0.5	.5	.2		
22			4	5	64	44	3	0.5	.5	.2		
23			3	5	51	31	3	0.5	.5	.1		
24			3	5	40	28	3	0.5	.5	.1		
25			3	5	31	23	3	0.5	.5	.1		
26			3	5	27	17	3	0.5	.3	.1		
27			3	4	24	15	2	0.5	.3	.1		
28			4	4	20	13	2	0.5	.3	.1		
29			5	*4		9	2	0.5	.3	.1		
30			11	4		8	2	0.5	.3	.1		
31			15	4		7		0.5		0		
Runoff, in acre-feet			254	508	1,343	3,575	319	63	28	16		

Seasonal runoff, in acre-feet: 6,106

* Estimated

TABLE 3—Continued

RUNOFF OF CLOVER CREEK NEAR UPPER LAKE, 1949-50

(Daily mean flow, in second-feet)

Station No. L-19 on Plate 3 — Record from U.S.E.D.

Date	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1					22	4	27	5	4	1.5	0.1	
2					19	4	21	8	3	1.5	0.1	
3					27	4	18	7	3	1.5	0	
4					280	4	16	6	3	1.5	0	
5					187	4	15	5	3	1.5	0	
6					250	4	16	5	3	1.5	0	
7					76	4	25	5	3	1.5	0	
8					50	4	40	5	3	1	0	
9					46	4	34	5	3	1	0	
10					62	4	31	5	3	1	0	
11					50	4	29	5	3	1	0	
12					47	4	25	5	3	1	0	
13					43	4	23	4	3	1	0	
14	NO FLOW	NO FLOW	NO FLOW	31	24	4	20	4	3	1	0	NO FLOW
15				3	20	4	18	4	3	1	0	
16				18	20	4	16	4	3	0.5	0	
17				217	18	7	14	4	3	0.5	0	
18				139	16	10	13	4	3	0.5	0	
19				57	14	29	12	4	3	0.5	0	
20				45	11	25	12	4	2	0.5	0	
21				144	10	18	11	4	2	0.2	0	
22				100	9	32	10	4	2	0.2	0	
23				86	8	57	9	4	2	0.2	0	
24				40	6	220	8	4	2	0.2	0	
25				32	5	87	7	4	1.5	0.2	0	
26				25	5	57	6	4	1.5	0.2	0	
27				30	4	50	6	4	1.5	0.2	0	
28				46	4	40	6	4	1.5	0.2	0	
29				36		38	5	4	1.5	0.2	0	
30				30		35	5	4	1.5	0.1	0	
31				25		31		4		0.1		
Runoff, in acre-feet				2,192	2,645	1,604	988	274	150	44		

Seasonal runoff, in acre-feet: 7,897

TABLE 3—Continued

RUNOFF OF CLOVER CREEK NEAR UPPER LAKE, 1950-51

(Daily mean flow, in second-feet)

Station No. L-19 on Plate 3 — Record from U.S.E.D.

Date	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1			2	8	11	19	8	5	3			
2			10	7	10	18	7	5	3			
3			650	10	20	17	7	10	3			
4			105	11	310	41	7	65	3			
5			43	9	185	56	7	37	3			
6			66	7	81	63	6	18	3			
7			74	7	51	64	6	13	3			
8			63	7	41	56	5	11	3			
9			45	9	38	73	5	9	2			
10			41	31	37	48	5	7	2			
11			45	46	207	38	5	7	2			
12			40	38	102	36	5	7	2			
13			43	32	66	32	5	7	2			
14	NO FLOW		104	28	45	30	5	6	2	NO FLOW	NO FLOW	NO FLOW
15			48	33	38	28	4	5	2			
16			41	42	27	27	5	5	2			
17		27	40	184	20	25	5	4	1			
18		66	37	296	16	22	5	4	1			
19		37	31	90	13	19	5	4	1			
20		49	25	47	11	18	4	3	1			
21		40	22	560	26	17	5	3	1			
22		25	19	396	26	15	5	3	0			
23		15	17	135	24	13	5	3	0			
24		9	15	80	23	12	5	3	0			
25		6	14	55	22	12	5	3	0			
26		4	12	42	21	11	4	3	0			
27		4	11	39	18	10	4	3	0			
28		3	10	28	19	10	8	3	0			
29		2	9	16		9	5	3	0			
30		2	9	14		9	5	3	0			
31			9	12		8		3				
Runoff, in acre-feet		573	3,370	4,600	3,000	1,700	320	520	90			

Seasonal runoff, in acre-feet: 14,173

Flows above approximately 350 second-feet were estimated from extension of log log rating curve.

TABLE 3—Continued

RUNOFF OF CLOVER CREEK NEAR UPPER LAKE, 1951-52

(Doily mean flow, in second-feet)

Station No. L-19 on Plate 3 — Record from U.S.E.D.

Date	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	NO FLOW		2,600	113	951	54	*53	*23	NO FLOW	NO FLOW	NO FLOW	NO FLOW
2			1,440	85	546	52	*52	*22				
3			1,890	70	221	53	*51	*21				
4			1,990	64	155	52	*50	*20				
5			399	58	121	51	*49	*19				
6			90	68	103	52	*18	*18				
7			64	61	87	52	*47	*17				
8			46	58	72	55	*46	*16				
9			38	55	66	55	*45	*15				
10			35	111	61	56	*44	*14				
11			32	196	110	51	*43	*13				
12			32	159	82	51	*42	*12				
13			28	132	69	51	*41	*11				
14			27	322	64	52	*40	*10				
15			27	203	64	59	*39	*9				
16			27	145	118	60	*38	*8				
17			27	121	100	58	*37	*7				
18			27	106	80	106	*36	*6				
19			26	97	69	103	*35	*5				
20		1,000	26	162	68	83	*34	*4				
21		811	26	121	62	73	*33	*3				
22		788	26	116	67	68	*32	*2				
23		788	26	105	94	66	*31	*1				
24		788	26	337	83	79	*30	*0				
25		788	26	289	72	89	*29	0				
26		935	155	262	67	78	*28	0				
27		806	399	174	58	67	*27	0				
28		1,090	478	138	56	58	*26	0				
29		920	453	116	55	54	*25	0				
30		1,180	284	129		54	*24	0				
31			166	188		54		0				
Runoff, in acre-feet		19,620	21,690	8,650	7,579	3,860	2,291	547				

Seasonal runoff, in acre-feet: 64,237

* Estimated

Flows above approximately 350 second-feet were estimated from extension of log log rating curve.

TABLE 3—Continued

RUNOFF OF CLOVER CREEK NEAR UPPER LAKE, 1952-53

(Doily mean flow, in second-feet)

Station No. L-19 on Plate 3 — Record from U.S.E.D.

Date	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	NO FLOW	NO FLOW	0	103	*18	5.4	12	20	4.3	2.5	*0.8	*0
2			0	85	*18	5.1	12	18	4.1	2.1	*0.8	*0
3			0	65	*16	4.8	10	15	4.1	2.1	*0.7	*0
4			0	51	*15	4.8	9.6	14	4.1	1.9	*0.7	*0
5			49	43	*14	4.8	8.8	12	4.1	1.8	*0.6	*0
6			337	136	*13	4.8	8.2	12	7.8	1.8	*0.6	*0
7			276	210	*12	4.8	8.5	11	5.4	1.8	*0.6	*0
8			42	207	*11	4.8	7.8	9.9	4.8	1.8	*0.6	*0
9			51	821	*9.9	4.6	8.5	8.8	4.3	1.7	*0.5	*0
10			82	548	*9.2	4.8	9.6	8.5	4.1	1.6	*0.5	*0
11			80	122	*8.2	5.1	8.8	8.2	3.8	1.4	*0.5	*0
12			40	134	*7.4	13	7.4	6.8	4.1	1.4	*0.4	*0
13			20	181	*6.4	9.6	6.8	6.4	4.1	*1.4	*0.4	*0
14			16	196	*6.4	7.8	6.1	6.4	4.1	*1.4	*0.4	*0
15			22	118	*6.4	6.8	5.9	6.1	4.1	*1.3	*0.3	*0
16			21	82	*6.8	7.1	7.1	5.6	3.8	*1.3	*0.3	*0
17			21	170	*6.8	7.4	8.2	5.1	3.6	*1.3	*0.3	*0
18			21	284	*6.4	13	6.4	5.1	3.6	*1.2	*0.2	*0
19			60	231	*6.4	170	6.1	6.8	3.6	*1.2	*0.2	
20			56	224	6.4	105	6.4	5.4	3.4	*1.2	*0.2	
21			30	142	6.1	92	5.9	9.9	3.2	*1.1	*0.2	
22			29	33	6.1	69	5.4	6.1	3.2	*1.1	*0.1	
23			25	58	6.1	55	5.1	5.9	3.0	*1.1	*0.1	
24			22	44	5.9	43	5.4	6.1	2.8	*1.0	*0.1	
25			27	*33	5.6	34	5.4	7.8	2.8	*1.0	*0.1	
26			103	*30	5.6	27	5.9	5.9	2.8	*1.0	*0.1	
27			134	*28	5.9	23	97	5.6	2.8	*0.9	*0	
28			75	*25	5.9	20	41	5.4	2.7	*0.9	*0	
29			73	*23		18	36	4.8	2.5	*0.9	*0	
30			181	*22		15	26	5.1	2.5	*0.8	*0	
31			80	*20		13		4.6		*0.8	*0	
Runoff, in acre-feet			3,913	8,864	498	1,592	788	512	225	85	*20	

Seasonal runoff, in acre-feet: 16,497

* Estimated

Flows above approximately 350 second-feet were estimated from extension of log log rating curve.

TABLE 3—Continued

RUNOFF OF CLOVER CREEK AT BRIDGE SOUTH OF UPPER LAKE, 1949-50

(Daily mean flow, in second-feet)

Station No. L-20 on Plate 3 | Record from D.W.R.

Date	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1			0.3	0.5	24	13	40	15				
2			0.3	0.3	20	13	35	19				
3			0.3	0.3	28	12	28	15				
4			0.3	0.3	500	12	26					
5			0.3	0.3	300	15	24					
6			0.3	0.3	487	15	26					
7			0.3	0.3	181	14	47					
8			1.0	0.3	98	13	105					
9			0.5	0.3	90	13	80					
10		4	0.5	2	165	13	61					
11		3	0.5	2	100	13	47					
12		9.3	0.5	2	85	13	42					
13		0.3	0.5	2	70	12	37					
14	NO FLOW	0.3	0.5	21	40	12	34		NO FLOW	NO FLOW	NO FLOW	NO FLOW
15		0.3	0.5	2	40	12	30					
16		0.3	0.5	28	40	12	26					
17		0.2	0.5	278	35	40	23					
18		0.2	0.5	181	30	21	21					
19		0.2	0.5	70	26	92	19					
20		0.2	0.5	47	23	92	17					
21		0.2	0.5	185	23	34	15					
22		0.2	0.5	170	21	70	15					
23		0.2	0.5	148	19	50	15					
24		0.2	0.5	70	19	487	15					
25		0.2	0.5	47	17	181	15					
26		0.2	0.5	34	16	100	15					
27		0.3	0.5	40	15	92	15					
28		0.3	0.5	61	13	70	15					
29		0.3	0.5	40		65	15					
30		0.3	0.5	28		50	15					
31			0.5	26		45						
Runoff, in acre-feet		23	28	2,947	5,008	3,364	1,821	97				

Seasonal runoff, in acre-feet: 13,288

TABLE 3—Continued

RUNOFF OF MIDDLE CREEK NEAR UPPER LAKE, 1948-49

(Daily mean flow, in second-feet)

Station No. L-21 on Plate 3 | Record from U.S.E.D.

Date	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1			0	119	10	48	68	11	3	3	0.2	
2			0	69	11	176	56	12	3	3	0.2	
3			0	36	11	231	50	12	3	3	0.2	
4			0	21	26	179	46	10	3	3	0	
5			0	18	42	156	42	9	3	2	0	
6			0	18	37	133	38	8	3	2	0	
7			0	25	48	110	34	8	3	2	0	
8			0	25	38	88	32	8	3	2	0	
9			0	18	45	98	30	7	3	2	0	
10			0	11	84	269	28	7	3	2	0	
11			0	12	210	326	26	7	3	3	0	
12			20	13	91	254	23	6	3	4	0	
13			80	11	57	336	22	6	3	4	0	
14	NO FLOW	NO FLOW	60	9	49	300	22	6	4	4	0	NO FLOW
15			32	8	41	250	21	6	4	4	0	
16			23	7	47	332	20	6	4	4	0	
17			16	7	57	470	19	5	4	3	0	
18			13	8	68	640	18	6	4	3	0	
19			13	9	68	795	16	6	4	3	0	
20			16	10	86	590	15	5	4	2	0	
21			18	11	93	416	14	5	3	2	0	
22			16	11	217	334	14	4	3	2	0	
23			11	10	165	308	14	4	3	2	0	
24			9	10	120	255	14	4	3	2	0	
25			11	9	293	214	14	4	3	2	0	
26			16	7	81	186	13	3	3	1	0	
27			24	7	65	160	13	3	3	1	0	
28			25	8	55	136	13	3	3	1	0	
29			34	9		112	12	3	3	1	0	
30			62	10		94	12	3	3	0.5	0	
31			66	10		72		3		0.5		
Runoff, in acre-feet			1,120	1,103	3,997	16,042	1,505	377	192	145	1.5	

Seasonal runoff, in acre-feet: 24,483

Flows above approximately 500 second-feet were estimated from extension of log log rating curve.

TABLE 3—Continued

RUNOFF OF MIDDLE CREEK NEAR UPPER LAKE, 1949-50

(Daily mean flow, in second-feet)

Station No. L-21 on Plate 3 — Record from U.S.E.D.

Date	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1					13	23	77	20				
2					10	20	69	36				
3					19	18	61	36				
4					525	20	55	27				
5					592	30	53	18				
6					720	30	60	16				
7					332	24	122	12				
8					216	20	183	10				
9					170	23	150	9				
10					240	21	122	8				
11					172	20	100	7				
12					140	18	92	6				
13					114	17	81	6				
14				5	96	15	70	5				
15	NO FLOW	NO FLOW	NO FLOW	10	80	14	64	4	NO FLOW	NO FLOW	NO FLOW	NO FLOW
16				120	85	13	56	4				
17				540	69	245	52	3				
18				400	55	190	47	2				
19				140	50	265	40	2				
20				60	45	176	38	1				
21				340	42	128	32	2				
22				235	38	232	30	2				
23				235	36	316	27	0				
24				130	34	705	23	0				
25				60	32	365	18	0				
26				28	30	263	17	0				
27				30	27	208	16	0				
28				78	26	170	13	0				
29				46		138	12	0				
30				28		115	10	0				
31				18		95		0				
Runoff, in acre-feet				4,963	7,948	7,807	3,550	468				

Seasonal runoff, in acre-feet: 24,736

Flows above approximately 500 second-feet were estimated from extension of log log rating curve.

TABLE 3—Continued

RUNOFF OF MIDDLE CREEK NEAR UPPER LAKE, 1950-51

(Daily mean flow, in second-feet)

Station No. L-21 on Plate 3 — Record from U.S.E.D.

Date	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1			75	8	9	8	6	6	6			
2			102	8	8	8	6	6	6			
3			1,500	11	11	8	6	7	6			
4			570	10	440	10	6	7	6			
5			170	9	565	13	6	11	6			
6			196	8	175	21	6	9	6			
7			230	8	78	29	6	8	6			
8			210	8	33	26	6	7	6			
9			183	8	15	72	6	7	5			
10			90	17	13	26	6	6	5			
11			135	117	268	15	6	6	5			
12			75	59	193	13	6	6	5			
13			50	22	90	12	6	6	4			
14			255	14	45	11	6	6	4			
15	NO FLOW		132	50	24	11	6	6	4	NO FLOW	NO FLOW	NO FLOW
16			83	54	14	10	6	6	3			
17		196	53	390	13	9	6	6	3			
18		300	31	728	12	9	6	6	3			
19		230	18	328	11	9	6	6	3			
20		360	14	180	10	8	6	6	2			
21		316	13	900	10	8	6	6	2			
22		180	12	960	10	8	6	6	2			
23		127	11	335	9	8	6	6	1			
24		102	10	132	9	7	6	6	1			
25		85	10	47	8	7	6	6	1			
26		73	10	22	8	7	6	6	1			
27		73	9	13	8	7	6	6	1			
28		65	9	12	8	7	7	6	1			
29		43	9	11		7	6	6	0			
30		77	9	10		7	6	6	0			
31			8	9		6		6				
Runoff, in acre-feet		4,409	8,493	8,902	4,159	807	359	397	190			

Seasonal runoff, in acre-feet: 27,716

Flows above approximately 500 second-feet were estimated from extension of log log rating curve.

TABLE 3—Continued

RUNOFF OF MIDDLE CREEK NEAR UPPER LAKE, 1951-52

(Daily mean flow, in second-feet)

Station No. L-21 on Plate 3 — Record from U.S.E.D.

Date	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1		0	1,300	219	4,480	86	74	25				
2		0	262	158	1,180	72	67	19				
3		0	771	98	735	74	60	0				
4		0	828	86	382	67	50	0				
5		0	557	76	285	57	53	0				
6		0	212	98	219	84	47	0				
7		0	104	84	182	82	44	0				
8		0	61	74	148	86	42	32				
9		0	43	66	121	100	38	24				
10		0	33	172	104	110	36	19				
11		0	28	304	209	92	34	0				
12		0	22	322	144	100	31	0				
13		0	19	270	114	96	33	0				
14		0	19	919	100	104	35	0				
15	NO FLOW	0	*19	519	102	126	*32	0	NO FLOW	NO FLOW	NO FLOW	NO FLOW
16		0	*19	304	289	124	*28	0				
17		0	*19	194	216	124	*24	0				
18		0	20	144	175	266	*21	0				
19		0	24	131	161	277	*18	0				
20		0	*22	402	151	219	*14	0				
21		0	*22	318	131	197	*10	0				
22		0	*22	258	136	182	*7	0				
23		0	*21	212	178	175	*4	0				
24		0	*21	764	172	206	*0	0				
25		0	*21	771	161	222	*0	0				
26		85	648	786	141	197	*0	0				
27		22	2,490	557	124	158	*0	0				
28		67	1,470	418	110	136	*0	0				
29		41	1,010	396	100	116	*0	0				
30		191	634	440		100						
31			350	811		84						
Runoff, in acre-feet		805	22,000	20,600	22,600	8,170	1,590	236				

Seasonal runoff, in acre-feet: 76,001

* Estimated
Flows above approximately 500 second-feet were estimated from extension of log log rating curve.

TABLE 3—Continued

RUNOFF OF MIDDLE CREEK NEAR UPPER LAKE, 1952-53

(Daily mean flow, in second-feet)

Station No. L-21 on Plate 3 — Record from U.S.E.D.

Date	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	0	0	0	318	53	21	53	84	22	6.1	*1.2	*0
2	0	0	0	228	50	20	46	70	22	5.8	*1.1	*0
3	0	0	0	141	*47	19	43	61	22	5.1	*1.1	*0
4	0	0	17	84	*43	19	40	57	21	4.6	*1.0	*0
5	0	0	102	59	*42	19	39	53	20	4.8	*1.0	*0
6	0	0	1,360	338	*41	20	34	51	35	4.6	*1.0	*0
7	0	0	1,120	1,010	*35	19	35	51	23	4.3	*1.0	*0
8	0	0	166	1,020	*33	19	32	48	23	4.1	*0.9	*0
9	0	0	175	2,690	*28	20	36	44	22	4.1	*0.9	*0
10	0	0	285	902	*24	36	37	42	22	3.9	*0.8	*0
11	0	0	258	424	*22	37	35	40	21	3.6	*0.8	*0
12	0	0	96	525	*20	64	32	38	20	3.4	*0.7	*0
13	0	0	9.4	663	*19	57	33	37	19	3.4	*0.7	*0
14	0	0	32	902	*22	43	33	36	17	*3.4	*0.6	*0
15	0	0	25	456	*21	38	33	33	15	*3.0	*0.6	*0
16	0	0	23	289	*20	39	38	31	15	*2.2	*0.6	*0
17	0	0	22	726	*22	43	40	30	13	*2.2	*0.6	*0
18	0	0	22	1,200	*21	57	33	29	13	*2.1	*0.5	*0
19	0	0	57	1,070	*22	621	31	42	12	*2.1	*0.5	*0
20	0	0	56	1,070	19	440	28	36	11	*1.9	*0.4	
21	0	0	36	656	19	434	25	60	9.9	*1.9	*0.4	
22	0	0	35	223	19	378	23	43	9.4	*1.9	*0.4	
23	0	0	27	300	19	313	19	39	8.6	*1.8	*0.3	
24	0	0	23	222	19	262	18	38	8.1	*1.7	*0.3	
25	0	0	28	172	19	203	16	44	7.4	*1.7	*0.3	
26	0	0	394	141	19	161	18	39	7.1	*1.7	*0.2	
27	0	0	373	114	19	131	440	37	7.1	*1.5	*0.2	
28	0	0	121	96	21	110	203	35	6.8	*1.5	*0.1	
29	0	0	161	78		100	148	32	6.1	*1.4	*0.1	
30	0	0	518	64		80	112	29	6.1	*1.4	*0.1	
31	0		188	57		63		25		*1.2	*0	
Runoff, in acre-feet	0	0	11,360	32,210	1,503	7,708	3,477	2,646	922	183	36	0

Seasonal runoff, in acre-feet: 60,045

* Estimated
Flows above approximately 500 second-feet were estimated from extension of log log rating curve.

TABLE 3—Continued

RUNOFF OF MIDDLE CREEK AT BRIDGE SOUTH OF UPPER LAKE, 1948-49

(Daily mean flow, in second-feet)

Station No. L-22 on Plate 3 — Record from D.W.R.

Date	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1		0	5	200	25	90	78	32	7	2		
2		0	10	120	28	360	76	31	7	2		
3		0	10	90	30	460	73	30	6	2		
4		0	10	65	40	360	71	29	6	1		
5		0	10	40	58	310	71	28	6	1		
6		0	10	40	50	270	71	26	6	1		
7		0	10	50	160	220	69	24	5	0.5		
8		0	10	50	100	180	67	22	5	0.5		
9		0	10	40	150	200	66	20	5	0.5		
10		0	10	25	250	540	65	17	5	0.3		
11		6	10	26	800	650	63	14	5	0.3		
12		0	30	25	350	500	62	14	5	0.2		
13		0	50	25	150	670	60	13	5	0.2		
14		0	40	26	120	600	58	13	5	0.1		
15	NO FLOW	0	25	25	85	500	58	12	5	0	NO FLOW	NO FLOW
16		0	20	20	110	660	57	12	5	0		
17		0	20	18	155	800	56	12	5	0		
18		0	15	20	170	900	56	12	5	0		
19		0	20	20	180	700	55	11	5	0		
20		0	20	22	210	600	54	11	5	0		
21		0	20	24	250	500	52	11	5	0		
22		0	15	25	550	440	50	10	5	0		
23		0	10	22	400	360	49	10	5	0		
24		0	10	20	300	250	42	9	5	0		
25		0	10	20	250	175	41	9	5	0		
26		0	15	15	200	115	40	9	4	0		
27		0	20	15	160	105	39	8	4	0		
28		0	22	20	140	98	37	8	4	0		
29		0	24	22		92	35	8	3	0		
30		0	50	24		86	33	7	2	0		
31		0	58	26		80		7		0		
Runoff, in acre-feet		12	1,188	2,340	10,851	23,545	3,380	950	297	24		

Seasonal runoff, in acre-feet: 42,587

TABLE 3—Continued

RUNOFF OF MIDDLE CREEK AT BRIDGE SOUTH OF UPPER LAKE, 1949-50

(Daily mean flow, in second-feet)

Station No. L-22 on Plate 3 — Record from D.W.R.

Date	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1		0	1	1	48	40	150					
2		0	1	1	50	40	125					
3		0	1	1	55	40	108					
4		0	1	1	750	40	100					
5		0	1	1	1,000	52	90					
6		0	1	1	750	52	120					
7		0	2	1	400	45	200					
8		0	3	1	260	40	286					
9		1	1	1	200	40	240					
10		4	1	2	450	40	200					
11		1	1	4	200	40	170					
12		0.5	1	3	180	40	150					
13		0.5	1	2	160	38	135					
14		0.5	1	26	150	30	124					
15	NO FLOW	0.5	1	27	135	30	115	NO FLOW	NO FLOW	NO FLOW	NO FLOW	NO FLOW
16		0.5	1	28	121	30	106					
17		0.5	1	500	115	310	100					
18		0.5	1	350	105	90	90					
19		0.3	1	250	95	750	80					
20		0.3	1	150	87	350	72					
21		0.3	1	325	73	210	67					
22		0.2	1	250	70	550	64					
23		0.2	1	250	64	310	58					
24		0.2	1	225	61	1,758	55					
25		0.2	1	140	61	820	51					
26		0.2	1	104	61	600	47					
27		0.3	1	110	61	440	43					
28		0.3	1	175	59	310	40					
29		0.3	1	140		250	38					
30		0.3	1	104		200	35					
31			1	100		175						
Runoff, in acre-feet		24	67	6,494	11,545	15,391	6,464					

Seasonal runoff, in acre-feet: 39,985

TABLE 3—Continued

RUNOFF OF DAYLE CREEK NEAR LOWER END OF BACHELOR VALLEY, 1948-49

(Daily mean flow, in second-feet)

Station No. L-23 on Plate 3 — Record from D.W.R.

Date	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1			0	3.0	5	15	14	2				
2			0	2.0	7	25	13	2				
3			0	2.0	9	120	12	2				
4			0	1.5	26	100	12	2				
5			0	1.5	17	90	12	2				
6			0	1.5	19	80	11	1				
7			0	1.0	21	40	11	1				
8			0	1.0	19	20	10	1				
9			0	1.0	20	23	10	1				
10			0	1.0	35	280	9	0.5				
11			0	1.0	150	300	8	0.3				
12			0	1.0	40	250	8	0.3				
13			1.0	1.0	25	200	7	0.3				
14			1.0	1.0	20	180	7	0.3				
15	NO FLOW	NO FLOW	1.0	1.0	19	160	7	0.3	NO FLOW	NO FLOW	NO FLOW	NO FLOW
16			1.0	1.0	20	200	7	0.2				
17			1.0	1.0	22	250	7	0.2				
18			1.0	1.5	24	300	6	0.2				
19			1.0	1.5	24	350	6	0.2				
20			1.0	1.5	28	300	6	0.2				
21			1.0	1.5	15	200	6	0				
22			0.5	1.5	30	100	5	0				
23			0.5	1.5	23	48	5	0				
24			0	1.5	19	40	4	0				
25			0	1.5	16	36	3	0				
26			0	1.5	15	20	2	0				
27			0.5	1.5	12	18	2	0				
28			1.0	1.5	10	16	2	0				
29			1.5	1.5		15	2	0				
30			1.5	1.5		15	2	0				
31			2.0	1.5		14		0				
Runoff, in acre-feet			32	86	1,368	7,547	428	36				

Seasonal runoff, in acre-feet: 9,497

TABLE 3—Continued

RUNOFF OF DAYLE CREEK AT LOWER WEST VALLEY ROAD, 1949-50

(Daily mean flow, in second-feet)

Station No. L-24 on Plate 3 — Record from D.W.R.

Date	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1				0	7	5	17					
2				0	6	5	16					
3				0	21	5	15					
4				0	150	5	14					
5				0	150	7	13					
6				0	100	5	14					
7				0	50	5	18					
8				0	25	5	27					
9				0	20	5	20					
10				0	50	5	15					
11				2	25	5	13					
12				2	20	5	13					
13				0	13	5	13					
14				5	12	5	13					
15	NO FLOW	NO FLOW	NO FLOW	10	11	4	13	NO FLOW	NO FLOW	NO FLOW	NO FLOW	NO FLOW
16				60	10	4	13					
17				65	9	20	13					
18				15	8	7	12					
19				12	7	50	12					
20				8	7	12	12					
21				20	7	12	12					
22				15	7	20	11					
23				15	7	20	11					
24				10	7	164	11					
25				7	7	47	11					
26				5	7	35	10					
27				5	7	27	10					
28				15	6	25	10					
29				12		23	10					
30				10		21	10					
31				8		19						
Runoff, in acre-feet				597	1,499	1,154	797					

Seasonal runoff, in acre-feet: 4,047

ABLE 3—Continued

RUNOFF OF DAYLE CREEK AT UPPER WEST VALLEY ROAD, 1949-50

(Daily mean flow, in second-feet)

Station No. L-25 on Plate 3 — Record from D.W.R.

Date	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1				0	2	0.5	2					
2				0	2	0.5	1					
3				0	8	0.5	1					
4				0	30	0.5	1					
5				0	20	1.0	1					
6				0	20	0.5	1					
7				0	10	0.5	2					
8				0	7	0.5	3					
9				0	5	0.5	3					
0				0	10	0.5	2					
1				0	8	0.5	2					
2				0	6	0.5	2					
3				0	5	0.3	2					
4				5	5	0.2	2					
5	NO FLOW	NO FLOW	NO FLOW	8	4	0.2	2	NO FLOW	NO FLOW	NO FLOW	NO FLOW	NO FLOW
6				10	4	0.3	2					
7				15	4	1	2					
8				2	3	1	2					
9				2	3	3	1					
0				2	3	2	1					
1				10	3	2	1					
2				7	2	3	0.5					
3				4	2	3	0.5					
4				3	2	10	0.5					
5				2	2	5	0.5					
6				1	1	4	0.2					
7				1	1	4	0					
8				5	1	3	0					
9				4		3	0					
0				3		2	0					
1				2		2						
unoff, in acre-feet				171	343	111	75					

easonal runoff, in acre-feet: 700

APPENDIX D

RECORDED AND ESTIMATED ANNUAL MAXIMUM AND MINIMUM WATER SURFACE LEVELS OF CLEAR LAKE, 1873-1953

Water levels for 1873-1900, inclusive, were obtained from United States Geological Survey Water-Supply Paper No. 45 but have been corrected to Rumsey gage readings.

Levels for 1901-1912, inclusive, were estimated from gage heights and flows at United States Geological Survey gaging station on Clear Lake outlet channel (Cache Creek) near Lower Lake.

Data for 1913-1953 were obtained from records of United States Geological Survey.

ANNUAL MAXIMUM AND MINIMUM WATER SURFACE LEVELS OF CLEAR LAKE, 1873-1953

(Corrected to Rumsey gage readings)

Year	Water levels		Year	Water levels		Year	Water levels	
	Maximum and minimum			Maximum and minimum			Maximum and minimum	
	Month	Gage reading, in feet		Month	Gage reading, in feet		Month	Gage reading, in feet
1873		----	1900	March	5.66	1927	February	9.00
	November	1.08			----		October, November	1.30
1874	March	8.62	1901	February, March	8.13	1928	April	7.35
	October	3.41		November	1.92		October, November	1.70
1875	February	6.60	1902	March	9.98	1929	March, April	3.30
	November	1.75		October, November	2.77		December	—0.32
1876	March	12.37	1903	March	7.81	1930	April	6.00
	January	3.71		October, November	1.67		December	1.25
1877	March	5.64	1904	April	11.91	1931	March, April	2.20
	October	1.77		November	2.67		December	—0.85
1878	March	12.39	1905	April	8.68	1932	March, April	3.78
	January	1.95		November	1.72		November, December	—0.10
1879	March	8.31	1906	April	9.66	1933	April	2.60
	November	3.56		December	2.17			
1880	April	10.08	1907	March	11.64	1934	March, April	3.60
	November	3.83		November	2.42		October	0.07
1881	February	10.25	1908	March	7.53	1935	April	7.28
	November	3.08		October, November	1.37		November, December	2.78
1882	March	6.16	1909	February	13.38	1936	February	8.20
	November	2.39		November	2.42		December	1.85
1883	May	4.12	1910	April	6.95	1937	April	7.05
	November	1.47		November, December	1.27		November	1.10
1884	April	5.58	1911	March	9.09	1938	February	10.25
	December	1.41		January	1.27		November	1.10
1885	January	6.02	1912	March	3.78	1939	Mar. 28-April 7	3.85
	October	1.41			----		September	0.10
1886	January	8.94	1913	January, February	4.16	1940	March	8.40
	December	3.08		October	0.62		November	—0.35
1887	March	5.42	1914	January	11.12	1941	April	8.90
	December	1.82		November	2.20		October	2.55
1888	March	4.86	1915	February	10.68	1942	February	9.60
	November	1.56		November	2.48		September	2.62
1889	April	5.88	1916	February	8.53	1943	April	7.58
	October	2.88		November	1.37		September	1.80
1890	January	13.66	1917	April	6.60	1944	May	5.00
	November	3.25		December	0.61		September	0.72
1891	April	6.47	1918	April	3.03	1945	April	5.80
	November	2.35		October	—2.00		September	0.27
1892	May	5.08	1919	April	4.42	1946	April	7.27
	November	1.75		November, December	—1.50		October	0.00
1893	March	9.70	1920	April, May	—0.50	1947	April	3.40
	November	2.83		September	—3.50		November	0.15
1894	March	8.66	1921	March, April	7.20	1948	May	4.62
	November	2.50		November	1.75		October	0.00
1895	January	12.25	1922	April	6.50	1949	April	6.03
	November	2.58		October	1.18		November	0.43
1896	February	7.75	1923	April	5.70	1950	April	4.80
	November	2.91		December	0.70		September	0.18
1897	April	8.16	1924	February	1.80	1951	March	7.56
	November	2.25		October	—1.52		October	0.00
1898	March	3.41	1925	May	6.90	1952	February	8.13
	November	0.08		November	2.00		October	1.81
1899	April	3.08	1926	April	7.48	1953	January	7.92
	October	0.25		November	1.90		November	1.42

APPENDIX E

GEOLOGY OF THE BIG VALLEY-SCOTT VALLEY-UPPER LAKE AREA

TABLE OF CONTENTS

GEOLOGY OF THE BIG VALLEY-SCOTT VALLEY-UPPER LAKE AREA

Introduction

The geology of the area surrounding Clear Lake has never been completely worked out, although several investigators have published detailed geological reports on portions of the area. Several of these have been in connection with a study of the quicksilver resources in the vicinity of the eastern part of the lake. Papers by Becker (1888) and Everhard (1946) are notable. An excellent discussion of the volcanic rocks, including a geologic map of the area surrounding the southeastern part of the lake, was published by Anderson (1936). The physiographic history of the formation of Clear Lake has been described by Davis (1933). The prominent springs of Lake County have been described by Waring (1915). More recently, a map and geologic study of the Lower Lake quadrangle was made by Brice (1953), and Upson and Kunkel (1955) described ground water in the Lower Lake-Middletown Area in connection with a cooperative investigation between the State Department of Water Resources and the U. S. Geological Survey.

Big Valley, Scott Valley, and the Upper Lake area, with all of which the present report is concerned, lie west of areas on which most detailed study has previously been made. Work for the present report has included reconnaissance study of the rocks surrounding the alluvial basins and more careful study of the water-bearing sediments through the use of well logs supplemented by field observation.

Physiography

Big Valley, Scott Valley, Bachelor Valley, Clover Valley, and Middle Creek Valley are all relatively flat alluviated valleys surrounded by highlands composed of older rocks, except where the valleys lead into each other or into Clear Lake. The older rocks also underlie the floors of the valleys, and in some places, particularly in Scott and Bachelor Valleys, they project as "islands" above the alluvium. Two sizeable terraces are worthy of note. Both are underlain in part by sands and gravels older than Recent alluvium and in part by still older formations. One lies southwest of Kelseyville between Kelsey and Adobe Creeks, and the other is located east of Scott Valley where it underlies Lakeport in part. The terrace southwest of Kelseyville may be somewhat the younger, as it is only mildly dissected while dissection of the Lakeport terrace is deep.

The physiographic history of Clear Lake, first described by Davis and modified by later workers, is here interpreted to have been as follows: A divide originally existed somewhere in the area occupied by the lake, east of which drainage took place through Cache Creek into the Sacramento River, and west of which drainage flowed through Cold Creek into the Russian River. These conditions were changed by a lava flow which blocked the Cache Creek drainage at a point less than a mile northeast of the present village of Lower Lake. As a result, water was ponded behind this flow to form a lake occupying the part of present Clear Lake east of the original divide. This original divide eventually was breached, and the whole area became tributary to Cold Creek on the west. At this time upper Scott Creek was tributary to Cold Creek just south of the present location of Blue Lakes, and drainage between this point and Clear Lake was opposite to its present direction. At a later date, perhaps "some tens of centuries ago" as suggested by Anderson, a landslide blocked Cold Creek at the western end of the present location of Blue Lakes. Drainage was thus again ponded in the Clear Lake area between the new slide and the lava flow, and this time it was the flow which was eventually breached to form the present outlet of the lake into Cache Creek.

Before the final breaching of the lava flow, Clear Lake stood higher than its present level. Sediments identified as having been deposited in the lake when at a higher elevation are present on the west side of Buckingham Peninsula and in the vicinity of Sulphur Bank mine. Some of the sediments encountered in wells in Big Valley and the Upper Lake area were undoubtedly laid down in Clear Lake at this time.

Stratigraphy

The geologic formations of the Big Valley, Scott Valley, and Upper Lake areas range in age from Jurassic to Recent. The younger formations fill the valleys and contain nearly all water which is yielded to wells, and the older formations generally form the basins enclosing the younger sediments. The following table lists the formations of the area under consideration.

Geologic Formations of Big Valley-Scott Valley-Upper Lake Area

Age	Formation
Recent	Alluvium
Upper Pleistocene (?)	Older lake and terrace deposits
Middle and Upper Pleistocene	Volcanic rocks
Lower Pleistocene or Upper Pliocene	Cache formation
Cretaceous	Shasta series
Jurassic	Franciscan group

Franciscan Group. Rocks of the Franciscan group underlie most of the highlands surrounding the valleys with which this report is mainly concerned. The most common rock type is sandstone, but shale and serpentine also occur in large amounts, and other types are probably also present. The sandstone is dark in color and very hard, and the shale is black.

The sandstone is high in feldspar and also contains quartz and biotite. In places it is crossed by quartz veins. Serpentine does not occur in some areas of the Franciscan, but in others it makes up most of the rock. The Franciscan rocks of this area are very highly sheared, contorted, and fractured, which is a common condition of the formation elsewhere in the State.

Franciscan rocks bound Big Valley on the west and south and crop out in places in the southern part of the Big Valley terrace. Scott Valley is bounded by Franciscan on the west and north, sandstone being the predominant rock type there. Franciscan sandstone, shale, serpentine, and volcanics principally bound Bachelor Valley, compose the hills projecting up from the floor of the valley, and are encountered in some wells. Similar rocks bound Clover Valley and the valley of Middle Creek north of Upper Lake.

Water occurs in the Franciscan group principally in fractures in the rock. In general, the amount of this water is believed to be small. However, wells furnishing all water for the City of Lakeport in 1948 apparently drew from fractured Franciscan sandstone in and adjacent to the bed of Scott Creek at the head of Scott Valley whenever the creek was not flowing. When the creek did flow, creek water flowed into the wells and supplemented the supply from the Franciscan group.

Several of the springs described by Waring in and near the area of this report evidently issue from Franciscan rocks. Included are Highland Springs, on Adobe Creek about 7½ miles south of Lakeport; three springs in the canyon of Scott Creek between four and six miles southwest of Lakeport; Hayvilla Sulphur Spring, on the McMath property in Bachelor Valley; Witter Springs, about a mile west of Bachelor Valley; and Saratoga Springs, about two miles southeast of Witter Springs.

Shasta Series. Recent geologic investigations by the Department of Water Resources have shown that some rocks of the Shasta series of Cretaceous age occur flanking Bachelor Valley and Middle Creek Valley in areas formerly thought to be underlain only by Franciscan rocks. The Shasta rocks are sandstone, shale, and conglomerate but are less contorted and fractured than the Franciscan rocks. Water-bearing characteristics are similar to the Franciscan.

Cache Formation. The Cache formation was first named the "Cache Lake beds" by Becker, but the name was given its present form by Anderson. The best exposures of the formation are in the area west of the north fork of Cache Creek, where it consists principally of light-colored gravels and sands. Other lithologic types found in the area around the southeast part of the lake include tuffaceous and diatomaceous sands and silts, limestone, and intercalated volcanic rocks. Neither the reconnaissance geologic map by Becker nor the map by Anderson which extends only a little west of Kelseyville shows any of the area of the present report underlain by the Cache formation. Nevertheless, certain pre-terrace sediments here are tentatively identified as Cache on the basis of stratigraphic position and lithologic similarity to known beds of that formation.

In the area of the present report, beds identified as Cache at the surface are most commonly buff colored sandy silt or very fine sand. Some shale containing black carbonaceous (?) spots occurs in thin layers in some places, and some pebble layers are also present. Grains in the sands are moderately well rounded, and the material is generally poorly consolidated. The mineral assemblage in the sands and gravels suggests a Franciscan source. The log of well 13N/9W-15H3 gives an excellent subsurface section of the Cache formation. The well was drilled on the hill a short distance from a prominent exposure identified as Cache beds on Steheli Drive immediately south of its junction with State Highway 29. Folowing is a log of this well:

0- 12 ft.—Soil
12- 42 ft.—Yellow clay
42- 45 ft.—Gravel
45-396 ft.—Blue clay with 2 thin layers of gravel
396-403 ft.—Brown conglomerate—very hard. (It took 4 days to drill this distance)
403-420 ft.—White sandy substance believed to be tuff

All sediments below 12 feet in the above log probably belong to the Cache formation. The 351-foot thickness of blue clay is of particular interest, since a great many logs, both on the terrace and in the valleys, report blue clay at corresponding depths. It is believed that a large part of the blue clay in other wells does belong to the Cache formation, but some is probably younger.

The Cache formation is largely made up of lake deposits, but some stream deposits are probably included. Becker and Anderson disagree as to the relation between the lake in which the Cache deposits were laid down and the present Clear Lake. Becker stated that "Cache Lake overlapped the area at present occupied by Clear Lake" and believed that the history of the lakes "must have been continuous." Anderson, however, believed that topography during Cache time was probably quite different from that at the present, and that there was "no connection" between Clear Lake and lakes in which deposition took place during Cache time. The age of the Cache formation is probably upper Pliocene or lower Pleistocene or both.

The Cache formation appears at the surface on the east side of the Big Valley terrace, where it is exposed in road cuts at several places. It probably underlies all the terrace, although beneath younger deposits in most places. A wildcat oil well drilled in 1949 on the Eiberger property about six-tenths of a mile airline east of the junction of Wight Road and Adobe

·eek Drive is believed to have entered the Cache for-
ıtion at a shallow depth. Its log shows a great pre-
nderance of blue clay and blue shale above 400
·t. Below that point, the driller orally reported
ernating strata of shale and limestone for hundreds
feet, which is probably Cache formation lithologi-
lly similar to some of that exposed in the eastern
rt of the Clear Lake area. Outcrops of the Cache
·mation in the Lakeport-Scott Valley-Upper Lake
·a are much less numerous than outcrops of Fran-
can rocks and terrace materials. A few exposures of
at is probably Cache formation show in road cuts
ar the intersection of Highway 29 and the Nice cut-
·.

Volcanic rocks apparently interbedded with the
che formation occur along Highway 29 southeast
Kelseyville. Tuff has been observed in road cuts
·e, and Anderson states that pumice-breccia is also
esent. These rocks probably accumulated during
che time as they are overlain by fine sands typical
the Cache formation.

The permeability of the Cache formation is gen-
lly low. Most of the strata are too high in clay or
for water movement to be great. Drillers' experi-
·es with deep wells bear out this contention. S. L.
ımmel, who has probably drilled as many wells in
· area of this report as any other driller, reports
ht there is very little chance of getting any water
oduction from wells at depths greater than 150
t except from beds of "volcanic ash." Some of the
diments below 150 feet may be post-Cache, but
ither they nor the Cache beds evidently yield much
ter. Nevertheless, ground water flow through a few
rse sedimentary strata and volcanic deposits in the
che formation is probably appreciable.

Volcanic Rocks. Lava flows and tuffs make up the
stern slopes of Mount Konocti east of Kelseyville,
cording to Anderson. The flows are mostly massive,
contain pumiceous bands locally. The predomi-
ıt rock type was called rhyodacite by Anderson, al-
ugh Brice stated that "most of the lavas on and
und Mount Konocti are dacitic." The tuffs are
er-bedded with the flows, and are composed princi-
lly of ash with some fragments of pumice. The age
these volcanic rocks is probably Middle to Late
istocene.

t is probable that the volcanic rocks of Mount
nocti contain notable amounts of water. Lavas are
mmonly highly fractured, and the fractures are
ficiently interconnected to serve as conduits for
·er and form a reservoir. Although rainfall on Mt.
nocti is relatively high, runoff is very low. The
orption of rainfall and surface flow by the Konocti
canics is thus indicated and appears to be quite
ıh.

Beds of volcanic fragments forming an unconsoli-
ted coarse ash or fine breccia have been encountered
in a number of wells in the Big Valley district. The ash from a depth of 150 feet in well 13N/9W-20A2 is composed of volcanic fragments, some of which are pumice, up to one-half inch in diameter. It probably represents a fall of volcanic material into quiet lake waters. Volcanic ash has been found at depths between about 70 and 240 feet in various wells. The age of the ash beds may be Cache, post-Cache, or both.

The ash beds are highly permeable and have proved to be excellent water producers. At least in some cases, the water level in wells which pierce them is apparently independent of the level of the shallower water.

Terrace and Older Lake Deposits. Sediments younger than the Cache formation, yet older than alluvium laid down during the present stage of Clear Lake, have been recognized by Anderson and Everhart in the eastern part of the Clear Lake area. Deposits of corresponding age in the area of the present report are of two types: sediments in terraces now topographically higher than the adjacent parts of Big Valley, Scott Valley, and the Upper Lake area, and older lake deposits in these valleys now buried by the youngest alluvium.

Terrace deposits are present in the Big Valley terrace, the Lakeport-Scott Valley area, and between Lakeport and Upper Lake, including both sides of the broad lowland extending from Clear Lake to and beyond Upper Lake. Terrace material exposed in road cuts in the Lakeport-Scott Valley area includes sands, gravels, and clays. The gravels are most common. They are generally red-brown, poorly stratified, and moderately well rounded. In some exposures they are slightly tilted. They commonly occur in a matrix of residual clay, formed as a result of long weathering. The constituent pebbles have often weathered so greatly that they disintegrate under a hammer blow or even under hand pressure. The red color is due to heavy oxidation. Sands vary from fine to coarse. They are commonly yellowish to reddish and have a high clay content. A soft greenish clay is exposed in a road cut in Scott Valley just west of the eastern boundary of Section 15, T14N, R10W.

The terrace material exposed in cuts along Highway 29 between Lakeport and the junction with Highway 20 west of Upper Lake, and along Highway 20 southeast of Upper Lake, is similar to that just described. An excellent exposure of terrace gravel overlying fine silty sand of the Cache formation appears in a road cut on the Nice cutoff about one-tenth of a mile east of Highway 29. The contact is an erosional unconformity.

Material at the surface of the Big Valley terrace southwest of Kelseyville is most commonly gravel or sand. In some places it is fresh; in others it is weathered to a reddish color, contained in a clay matrix, and generally very similar to the terrace material on the west side of the lake. Loose gravel covers much of the surface of the terrace. In well 13N/9W-22F1, the material encountered was fresh gravel, very little affected by weathering.

Most of the terrace deposits are believed to have been laid down by streams flowing from the highlands toward the Clear Lake basin at a time when the lake stood at a higher level than at present.

The pre-alluvium sediments found by Anderson and Everhart east of the area here discussed lie at elevations up to 100 feet above the present level of Clear Lake. It is believed that Clear Lake at the time these sediments were laid down must have extended into Big Valley and the valleys of the Upper Lake area. Sediments deposited in these arms of the lake were undoubtedly mostly blue lake clays and silts, and these cannot be differentiated in well logs from the still older blue clays of the Cache formation, which probably underlie them in some places at least. Fragments of wood identified as the redwood *Sequoia sempervirens* were found by Everhart in the post-Cache sediments at the end of the eastern arm of the lake. Redwood has also been reported from a great many wells in the area of the present investigation. Hummel reports that redwood in wells generally is found between depths of 40 and 250 feet. He states that 90 per cent of new wells pump leaves and wood (not necessarily redwood) between depths of 75 and 250 feet. Some of the sediments in which the redwood is found are undoubtedly of the same age as the high level post-Cache deposits to the east. It is certainly possible that the underlying Cache formation also contains some redwood. Since no redwood grows in the Clear Lake area at present, climatic conditions have probably changed since the time when these trees lived. Everhart states that sediments containing *Sequoia sempervirens* may be either Pleistocene or post-Pleistocene in age.

A fresh water gastropod found in blue clay at a depth of 70 feet in well 14N/9W-31P1 has been kindly identified by Dr. G. D. Hanna of the California Academy of Sciences as *Valvata virens*, a form now living in Clear Lake. Dr. Hanna expressed the opinion that the sediments from which the shell came might be as old as Pleistocene, but no older.

The permeability of terrace materials is generally low, mainly because of the high clay content common even in the coarse clastics. A very few wells in the Big Valley terrace yield sufficient water for irrigation, possibly from both terrace and Cache beds. No irrigation wells in terrace material are known in the Lakeport-Scott Valley-Upper Lake district.

The permeability of the older lake beds is likewise low, since they are principally composed of clays and silts.

Alluvium. The uppermost deposits in Big Valley, Scott Valley, and the Upper Lake area are made up of Recent alluvium. The character of these deposi varies notably among the various valleys.

In Big Valley, the younger alluvial deposits, ge erally extending to depths of 40 to 90 feet, consist alternating strata of gravel, sand, silt, and clay. T most common colors are yellow and brown, althou some blue occurs. The coarse clastics particularly c cur as stringers and lenses rather than beds whi are continuous over notable distances. These coar stringers are former channels of the streams flowi from the highlands into Clear Lake, channels whi were later buried as the land was built up by t deposition of more material from the highlands. Du ing and after the withdrawal of Clear Lake from B Valley, then, it is apparent that the valley has be built up to its present level by the process of depo tion from the highlands by shifting streams. Certa fairly extensive beds of fines (silt, clay, and san clay) were either deposited in remaining extensio of Clear Lake or in areas between stream channe

The northern part of Scott Valley is underlain a blanket of sandy and silty clay about 60 to 90 fe thick and mostly blue in color. Below this lie fair continuous gravel strata in which water is under su cient pressure to flow at the surface throughout m of the northern part of the valley. Lack of continu of the artesian aquifer is shown by the fact that so wells do not strike it even though drilled to and yond the proper depth. In the southern part of t valley, gravels and clays are interbedded at shallow depths.

Northern Scott Valley was probably occupied by lake until fairly recent times, and the blue clays we laid down on that lake bottom.

The valleys of the Upper Lake district are simil to Big Valley in containing alternating strata of t various clastic sediments. A stratum of brownish-bl to yellow sandy and silty clay about 60 to 110 f thick occurs in Middle Creek Valley in the Upp Lake vicinity and serves as the capping bed for artesian aquifer of sand and gravel. The capping b and its underlying artesian aquifer extend to the w toward the southern end of Bachelor Valley. T capping bed of fines was probably partly deposited Clear Lake when the lake extended into the area question. Indeed, Clear Lake at times of high wat still extends over a notable part of the artesian ar In part the deposits were probably made at times flood from Middle and Clover Creeks, particularly the immediate vicinity of Upper Lake, where floo covering extensive areas still occur.

Alluvium to the north in Middle Creek Valley a in Clover Valley was probably mostly built up streams draining the surrounding highlands. String and lenses of sand and gravel alternate with imp vious silts and clays.

The alluvium of Bachelor Valley contains only a ew lenses of sand and gravel of high permeability. Iost of the valley is evidently filled with clay, silt, nd clay and gravel.

round Water Geology

Recharge of the underground reservoirs in all the alleys covered by this report takes place principally y percolation of the streams crossing them. The most fective recharge takes place in the upstream parts of ie valleys.

Big Valley. Percolation from Kelsey and Adobe reeks furnishes most of the recharge of the underround reservoir of Big Valley. Wells in the vicinity spond with marked rises in the fall as soon as the ow of Kelsey Creek extends as far north as Kelseyille. Adobe Creek begins to percolate heavily as soon s it reaches the valley about a mile downstream from ighland Springs. Other creeks may contribute minor nounts of recharge. Movement of ground water from eneath these two principal sources of recharge takes ace into the unwatered sands and gravels on either de, and from thence is in the direction of Clear ake. Discharge of ground water takes place into the ownstream reaches of creeks crossing Big Valley and to abandoned stream channels known as sloughs, om whence it moves on the surface into Clear Lake. his ground water discharge naturally increases as e ground water reservoir fills.

The volcanic ash which is such a good water procer in parts of Big Valley apparently occurs in ore than one bed. Wherever it occurs, the water it ntains is found to be under pressure. One stratum volcanic ash is tapped by five wells in Section 20, 13N, R9W, just downstream from the junction of ighland and Adobe Creeks. It is reached at depths rying from 70 to 150 feet. This bed rises to the uth and probably receives its recharge by percolan of Highland and Adobe Creeks in the vicinity of eir junction. Well 13N/9W-20A2, the northernmost the five wells, flows when water levels are high. ithin a mile and a half north and east of this well, lcanic ash has been reached in five additional wells depths of from 202 to 240 feet. It is not known hether the two groups of five wells each penetrate e same or different volcanic ash strata. The drillig of additional wells between the groups would help lve this problem.

Volcanic ash which may be entirely separate from t bed or beds just described occurs in the valley of lsey Creek south of Kelseyville at depths between and 120 feet. No ash is reported north of Kelseyle in wells drilled as deep as 400 feet. Hummel ates that a well on the high ground southwest of lseyville, not far from the cemetery near the center Section 15, encountered volcanic ash mixed with avel at an unstated depth. Further evidence is needed before it can be stated definitely whether the ash beds extend beneath the high ground as part of the Cache formation, or whether they occupy the valleys only and may be younger.

The elevation of the pressure surface of water in the volcanic ash beds does not appear to differ greatly from the water level in shallower aquifers.

Some effects characteristic of free ground water and some characteristics of water under pressure are found in Big Valley wells which do not penetrate volcanic ash. Several examples follow. Water levels typically show a drop or no change between summer and fall in free ground water areas and a rise in pressure areas, but in some parts of Big Valley water levels rose and in some others they fell during that period in 1949. Continuous recorders on wells 13N/9W-8B1 and 13N/9W-2L1 showed pressure effects, while a recorder on well 14N/9W-33Q2 showed free ground water effects. Several wells within about a mile of Clear Lake flow at times, and even well 13N/9W-9H2, about three miles from the lake, flows when Kelsey Creek is high. Yet both Kelsey Creek and Adobe Creek percolate heavily in the southern part of their reaches in Big Valley, a definite indication of free ground water conditions.

The percolation of Kelsey Creek and Adobe Creek determines that Big Valley south of a line running approximately along the boundary between T13N and T14N should be considered a free ground water area. Pressure effects south of this line in wells which do not penetrate volcanic ash are probably caused by either of the following factors: The principal water production may be from deep sand or gravel strata beneath notable thicknesses of blue clay; or the production may be from shallower strata where the water is under pressure beneath clay beds of moderate extent in the alluvium.

North of the line running approximately along the boundary between T13N and T14N, water in all aquifers appears to be under pressure. The confining beds of silt and clay in the pressure area extend downward from the surface in most places, and the aquifers occur as stringers of sand and gravel within these beds. Nearly all wells in the pressure area in 1949 pumped from aquifers less than 110 feet deep. The sand and gravel aquifers evidently pinch out or grade into silts and clays toward and beneath Clear Lake.

If appreciable subsurface movement of ground water derived from rainfall penetration took place from the volcanic rocks of Mt. Konocti into the alluvium of Big Valley, the water table in the spring on the east side of the valley ought to be higher adjacent to the mountain than at some distance from it. Ground water contour maps show the opposite to be the case. Subsurface movement of water from the volcanics of Mt. Konocti into Big Valley is thus considered to be negligible under existing ground water conditions. The reason for this evident lack of ground water movement into Big Valley from the east is not apparent. It seems probable that the cause is low permeability of the particular zones in the volcanics which are in contact with the water-bearing sediments of Big Valley.

The actual discharge of a large part or perhaps practically all of the water entering the Konocti volcanics is believed to take place into Clear Lake through springs in Soda Bay, immediately north of the mountain. Waring says of this area that "numerous warm, bubbling springs rise along the border of the lake for a distance of half a mile on the east side of the bay." He states that the flow of the largest spring "is probably several hundred gallons a minute, and much water also rises at other points near by." Analyses given by Waring of the water from two springs show that both are high in carbonate, one is distinctly ferruginous, and the other contains prominent ammonium metaborate radicles. Waring reports that "all of the vents are said to be more active when the lake is high." This is in agreement with the theory here presented that the water, at least in part, comes from the volcanic rocks at Mt. Konocti. Periods of high water in the lake follow periods of heavy precipitation, when infiltration into underground storage has been high. After such periods water in the Konocti volcanics is under high head, and discharge is correspondingly great. It is of course possible that some of the water discharged by the warm mineralized springs comes from deep-seated sources entirely separate from the Konocti volcanics.

Scott Valley. Recharge of the artesian aquifer takes place by percolation of Scott Creek between a point in Section 22, T14N, R10W, about a quarter of a mile south of the northern boundary of the section, and a permanent spring about 0.2 mile upstream from the bridge near the west boundary of Section 14. The depth to the artesian aquifer varies from about 60 to about 90 feet. The artesian aquifer on the west side of Scott Valley is much thinner than on the east, according to Sheldon Deacon, a resident. Two gravel stringers, each about one foot thick, yield the artesian flow in the Deacon well, 14N/10W-10G1. The volume of artesian flow on the west side of the valley is not sufficient for irrigation, according to Deacon, but the thicker aquifers on the east side yield larger amounts. It is reported that the head on one of the early wells on the east side of the basin was twenty-one feet above the surface when first drilled.

Under original conditions, the only discharge o water from the artesian aquifer was by artcsiai springs, which are reported to have been numerous Present discharge through wells has cut down th discharge by springs, but a number of springs stil existed in 1949. Scott Creek is reported to flow in suffi cient volume through the artesian area during norma summers that portable pumps are used to take wate from it for irrigation. Part of this flow is believed t be due to artesian springs. An area of standing wa ter southeast of well 14N/10W-10G1 in 1949 was ap parently caused by an artesian spring.

Upper Lake Area. Recharge of the principal arte sian aquifer of the Upper Lake Area evidently take place for the most part by percolation of Middl Creek. Conditions as of December 1, 1948, which wer believed to be little different from those in effect a the end of the summer, showed Middle Creek dr upstream from the point where it leaves Section 25 T16N, R10W, and containing standing water or flow ing below this point. The principal percolation o Middle Creek is thus upstream from this point. Perco lation of Clover Creek and Alley Creek in the eas half of and upstream from Section 5, T15N, R9W also reaches the artesian aquifer. Artesian produc tion comes from thin sand and gravel strata betwee the depths of about 60 and about 110 feet. No exac measurements of head in Upper Lake are available but it is reported that artesian flow occurred at on time on the second floor of buildings.

Notable ground water recharge in Bachelor Valle takes place by percolation in and upstream from th NW¼ Section 33, T16N, R10W, as shown by rise o water level in well 16N/10W-33E1. Dayle Cree and other creeks probably also percolate to some ex tent, especially where they first reach the valley floor

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APPENDIX F

RECORDS OF DEPTHS TO GROUND WATER AT MEASUREMENT WELLS IN CLEAR LAKE AREA

DEPTHS TO GROUND WATER AT MEASUREMENT WELLS IN CLEAR LAKE AREA

(DEPTHS TO WATER IN FEET MEASURED FROM REFERENCE POINT)

N 9W-1E1—Reference point—top of casing, elevation 1,334.6 feet. 0.18 mile south of and 0.06 mile west of intersection of Soda Bay Road and Clarks Drive, on east side of Cold Creek.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
/17/48	10.6	6/ 2/49	6.1	1/ 3/50	11.3	11/ 6/51	11.8
/15/48	10.1	7/ 5/49	7.8	2/ 1/50	7.8	4/ 8/52	3.0
/ 3/49	8.6	8/ 2/49	11.9	3/ 1/50	5.3	11/ 7/52	11.1
/ 1/49	8.3	9/ 1/49	10.0	4/ 4/50	4.8	3/16/53	3.9
/ 2/49	5.7	10/ 1/49	11.3	4/26/50	5.2	10/20/53	9.8
/ 5/49	4.2	11/ 2/49	11.4	10/31/50	12.3		
/ 2/49	4.8	12/ 1/49	11.5	3/27/51	3.7		

N 9W-1N1—Reference point—edge of pump base, elevation 1,342.8 feet. 0.01 mile north of and 0.05 mile east of intersection of Loasa Drive and Clarks Drive.

Date	Depth to water	Date	Depth to water	Date	Depth to water
/21/48	21.5	3/31/50	18.8	11/ 6/52	20.7
/28/49	24.6	10/31/50	24.0	3/16/53	14.3
/14/49	22.2	11/ 5/51	23.3	10/20/53	19.1

N/9W-2C2—Reference point—pump base hole, elevation 1,345.7 feet. South side of Soda Bay Road, 0.08 mile southwest of Soda Bay Drive.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
/20/48	20.4	6/ 1/49	34.2*	2/ 1/50	15.8	10/30/50	21.0
/30/48	20.1	7/ 1/49	23.9	3/ 1/50	13.0	3/28/51	10.4
/ 3/49	17.4	8/ 2/49	21.6	4/ 4/50	11.8	11/ 6/51	24.6
/ 1/49	15.1	9/ 1/49	21.6	4/10/50	11.6	4/ 8/52	11.2
/ 2/49	12.7	10/ 1/49	28.1	4/25/50	11.8	11/ 7/52	21.4
/ 4/49	17.8	11/ 2/49	24.9	6/ 2/50	17.9	3/16/53	11.3
/ 8/49	10.6	12/ 1/49	22.4	7/ 1/50	23.5		
/ 2/49	16.6	1/ 3/50	21.3	8/ 1/50	27.6		

N/9W-2B1—Reference point—southeast corner of pump base, elevation 1,341.9 feet. East side of Soda Bay Drive, 0.07 mile south of Soda Bay Road.

Date	Depth to water	Date	Depth to water	Date	Depth to water
/20/48	16.8	3/28/50	7.7	11/ 7/52	17.3
/16/49	5.4	10/30/50	18.4	3/16/53	8.3
/27/49	19.4	3/28/51	6.1	10/20/53	16.9
/14/49	19.3	11/ 6/51	18.6		

N/9W-2B2—Reference point—top of wood pit curb, elevation 1,340.9 feet. East side of Soda Bay Drive, 0.14 mile south of Soda Bay Road.

Date	Depth to water	Date	Depth to water	Date	Depth to water
/16/49	3.7	3/28/50	6.4	3/16/53	5.3
/27/49	17.8	3/28/51	4.7		
/14/49	17.7	4/ 8/52	4.6		

N/9W-2E1—Reference point—top of casing, elevation 1,348.9 feet. East side of Benson Lane, 0.49 mile north of Loasa Drive.

Date	Depth to water	Date	Depth to water	Date	Depth to water
/19/48	21.2	11/ 1/50	18.6	11/ 7/52	22.6
/27/49	24.9	3/28/51	6.2	3/16/53	7.0
/14/49	24.5	11/ 6/51	24.0	10/20/53	22.1
/31/50	7.1	4/ 8/52	6.2	3/23/54	5.0

N/9W-2F1—Reference point—pump base, elevation 1,345.6 feet. 0.30 mile south of and 0.25 mile west of intersection of Soda Bay Road and Soda Bay Drive.

Date	Depth to water	Date	Depth to water	Date	Depth to water
/20/48	18.7	3/28/50	7.2	4/ 8/52	5.6
/18/49	4.6	11/ 1/50	19.4	11/ 7/52	19.6
/27/49	21.9	3/28/51	5.8	3/16/53	6.5
/14/49	21.6	11/ 6/51	23.8	10/20/53	19.4

N/9W-2F2—Reference point—top of casing, elevation 1,346.9 feet. 0.39 mile south of and 0.25 mile west of intersection of Soda Bay Drive and Soda Bay Road.

Date	Depth to water	Date	Depth to water	Date	Depth to water
/20/48	20.0	3/28/50	7.8	4/ 8/52	7.6
/18/49	5.3	11/ 1/50	21.4	11/ 7/52	19.6
/27/49	23.4	3/28/51	6.5	3/16/53	5.7
/14/49	23.1	11/ 6/51	23.6	10/20/53	19.3

13N 9W-2F3—Reference point—top of 4" x 4" at top of wood well casing, elevation 1,345.1 feet. 0.22 mile south of and 0.25 mile west of intersection of Soda Bay Road and Soda Bay Drive.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
10/20/48	18.5	11/ 1/50	19.6	4/ 8/52	6.7	10/20/53	19.4
3/18/49	4.9	3/27/51	6.1	11/ 7/52	19.6		
3/28/50	7.5	11/ 6/51	24.0	3/16/53	8.0		

13N 9W-2G1—Reference point—top of wood pit curb, elevation 1,341.5 feet. East side of Soda Bay Drive, 0.26 mile south of Soda Bay Road.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
3/16/49	3.5	3/28/50	6.0	4/ 8/52	4.5	10/20/53	15.8
10/27/49	18.5	3/28/51	4.7	11/ 7/52	16.1		
11/14/49	18.2	11/ 6/51	17.8	3/16/53	5.2		

13N 9W-2G2—Reference point—hole in pump base, elevation 1,341.1 feet. East side of Soda Bay Drive, 0.41 mile south of Soda Bay Road.

Date	Depth to water	Date	Depth to water	Date	Depth to water
10/20/48	14.1	3/28/50	4.4	4/ 8/52	2.9
3/16/49	2.0	10/30/50	17.9	11/ 7/52	15.3
10/27/49	17.7	3/28/51	3.3	3/16/53	3.8
11/14/49	17.9	11/ 6/51	17.3	10/20/53	15.1

13N 9W-2H1—Reference point—top of casing, elevation 1,335.6 feet. South side of Soda Bay Road, 0.28 mile west of intersection of Clarks Drive and Soda Bay Road.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
11/17/48	10.1	7/ 5/49	8.0	3/ 1/50	5.3	3/16/53	2.5
12/15/48	9.6	8/ 2/49	10.0	4/ 4/50	3.5	10/20/53	9.8
1/ 3/49	9.0	9/ 1/49	10.8	4/26/50	3.8	3/23/54	1.2
2/ 1/49	7.5	10/ 1/49	12.3	10/31/50	13.0		
3/ 2/49	5.1	11/ 2/49	12.5	3/27/51	2.3		
4/ 4/49	2.5	12/ 1/49	12.1	11/ 6/51	12.2		
5/ 2/49	3.7	1/ 3/50	11.4	4/ 8/52	1.0		
6/ 2/49	5.2	2/ 1/50	8.9	11/ 7/52	10.7		

13N 9W-2M1—Reference point—base of lower 2" x 4" at bottom of tin pump house, elevation 1,345.2 feet. 0.45 mile south and 0.26 mile west of intersection of Soda Bay Road and Soda Bay Drive.

Date	Depth to water	Date	Depth to water	Date	Depth to water
10/20/48	18.3	3/28/50	5.3	4/ 8/52	4.6
3/18/49	2.6	11/ 1/50	21.2	11/ 7/52	19.5
10/27/49	21.9	3/28/51	4.8	3/16/53	5.7
11/14/49	21.4	11/ 6/51	21.7	10/20/53	19.3

13N 9W-2M2—Reference point—hole in side of pump, elevation 1,349.7 feet. 0.36 mile north and 0.14 mile east of intersection of Loasa Drive and Benson Lane.

Date	Depth to water	Date	Depth to water	Date	Depth to water
10/21/48	22.5	3/31/50	8.7	4/ 8/52	6.9
3/18/49	6.8	11/ 1/50	22.1	11/ 7/52	23.4
10/27/49	26.1	3/28/51	6.8	3/16/53	7.8
11/14/49	25.5	11/ 6/51	21.0	10/20/53	22.1

13N/9W-2M3—Reference point—metal base of pump at edge, elevation 1,351.3 feet. East side of Benson Lane, 0.37 mile north of Loasa Drive.

Date	Depth to water	Date	Depth to water	Date	Depth to water
10/21/48	23.8	3/31/50	11.3	4/ 8/52	8.3
3/18/49	7.7	11/ 1/50	23.3	11/ 7/52	24.6
10/27/49	27.6	3/28/51	8.7	3/16/53	9.0
11/14/49	26.7	11/ 6/51	26.4	10/20/53	24.1

13N/9W-2K1—Reference point—top of concrete around casing under concrete block, elevation 1,341.7 feet. 0.37 mile north and 0.06 mile east of intersection of Soda Bay Drive and Loasa Drive.

Date	Depth to water	Date	Depth to water	Date	Depth to water
3/16/49	1.7	10/27/49	18.1	10/30/50	18.3
6/17/49	9.2	11/14/49	17.7	3/28/51	2.6
6/23/49	10.0	3/28/50	3.8		

DEPTHS TO GROUND WATER AT MEASUREMENT WELLS IN CLEAR LAKE AREA—Continued

(DEPTHS TO WATER IN FEET MEASURED FROM REFERENCE POINT)

13N/9W-2K2—Reference point—hole in pump base, elevation 1,344.7 feet. East side of Soda Bay Drive, 0.29 mile north of intersection of Soda Bay Drive and Loasa Drive.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
10/27/49	20.1	10/30/50	19.9	4/ 8/52	2.7	10/20/53	16.5
11/14/49	19.7	3/28/51	2.9	11/ 7/52	16.6		
3/28/50	4.4	11/ 6/51	22.9	3/16/53	2.9		

13N/9W-2P1—Reference point—top of casing, elevation 1,347.3 feet. 0.1 mile north of and 0.19 mile west of intersection of Soda Bay Drive and Loasa Drive.

Date	Depth to water	Date	Depth to water	Date	Depth to water
10/21/48	17.5	11/14/49	21.8	11/ 7/52	19.0
3/18/49	0.5	3/31/50	2.8	3/16/53	2.7
10/27/49	21.9	3/28/51	2.4		

13N/9W-2P2—Reference point—base of flange elbow in discharge pipe over pit, elevation 1,349.8 feet. North side of Loasa Drive, 0.23 mile west of Soda Bay Drive.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
11/30/48	19.2	6/ 2/49	6.3	12/ 1/49	23.9	11/ 1/50	23.4
1/ 3/49	13.2	7/ 5/49	17.2*	1/ 4/50	19.2	3/28/51	2.6
2/ 1/49	6.9	8/ 2/49	18.9*	2/ 1/50	9.6	11/ 6/51	24.2
3/ 2/49	4.2	9/ 1/49	21.6*	3/ 1/50	4.8	4/ 8/52	2.1
4/ 5/49	3.1	10/ 3/49	25.6*	4/ 4/50	3.8		
5/ 2/49	4.2	11/ 2/49	26.4	4/26/50	4.0		

13N/9W-2Q1—Reference point—base of pump, elevation 1,342.8 feet. East side of Soda Bay Drive, 0.12 mile north of Loasa Drive.

Date	Depth to water	Date	Depth to water	Date	Depth to water
10/21/48	14.9	3/28/50	1.8	4/ 8/52	2.9
3/16/49	0.6	10/30/50	17.3	11/ 7/52	14.9
10/27/49	19.0	3/28/51	0.0	3/16/53	0.2
11/14/49	16.7	11/ 6/51	16.0	10/20/53	14.8

13N/9W-2R1—Reference point—ground level, elevation 1,344.0 feet. 0.02 mile north and 0.3 mile east of intersection of Soda Bay Drive and Loasa Drive.

Date	Depth to water	Date	Depth to water	Date	Depth to water
3/21/49	0.5	10/31/50	12.6	11/ 6/52	12.0
10/28/49	11.4	3/27/51	3.6	3/16/53	4.1
11/14/49	12.0	11/ 6/51	19.4	10/20/53	11.3
3/31/50	4.5	4/ 8/52	2.7		

13N/9W-3D1—Reference point—top of casing, elevation 1,343.8 feet. 0.15 mile south and 0.06 mile east of 90° bend in Soda Bay Road, from south to east.

Date	Depth to water	Date	Depth to water	Date	Depth to water
11/ 2/48	14.3	11/15/49	17.6	11/ 6/52	16.6
3/ 9/49	4.1	3/28/50	4.3	3/18/53	3.5
10/26/49	18.0	3/27/51	3.0	10/20/53	15.4

13N/9W-3C1—Reference point—lower edge of flange over discharge column in pit, elevation 1,346.2 feet. West side of Park Drive, 0.24 mile south of Soda Bay Road.

Date	Depth to water	Date	Depth to water
10/21/48	14.2	3/ 9/49	7.4

13N/9W-3B1—Reference point—hole in pump base, elevation 1,349.0 feet. 0.03 mile south and 0.1 mile east of corner of Soda Bay Road and Park Drive.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
10/19/48	22.0	5/ 2/49	14.3	3/ 1/50	13.3	11/ 7/52	23.3
11/30/48	21.4	6/ 1/49	16.4	4/ 4/50	12.4	3/17/53	10.0
1/ 3/49	18.2	7/ 5/49	21.5	4/26/50	13.8	10/20/53	22.8
2/ 1/49	15.2	8/ 2/49	23.9	10/31/50	22.3		
3/ 2/49	13.2	1/ 4/50	18.3	3/27/51	9.9		
4/ 4/49	11.1	2/ 1/50	16.3	11/ 6/51	24.5		

13N/9W-3A1—Reference point—top of lowest 2" x 8" under pump on north side, elevation 1,351.3 feet. 0.19 mile south and 0.25 mile east of intersection of Soda Bay Road and Park Drive.

Date	Depth to water	Date	Depth to water	Date	Depth to water
10/20/48	16.6	11/16/49	27.0	3/ 7/52	12.0
3/15/49	4.0	3/28/50	12.7	10/20/53	24.9
10/26/49	27.3	11/ 6/52	25.5		

13N/9W-3E1—Reference point—top of casing, elevation 1,347. feet. North side of Finley Road, 0.42 mile west of Park Drive.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
10/28/48	17.4	3/28/50	5.5	4/ 7/52	4.5	10/20/53	18.
3/15/49	3.7	11/ 2/50	19.5	11/ 6/52	18.4	3/23/54	2.
10/27/49	20.9	3/28/51	4.5	3/18/53	5.0		
11/16/49	20.9	11/ 6/51	20.5				

13N/9W-3H1—Reference point—top of casing, elevation 1,351. feet. West bank of Kelsey Creek, 0.25 mile south and 0.34 mile east of corner of Soda Bay Road and Park Drive.

Date	Depth to water	Date	Depth to water	Date	Depth to water
10/20/48	23.5	3/28/50	11.7	4/ 7/52	10.0
3/15/49	10.2	10/31/50	22.2	11/ 7/52	25.8
10/27/49	26.8	3/28/51	10.3	3/17/53	11.2
11/16/49	26.4	11/ 6/51	25.9	10/20/53	24.5

13N/9W-3H2—Reference point—top of casing in pit, elevation 1,345.2 feet. East bank of Kelsey Creek, 0.29 mile south and 0.07 mile west of east-to-south right angle bend in Soda Bay Road.

Date	Depth to water	Date	Depth to water
10/20/48	17.8	10/28/49	21.1
3/16/49	3.7		

13N/9W-3H3—Reference point—top of casing in pit 5 feet below ground, elevation 1,350.0 feet. Near east bank of Kelsey Creek, 0.11 mile north and 0.33 mile east of intersection of Park Drive and Finley Road.

Date	Depth to water	Date	Depth to water	Date	Depth to water
10/28/49	23.3	11/ 2/50	21.8	11/ 7/52	26.3
11/16/49	23.0	11/ 6/51	27.7	3/17/53	11.7
4/ 4/50	6.8	4/ 7/52	10.7	10/20/53	26.1

13N/9W-3J2—Reference point—top of casing, elevation 1,355.3 feet. Near east side of Kelsey Creek, 0.29 mile east and slightly south of corner of Park Drive and Finley Road.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
10/21/48	26.9	11/15/49	30.4	4/ 7/52	9.7	10/20/53	29.7
3/16/49	10.6	3/31/50	12.4	11/ 7/52	28.0		
10/27/49	30.9	3/28/51	11.5	3/16/53	12.5		

13N/9W-3J3—Reference point—top of casing, elevation 1,351.0 feet. Near east bank of Kelsey Creek, 0.18 mile south and 0.25 mile east of corner Park Drive and Finley Road.

Date	Depth to water	Date	Depth to water	Date	Depth to water
10/21/48	22.2	3/31/50	6.4	11/ 7/52	24.2
3/21/49	3.7	11/ 1/50	13.1	3/16/53	7.0
10/27/49	26.4	11/ 6/51	26.5	10/20/53	24.1
11/15/49	25.9	4/ 7/52	5.3		

13N/9W-3J4—Reference point—top of casing, elevation 1,357.3 feet. East side Kelsey Creek, 0.25 mile north and 0.25 mile west of intersection of Benson Lane and Loasa Drive.

Date	Depth to water	Date	Depth to water	Date	Depth to water
10/21/48	28.2	3/31/50	11.2	4/ 7/52	13.0
3/21/49	9.4	11/ 1/50	16.6	11/ 7/52	30.2
10/27/49	32.4	3/28/51	10.9	3/16/53	11.5
11/14/49	31.9	11/ 6/51	33.5	10/20/53	29.4

13N/9W-3R1—Reference point—top of casing, elevation 1,358.4 feet. 0.04 mile north and 0.15 mile west of intersection of Benson Lane and Loasa Drive.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
10/24/48	28.9	4/10/50	9.4	11/ 1/50	22.5	3/16/53	9.5
3/21/49	7.5	4/25/50	9.8	3/28/51	9.2	10/20/53	29.6
10/27/49	33.5	6/ 2/50	12.8	11/ 6/51	31.7		
11/16/49	32.4	7/ 1/50	29.4*	4/ 7/52	9.0		
3/31/50	9.6	8/ 1/50	32.6*	11/ 7/52	29.3		

13N/9W-4D1—Reference point—hole in pump base, elevation 1,345.5 feet. 0.43 mile south and 0.05 mile east of intersection of Soda Bay Road and Park Drive, north of town of Finley.

Date	Depth to water	Date	Depth to water	Date	Depth to water
10/28/48	17.3	3/28/50	8.9	4/ 2/52	3.8
3/15/49	8.6	11/ 2/50	20.1	3/18/53	5.2
10/26/49	21.6	3/28/51	4.2	10/20/53	19.8
11/16/49	18.9	11/ 6/51	19.6	3/23/54	2.4

DEPTHS TO GROUND WATER AT MEASUREMENT WELLS IN CLEAR LAKE AREA—Continued

(DEPTHS TO WATER IN FEET MEASURED FROM REFERENCE POINT)

3N/9W-4G1—Reference point—top of casing, elevation 1,345.3 feet. 0.02 mile north and 0.51 mile east of intersection of Finley Road east and Stone Drive in town of Finley.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
0/28/48	15.9	3/28/50	4.7	4/ 3/52	2.2		
3/15/49	4.3	11/ 2/50	17.4	11/ 6/52	18.5		
0/27/49	18.5	3/28/51	1.6	3/17/53	2.1		
1/16/49	17.1	11/ 6/51	20.2	10/20/53	17.6		

3N 9W-4N1—Reference point—top of casing, elevation 1,353.7 feet. 0.02 mile northeast of south-to-southeast angle bend in State Highway 29, approximately ¼ mile south of town of Finley.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
1/ 2/48	11.3	3/31/50	4.4	11/ 6/52	16.8		
3/12/49	3.7	11/ 2/50	12.7	3/18/53	2.8		
0/28/49	15.7	3/28/51	5.1	10/20/53	15.1		
1/16/49	13.8	4/ 3/52	2.0				

3N/9W-4N2—Reference point—top of casing, elevation 1,357.2 feet. 0.29 mile south and 0.03 mile east of intersection of Finley Road and Stone Drive in town of Finley.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
3/15/49	5.8	10/26/49	20.0				

3N 9W-4P1—Reference point—top of casing, elevation 1,353.4 feet. 0.02 mile north and 0.1 mile west of east-to-south right angle bend in State Highway 29, approximately ½ mile southeast of town of Finley.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
1/ 2/48	17.3	3/31/50	8.2	4/ 3/52	3.5		
3/12/49	8.4	10/31/50	20.7	11/ 6/52	19.5		
0/28/49	19.6	3/28/51	4.5	3/18/53	4.8		
1/16/49	19.7	11/ 6/51	22.7	10/20/53	17.9		

3N 9W-4Q1—Reference point—top of casing, elevation 1,352.9 feet. 0.04 mile north and 0.07 mile east of east-to-south right angle bend in State Highway 29, approximately ½ mile southeast of town of Finley.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
3/12/49	7.6	11/ 2/50	21.9	11/ 6/52	20.3		
0/28/49	22.3	3/28/51	5.3	3/18/53	6.1		
1/16/49	21.1	11/ 6/51	21.5	10/20/53	21.6		
3/31/50	7.6	4/ 3/52	4.6				

3N/9W-5D1—Reference point—notch in casing 0.5 feet below top of casing, elevation 1,342.5 feet. 0.03 mile north and 0.07 mile east of intersection of State Highway 29 and Highland Springs Road.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
0/29/48	17.6	4/ 4/50	10.0	10/19/53	17.1		
3/15/49	8.8	3/27/51	6.1				
0/26/49	15.7	3/17/53	6.2				

3N/9W-5C1—Reference point—base of pump, elevation 1,346.0 feet. North side of State Highway 29, 0.11 mile west of east-to-south right angle bend, approximately 0.1 mile north of Clear Lake Grange.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
0/28/48	18.3	4/ 4/50	11.7	11/ 7/52	18.4		
0/26/49	19.9	3/29/51	6.4	3/17/53	8.0		
1/15/49	17.3	4/ 3/52	5.5	10/20/53	12.8		

3N/9W-5M1—Reference point—base of pump, elevation 1,351.6 feet. 0.05 mile east of Highland Springs Road and 0.5 mile north of Argonaut Road.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
0/29/48	16.8	3/31/50	9.7	4/ 3/52	9.5		
3/15/49	5.7	10/31/50	18.7	11/ 7/52	15.8		
0/26/49	18.6	3/27/51	9.0	3/17/53	7.6		
1/15/49	18.7	11/ 6/51	15.6	10/19/53	15.0		

3N/9W-5P1—Reference point—top of casing under pump, elevation 1,354.4 feet. West side of dirt road, 0.25 mile south of intersection with State Highway 29, ½ mile west of town of Finley.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
1/ 3/48	18.1	7/ 1/50	47.3*	10/29/53	26.3		
4/25/50	11.9	8/ 1/50	45.6*				
5/ 2/50	13.4	11/ 6/52	22.5				

13N/9W-6B1—Reference point—hole in pump base, elevation 1,340.4 feet. 0.06 mile south and 0.32 mile west of intersection of State Highway 29 and Soda Bay Road.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
11/ 1/48	12.7	7/ 5/49	12.9	3/ 1/50	7.4	3/18/53	5.0
11/30/48	12.4	8/ 1/49	15.6	4/ 4/50	5.9	10/19/53	14.1
1/ 3/49	11.7	9/ 1/49	15.6	4/26/50	6.1	3/23/54	2.9
2/ 1/49	10.8	10/ 1/49	14.5	10/30/50	14.7		
3/ 2/49	9.4	11/ 2/49	14.7	3/27/51	4.3		
4/ 4/49	4.7	12/ 1/49	13.4	11/ 6/51	13.6		
5/ 3/49	6.0	1/ 4/50	12.8	4/ 3/52	4.0		
6/ 1/49	11.4	2/ 1/50	10.7	11/ 7/52	9.6		

13N/9W-6F1—Reference point—base of pump, elevation 1,364.3 feet. 0.53 mile north and 0.1 mile east of intersection of Ackley Drive and Mathews Road near west edge of Big Valley.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
11/ 3/48	14.4	10/26/49	13.7	4/ 3/50	11.0		
3/15/49	9.7	11/15/49	14.3				

13N/9W-6N1—Reference point—top of casing, elevation 1,375.3 feet. 0.06 mile north and 0.09 mile west of intersection of Ackley Drive and Mathews Road near west edge of Big Valley.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
11/ 3/48	10.2	6/ 2/49	10.4*	1/ 3/50	11.5	11/ 4/52	10.8
11/30/48	10.8	7/ 6/49	12.3*	2/ 1/50	3.8	3/18/53	2.2
1/10/49	6.8	8/ 2/49	13.8*	3/ 1/50	1.7	10/19/53	10.0
2/ 2/49	4.7	9/ 2/49	9.6	4/ 3/50	1.5		
3/ 2/49	1.9	10/ 3/49	10.5	4/26/50	2.1		
4/ 4/49	2.1	11/ 2/49	11.1	10/30/50	10.3		
5/ 3/49	10.8*	12/ 2/49	11.4	3/27/51	1.6		

13N/9W-7E1—Reference point—top of concrete block beneath hand pump about 2 feet above ground, elevation 1,394.3 feet. 0.4 mile south and 0.2 mile west of corner of Mathews Road and Ackley Drive.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
11/ 1/48	14.6	11/15/49	15.6	3/27/51	2.3	10/19/53	13.9
3/15/49	2.4	4/ 3/50	2.8	11/ 6/51	14.2		
10/26/49	16.3	10/30/50	15.0	3/18/53	8.6		

13N/9W-8C1—Reference point—top of casing, elevation 1,361.3 feet. In northwest corner of intersection of Argonaut Road and private dirt road north to State Highway 29.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
11/ 2/48	12.6	10/26/49	15.3	3/28/51	4.5	3/17/53	5.4
3/15/49	6.2	11/15/49	14.9	11/ 6/51	16.0	10/21/53	16.3
6/29/49	13.8	3/31/50	6.9	4 /3/52	1.0		
7/ 6/49	13.6	10/30/50	15.1	11/ 7/52	16.4		

13N/9W-8C2—Reference point—top of casing, elevation 1,359.9 feet. 0.06 mile north and 0.36 mile east of intersection of Argonaut Road and Highland Springs Road.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
3/15/49	5.0	3/31/50	5.5	11/ 6/52	4.5		
10/26/49	13.6	3/28/51	3.0	3/17/53	4.0		
11/15/49	13.6	4/ 3/52	3.8	10/21/53	15.1		

13N/9W-8A2—Reference point—top of casing, elevation 1,365.4 feet. North side of Argonaut Road, 0.21 mile west of Thomas Drive, south of town of Finley.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
4/13/49	12.9	10/ 3/49	18.2	3/28/51	8.0	3/17/53	8.5
6/ 2/49	15.0	11/ 2/49	18.7	11/ 5/51	20.4	10/20/53	17.4
9/ 2/49	18.1	12/ 2/49	18.1	4/ 3/52	7.4		

13N/9W-8E1—Reference point—top of casing, elevation 1,359.2 feet. At walnut dehydrator plant in southeast corner of intersection of Argonaut Road and Highland Springs Road.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
10/29/48	8.6	6/ 2/49	4.8	1/ 3/50	8.5	11/ 6/51	10.8
11/30/48	7.8	7/ 6/49	7.3	3/21/50	4.9	4/ 3/52	2.8
1/ 3/49	6.1	8/ 2/49	9.7	3/ 1/50	3.2	3/17/53	3.0
2/ 1/49	5.5	9/ 2/49	10.0	4/ 3/50	2.7	10/19/53	11.0
3/ 3/49	1.8	10/ 3/49	10.3	4/26/50	3.3		
4/ 4/49	3.1	11/ 2/49	10.1	11/ 1/50	8.9		
5/ 3/49	3.8	12/ 2/49	9.2	3/29/51	2.8		

DEPTHS TO GROUND WATER AT MEASUREMENT WELLS IN CLEAR LAKE AREA—Continued

(DEPTHS TO WATER IN FEET MEASURED FROM REFERENCE POINT)

13N/9W-8K1—Reference point—hole in pump base, elevation 1,372.8 feet. 0.43 mile south and 0.06 mile east of intersection of Davis Drive and Argonaut Road, approximately ¾ mile southwest of town of Finley.

Date	Depth to water	Date	Depth to water	Date	Depth to water
11/ 3/48	14.9	3/31/50	8.4	4/ 8/52	7.4
3/15/49	7.4	11/ 2/50	15.1	11/ 7/52	16.0
10/26/49	18.0	3/29/51	8.0	3/17/53	7.5
11/16/49	17.0	11/ 5/51	17.4	10/20/53	16.9

13N/9W-8K3—Reference point—top of casing in pit, elevation 1,365.3 feet. 0.4 mile south and 0.11 mile east of intersection of Davis Drive and Argonaut Road, approximately ¾ mile southwest of town of Finley.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
5/26/49	21.0*	9/ 2/49	11.5	3/29/51	2.1	10/21/53	19.5
6/ 2/49	18.6*	10/ 3/49	12.4	4/ 8/52	1.7		
7/ 1/49	21.3*	11/ 2/49	13.3	11/ 7/52	14.7		
8/ 2/49	17.2*	3/31/50	2.6	3/17/53	2.5		

13N/9W-8N1—Reference point—top of casing inside pump base hole, elevation 1,375.0 feet. 0.09 mile north and 0.08 mile east of intersection of Highland Springs Road and Merritt Lane.

Date	Depth to water	Date	Depth to water	Date	Depth to water
11/ 1/48	7.1	4/ 3/50	4.3	4/ 8/52	3.8
3/15/49	2.6	11/ 1/50	9.5	11/ 6/52	12.0
10/26/49	9.5	3/29/51	3.6	3/17/53	3.0
11/15/49	9.0	11/ 5/51	10.3	10/19/53	10.4

13N/9W-8N2—Reference point—top of casing, elevation 1,377 feet. Inside house 0.04 mile north and 0.04 mile east of intersection of Highland Springs Road and Merritt Lane.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
11/ 1/48	9.4	7/ 6/49	12.0	3/ 1/50	5.9	3/17/53	7.1
11/30/48	9.6	8/ 2/49	18.3	4/ 3/50	5.5	10/19/53	12.7
1/ 3/49	9.4	9/ 2/49	12.8	4/26/50	6.0	3/23/54	6.8
2/ 1/49	8.4	10/ 3/49	12.5	11/ 1/50	11.3		
3/ 2/49	6.7	11/ 3/49	11.2	3/29/51	4.3		
4/ 4/49	4.9	12/ 2/49	11.0	11/ 5/51	11.9		
5/ 3/49	6.5	1/ 3/50	10.9	4/ 8/52	4.2		
6/ 2/49	15.5	2/ 1/50	7.8	11/ 6/52	13.5		

13N/9W-8R1—Reference point—hole in pump base, elevation 1,374.9 feet. North side of Merritt Lane, 0.4 mile east of Davis Drive.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
11/ 1/48	13.8	7/ 6/49	10.9	3/ 1/50	6.9	3/17/53	6.5
11/29/48	14.6	8/ 2/49	12.8	4/ 3/50	6.4	10/20/53	17.3
1/ 3/49	13.9	9/ 2/49	9.9	4/26/50	6.8	3/23/54	4.0
2/ 1/49	10.7	10/ 3/49	16.6	11/ 2/50	13.9		
3/ 3/49	7.3	11/ 2/49	18.1	3/29/51	5.3		
4/ 4/49	6.3	12/ 2/49	18.6	11/ 5/51	19.2		
5/ 3/49	7.1	1/ 3/50	18.9	4/ 8/52	7.2		
6/ 2/49	8.2	2/ 1/50	8.9	11/ 6/52	19.7		

13N/9W-9D1—Reference point—base of pump at edge, elevation 1,359.9 feet. In northeast corner of intersection of Thomas Drive and Argonaut Road, approximately ½ mile south of town of Finley.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
11/ 1/48	11.1	6/ 2/49	24.5*	2/ 1/50	9.2	4/ 3/52	2.7
11/30/48	10.9	7/ 6/49	12.7	3/ 1/50	5.9	11/ 6/52	14.9
1/ 3/49	10.5	9/ 2/49	14.0	4/ 3/50	4.7	3/17/53	3.8
2/ 1/49	9.5	10/ 3/49	14.1	4/26/50	5.3	10/20/53	15.0
3/ 2/49	7.9	11/ 2/49	14.6	10/30/50	13.5		
4/ 4/49	3.8	12/ 2/49	13.5	3/28/51	3.1		
5/ 3/49	6.2	1/ 4/50	13.2	11/ 6/51	16.1		

13N/9W-9D2—Reference point—base of pump, elevation 1,357.4 feet. East side of Thomas Road, 0.12 mile south of State Highway 29.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
4/ 7/49	5.3	9/ 2/49	16.6	10/30/50	14.6	3/18/53	3.9
5/ 3/49	9.4	10/ 3/49	19.0	3/29/51	4.3	10/20/53	16.8
6/ 2/49	39.5*	11/ 2/49	20.5	11/ 6/51	16.8		
7/ 1/49	18.9	12/ 2/49	15.1	4/ 3/52	2.0		
8/ 2/49	42.3*	3/31/50	6.3	11/ 7/52	16.1		

13N/9W-9F1—Reference point—hole in pump base, elevation 1,357.9 feet. 0.04 mile south and 0.46 mile east of intersection of Argonaut Road and Thomas Drive, south of town of Finley.

Date	Depth to water	Date	Depth to water	Date	Depth to water
11/ 2/48	15.9	3/31/50	7.7	4/ 3/52	4.4
3/15/48	7.4	10/30/50	19.5	11/ 6/52	16.8
10/28/48	18.7	3/28/51	5.0	3/17/53	5.9
11/16/49	18.0	11/ 6/51	21.6	10/20/53	17.0

13N/9W-9H1—Reference point—top of casing, elevation 1,352.[illegible] feet. Northeast side of State Highway 29, 0.14 mile northwest from intersection of State Highway 29 and Renfro Drive.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
11/30/48	13.6	7/ 6/49	17.5	2/ 1/50	8.7	3/17/53	3.[illegible]
1/ 3/49	9.9	8/ 2/49	29.5	3/ 1/50	5.1	10/20/53	18.4
2/ 1/49	7.3	9/ 1/49	23.4	4/ 3/50	3.0		
3/ 2/49	5.1	10/ 3/49	21.9	4/26/50	4.0		
4/ 4/49	7.4	11/ 3/49	22.4	10/30/50	20.0		
5/ 2/49	5.8	12/ 2/49	18.2	3/28/51	1.4		
6/ 2/49	10.9	1/ 4/50	15.3	11/ 6/51	17.8		

13N/9W-9Q1—Reference point—top of casing, elevation 1,368.[illegible] feet. 0.08 mile north and 0.37 mile west of intersection of Merritt Lane and Renfro Drive, approximately 1½ miles southeast of town of Finley.

Date	Depth to water	Date	Depth to water	Date	Depth to water
11/ 2/48	9.4	4/ 3/50	4.3	4/ 8/52	4.0
3/15/49	3.3	11/ 2/50	13.4	3/17/53	4.7
10/27/49	12.9	3/29/51	4.4	10/20/53	12.8
11/16/49	12.9	11/ 5/51	11.6		

13N/9W-9R1—Reference point—top of casing, elevation 1,417.[illegible] feet. North side of Merritt Lane, 0.11 mile west of Renfro Drive, approximately 1½ miles southeast of town of Finley.

Date	Depth to water	Date	Depth to water
3/15/49	52.6	10/27/49	55.2

13N/9W-10E1—Reference point—hole in pump side, elevation 1,355.8 feet. Northeast side of State Highway 29, 0.09 mile southeast from intersection of State Highway 29 and Renfro Drive, approximately 1 mile southeast of town of Finley.

Date	Depth to water	Date	Depth to water	Date	Depth to water
11/ 1/48	16.3	11/15/49	17.6	11/ 6/51	17.5
11/30/48	14.2	4/ 3/50	2.6	4/ 3/52	1.6
3/12/49	1.9	10/30/50	19.1	3/17/53	2.1
10/28/49	21.2	3/28/51	1.8	10/20/53	18.3

13N/9W-10G1—Reference point—top of casing, elevation 1,363.3 feet. 0.18 mile north and slightly west of intersection of State Highway 29 and Browns Drive, northwest of Kelseyville.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
10/25/48	28.5	6/ 2/49	10.0	2/ 1/50	7.9	10/30/50	16.6
11/30/48	25.0	7/ 6/49	25.9*	3/ 1/50	7.4	3/28/51	7.3
1/ 3/49	8.4	8/ 2/49	26.1	4/12/50	6.8	11/ 7/52	28.0
2/ 1/49	7.8	9/ 1/49	37.9*	4/25/50	9.0	3/16/53	8.0
3/ 2/49	6.7	10/ 3/49	37.9	6/ 2/50	10.8	10/20/53	29.6
4/ 5/49	6.9	12/ 2/49	26.6	7/ 1/50	15.5		
5/ 2/49	7.4	1/ 4/50	20.4	8/ 1/50	27.2		

13N/9W-10H1—Reference point—hole in pump base, elevation 1,364.1 feet. 0.36 mile south and 0.15 mile west of intersection of Benson Lane and Loasa Drive.

Date	Depth to water	Date	Depth to water	Date	Depth to water
10/24/48	29.2	3/31/50	7.0	4/ 7/52	7.2
3/18/49	5.0	11/ 1/50	19.2	11/ 7/52	28.0
10/27/49	33.8	3/28/51	6.8	3/16/53	7.2
11/16/49	29.4	11/ 5/51	29.1	10/20/53	29.2

DEPTHS TO GROUND WATER AT MEASUREMENT WELLS IN CLEAR LAKE AREA—Continued

(DEPTHS TO WATER IN FEET MEASURED FROM REFERENCE POINT)

13N/9W-10R1—Reference point—top of casing, elevation 1,373.1 feet. 0.07 mile north and 0.54 mile west of east-to-north right angle bend in Soda Bay Drive, ½ mile northeast of Kelseyville.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
10/24/48	18.9	12/ 1/49	14.2	10/ 2/50	34.8	10/20/53	17.8
3/17/49	4.2	3/31/50	5.6	11/ 1/50	18.3	3/23/54	6.0
5/26/49	8.2	4/10/50	5.4	3/28/51	5.8		
6/ 2/49	7.1	4/25/50	5.9	11/ 5/51	17.7		
7/ 1/49	12.8	6/ 2/50	7.2	4/ 8/52	7.0		
8/ 2/49	21.0	7/ 1/50	12.0	11/ 6/52	16.6		
9/ 1/49	23.9	8/ 1/50	24.6	3/16/53	6.7		

13N/9W-11B1—Reference point—top of casing, elevation 1,350.3 feet. 0.24 mile south and 0.11 mile east of intersection of Soda Bay Drive and Loasa Drive.

Date	Depth to water	Date	Depth to water	Date	Depth to water
10/21/48	18.2	11/16/49	20.4	4/ 8/52	2.9
3/16/49	4.5	3/28/50	5.4		
10/28/49	32.3	3/28/51	3.2		

13N/9W-11E1—Reference point—hole in pump base, elevation 1,362.7 feet. 0.47 mile south and 0.02 mile east of intersection of Loasa Drive and Benson Lane.

Date	Depth to water	Date	Depth to water	Date	Depth to water
8/ 2/49	37.2*	11/ 2/49	32.8	4/10/50	5.2
9/ 1/49	46.7*	12/ 1/49	23.4	3/28/51	4.7
10/ 3/49	51.3*	3/31/50	5.6		

13N/9W-11H1—Reference point—hole in pump base, elevation 1,358.8 feet. 0.12 mile north and 0.28 mile east of intersection of Soda Bay Drive and Clarks Drive.

Date	Depth to water	Date	Depth to water	Date	Depth to water
10/21/48	26.2	11/ 2/50	27.2	11/ 6/52	29.0
3/16/49	12.7	3/27/51	10.4	3/16/53	11.8
11/16/49	28.1	11/ 6/51	33.3	10/20/53	27.3
3/31/50	13.6	4/ 8/52	10.2		

13N/9W-11M1—Reference point—hole in side of pump, elevation 1,368.1 feet. 0.25 mile north and 0.46 mile west of east-to-north right angle bend in Soda Bay Drive.

Date	Depth to water	Date	Depth to water	Date	Depth to water
10/24/48	21.2	11/16/49	18.6	11/ 6/52	18.4
3/18/49	2.6	4/ 4/50	3.2	3/16/53	4.7
10/27/49	27.3	3/28/51	3.4	10/20/53	20.1

13N/9W-11Q1—Reference point—base of pump at edge, elevation 1,376.8 feet. 0.02 mile north and 0.04 mile east of east-to-north right angle bend in Soda Bay Drive.

Date	Depth to water	Date	Depth to water
10/24/48	33.4	11/16/49	36.8
3/17/49	5.5		

13N/9W-12D1—Reference point—hole in side of pump base, elevation 1,347.3 feet. North side of Clarks Drive, 0.12 mile south of Loasa Drive.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
10/20/48	18.5	5/ 2/49	20.8	4/ 4/50	10.2	3/16/53	7.8
11/30/48	17.4	11/ 2/49	23.4	4/26/50	10.7	10/20/53	19.7
1/ 3/49	15.2	12/ 1/49	19.5	10/31/50	21.3		
2/ 1/49	13.4	1/ 3/50	17.9	3/27/51	7.4		
3/ 2/49	11.8	2/ 1/50	14.2	11/ 6/51	19.0		
4/ 5/49	11.2	3/ 1/50	11.4	11/ 6/52	21.9		

13N/9W-12E1—Reference point—base of pump at north side, elevation 1,351.8 feet. 0.04 mile east of right angle bend in Clarks Drive.

Date	Depth to water	Date	Depth to water
10/21/48	22.2	10/28/49	28.7
3/16/49	13.6	11/16/49	25.8

13N/9W-12M1—Reference point—base of pump at hole, elevation 1,358.5 feet. South side of private dirt road, south 0.1 mile from right angle bend in Clarks Drive.

Date	Depth to water	Date	Depth to water	Date	Depth to water
10/21/48	26.9	3/31/50	18.5	11/ 6/52	31.0
3/16/49	18.4	10/31/50	29.6	3/16/53	16.7
10/28/49	32.4	3/27/51	16.2	10/20/53	27.4
11/16/49	31.1	11/ 5/51	27.4		

13N/9W-12M2—Reference point—base of pump, elevation 1,357.9 feet. 0.21 mile south and 0.05 mile east of right angle bend in Clarks Drive.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
10/21/48	25.5	7/ 1/49	28.9	2/ 1/50	20.5	4/ 3/52	7.0
1/ 3/49	21.4	8/ 2/49	34.9	3/ 1/50	18.1	11/ 6/52	28.4
2/ 1/49	20.0	9/ 1/49	50.6*	4/ 4/50	16.8	3/16/53	14.8
3/ 2/49	18.3	10/ 1/49	32.0	4/26/50	17.1	10/20/53	25.5
4/ 5/49	19.0	11/ 2/49	29.1	10/31/50	27.9	3/23/54	13.9
5/ 2/49	29.0	12/ 1/49	26.0	3/27/51	14.4		
6/ 2/49	29.9	1/ 3/50	24.6	11/ 5/51	25.8		

13N/9W-14D1—Reference point—base of pump, elevation 1,377.3 feet. 0.04 mile east and 0.05 mile south of intersection of Soda Bay Drive and 3rd Street, approximately ¼ mile north of town of Kelseyville.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
10/25/48	22.8	6/ 2/49	11.1	2/ 1/50	10.1	11/ 6/52	19.6
11/30/48	16.0	7/ 6/49	18.5	3/ 1/50	8.4	3/16/53	8.4
1/ 3/49	10.3	8/ 2/49	24.4	4/ 4/50	10.4	10/20/53	21.4
2/ 1/49	10.0	9/ 1/49	26.1	4/26/50	9.1		
3/ 1/49	8.9	10/ 3/49	23.2	11/ 1/50	20.4		
4/ 5/49	8.7	12/ 2/49	16.6	3/28/51	8.8		
5/ 2/49	9.3	1/ 3/50	17.8	11/ 5/51	18.4		

13N/9W-14L1—Reference point—top of casing under pump house, elevation 1,400.6 feet. 0.25 mile south and 0.04 mile west of intersection of Oakdale Drive and State Highway 29 in town of Kelseyville.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
11/ 1/48	18.1	7/ 6/49	29.3	4/ 3/50	17.1	11/ 6/52	26.7
11/30/48	17.5	9/ 2/49	28.7	4/12/50	17.1	3/17/53	17.8
1/ 3/49	20.4	10/ 3/49	25.5	4/25/50	17.8	10/20/53	26.6
2/ 1/49	20.6	11/ 3/49	22.0	6/ 2/50	22.1		
3/ 1/49	20.1	12/ 2/49	19.9	11/ 1/50	24.3		
4/ 5/49	19.8	1/ 4/50	19.3	3/27/51	20.8		
5/ 3/49	21.2	2/ 1/50	17.9	11/ 5/51	24.0		
6/ 2/49	24.5*	3/ 1/50	17.3	4/ 8/52	20.0		

13N/9W-15B1—Reference point—top of casing of south well outside pump house, elevation 1,376.4 feet. West side of Kelsey Creek, 0.15 mile south and 0.08 mile east of intersection of new State Highway 29 and Merritt Road, approximately ½ mile west of Kelseyville.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
3/17/49	5.6	3/31/50	7.5	11/ 5/51	15.4	3/16/53	8.3
10/27/49	22.3	11/ 1/50	11.2	4/ 8/52	8.6		
11/15/49	11.5	3/27/51	7.4	11/ 6/52	18.5		

13N/9W-15B2—Reference point—top of casing of north well in pump house, elevation 1,376.7 feet. West side of Kelsey Creek, 0.15 mile south and 0.08 mile east of intersection of new State Highway 29 and Merritt Road, approximately ½ mile west of Kelseyville.

Date	Depth to water	Date	Depth to water	Date	Depth to water
10/25/48	21.1	3/31/50	7.2	4/ 8/52	8.3
3/17/49	5.5	11/ 1/50	8.9	11/ 6/52	18.2
10/27/49	22.1	3/27/51	7.1	3/16/53	8.6
11/15/49	11.3	11/ 5/51	15.8	10/20/53	16.7

13N/9W-15K1—Reference point—hole in side of casing, elevation 1,431.1 feet. 0.03 mile south and 0.02 mile west of intersection of Bell Hill Road and Staheli Drive, slightly south of town of Kelseyville.

Date	Depth to water	Date	Depth to water	Date	Depth to water
11/ 4/48	39.7	3/ 1/50	37.8	4/ 8/52	35.6
3/21/49	36.3	11/ 1/50	44.1	11/ 6/52	39.7
10/28/49	41.4	3/28/51	36.2	3/17/53	33.9
11/15/49	42.9	11/ 5/51	39.3		

13N/9W-15N1—Reference point—rim of concrete lining, elevation 1,413.9 feet. 0.4 mile south and 0.19 mile west of intersection of Bell Hill Road and Gold Dust Drive, approximately 1 mile west of town of Kelseyville.

Date	Depth to water	Date	Depth to water	Date	Depth to water
11/ 4/48	15.1	3/31/50	14.6	4/ 8/52	11.0
3/21/49	13.6	11/ 1/50	16.0	11/ 6/52	13.8
10/28/49	15.7	3/28/51	12.8	3/17/53	10.8
11/16/49	15.6	11/ 5/51	15.0	10/19/53	13.4

DEPTHS TO GROUND WATER AT MEASUREMENT WELLS IN CLEAR LAKE AREA—Continued

(DEPTHS TO WATER IN FEET MEASURED FROM REFERENCE POINT)

13N/9W-16B1—Reference point—hole in pump base, elevation 1,378.9 feet. North side of Holdenreid Road, 0.24 mile east of intersection of Holdenreid Road and Smith Lane, approximately 1½ miles south of town of Finley.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
4/12/50	5.4	6/ 2/50	8.4				
4/25/50	6.1	11/ 2/50	14.9				

13N/9W-16A1—Reference point—base of pump, elevation 1,411.1 feet. 0.02 mile south and 0.15 mile west of intersection of Merritt Lane and Renfro Drive.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
11/ 2/48	46.0	10/27/49	48.6	4/ 3/50	45.8		
3/15/49	45.8	11/16/49	47.2	11/ 2/50	48.9		

13N/9W-16E2—Reference point—top of casing, under pump on south side, elevation 1,379.4 feet. North side of Smith Lane, 0.12 mile west of south-to-west right angle bend in Smith Lane.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
4/ 7/49	3.4	9/ 2/49	17.0	11/ 2/50	13.4	3/17/53	3.6
5/ 3/49	5.9	10/ 3/49	14.9	3/29/51	3.6	10/20/53	13.2
6/ 2/49	13.0	11/ 2/49	14.0	11/ 5/51	12.9		
7/ 1/49	16.3	12/ 2/49	13.3	4/ 8/52	2.3		
8/ 2/49	27.5	4/ 3/50	3.4	11/ 7/52	13.4		

13N/9W-16F2—Reference point—hole in pump base, elevation 1,384.5 feet. 0.23 mile south and 0.21 mile east of intersection of Smith Lane and Holdenreid Road.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
4/12/49	34.3*	8/ 2/49	39.4*	4/ 3/50	5.7	10/20/53	14.3
5/ 3/49	6.5	9/ 2/49	19.4	3/29/51	5.5		
6/ 2/49	16.3	10/ 3/49	17.6	4/ 8/52	5.2		
7/ 1/49	21.1	11/ 2/49	16.6	3/17/53	5.5		

13N/9W-16H1—Reference point—hole in side of pump, elevation 1,412.0 feet. West side of Renfro Drive, north of intersection of Renfro Drive and Bell Hill Road.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
11/ 1/48	25.5	7/ 6/49	27.8	2/ 1/50	26.3	4/ 8/52	24.9
11/30/48	25.6	8/ 2/49	26.7	3/ 1/50	24.8	11/ 6/52	34.0
1/ 3/49	25.6	9/ 2/49	25.8	4/ 4/50	24.8	3/17/53	21.2
2/ 1/49	25.7	10/ 3/49	26.1	4/26/50	25.3	10/20/53	24.2
3/ 1/49	25.6	11/ 2/49	26.7	11/ 1/50	26.5	3/23/54	21.1
4/ 4/49	25.0	12/ 2/49	26.2	3/28/51	23.1		
5/ 3/49	24.4	1/ 3/50	26.7	11/ 5/51	25.0		

13N/9W-16M1—Reference point—pipe in concrete base at north edge, elevation 1,394.0 feet. North side of Hummel Lane, 0.52 mile west of intersection of Hummel Lane and Bell Hill Road.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
11/ 1/48	15.4	9/ 2/48	20.3	4/25/50	11.7	4/ 8/52	10.2
3/21/48	11.1	10/ 3/48	19.8	6/ 2/50	13.5	11/ 6/52	25.2
4/12/48	7.1	10/21/48	17.4	7/ 1/50	21.7	3/17/53	11.3
5/ 3/48	14.2	11/ 2/48	16.7	8/ 1/50	27.2	10/19/53	21.3
6/ 2/48	15.0	12/ 2/49	15.8	11/ 1/50	18.3		
7/ 1/48	29.2	3/31/50	12.0	3/28/51	10.6		
8/ 2/48	41.7	4/12/50	11.6	11/ 5/51	19.4		

13N/9W-16Q1—Reference point—hole in board beside base of hand pump, elevation 1,405.9 feet. 0.03 mile northwest of Bell Hill Road at point 0.14 mile southwest along road from intersection of Bell Hill Road and Hummel Lake.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
11/ 4/48	23.0	6/ 2/49	23.1	1/ 3/50	27.1	11/ 5/51	22.1
11/30/48	23.2	7/ 7/49	24.8	2/ 1/50	22.6	4/ 8/52	14.5
1/ 3/49	23.1	8/ 2/49	24.6	3/ 1/50	20.0	11/ 6/52	20.9
2/ 1/49	23.2	9/ 2/49	24.2	4/ 4/50	19.9		
3/ 1/49	22.5	10/ 3/49	23.8	4/26/50	19.8		
4/ 5/49	19.2	11/ 2/49	26.4	11/ 1/50	24.2		
5/ 3/49	20.7	12/ 2/49	25.6	3/28/51	16.4		

13N/9W-17D1—Reference point—top of casing, elevation 1,383.3 feet. East side of Highland Springs Road, 0.19 mile south of intersection of Highland Springs Road and Merritt Lane.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
11/ 3/48	9.2	11/15/49	10.7	3/29/51	4.1	11/ 7/52	10.0
3/15/49	4.2	3/31/50	4.3	11/ 5/51	10.9	3/17/53	4.3
10/26/49	10.5	11/ 2/50	9.8	4/ 8/52	4.1	10/19/53	9.4

13N/9W-17C1—Reference point—top of casing, elevation 1,377.5 feet. 0.24 mile south and 0.45 mile east of intersection of Highland Springs Road and Merritt Lane.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
3/15/49	0.5	11/ 2/50	6.8	11/ 6/52	11.5		
10/26/49	10.2	3/29/51	0.7	3/17/53	Flowing		
11/15/49	10.6	11/ 5/51	10.7	10/20/53	9.6		
3/31/50	0.4	4/ 8/52	0.8				

13N/9W-17B1—Reference point—top of casing, elevation 1,381.5 feet. 0.21 mile south and 0.05 mile east of intersection of Merritt Lane and Davis Drive near west bank of Adobe Creek.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
11/ 3/48	14.3	3/31/50	6.0	4/ 8/52	6.1		
3/15/49	5.1	11/ 2/50	9.0	11/ 6/52	17.2		
10/26/49	16.6	3/29/51	6.4	3/17/53	6.4		
11/15/49	16.4	11/ 5/51	16.6	10/20/53	15.9		

13N/9W-17A1—Reference point—hole in pump base, northwest side, elevation 1,382.7 feet. 0.15 mile south of Merritt Lane and 0.24 mile east of Davis Drive, on east side of Adobe Creek.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
5/10/49	9.4	9/ 2/49	16.5	4/ 3/50	7.8		
6/ 2/49	11.0	10/ 3/49	15.9	3/29/51	6.6		
7/ 1/49	41.0*	11/ 2/49	13.0	10/20/53	16.8		
8/ 2/49	56.1*	12/ 2/49	12.0				

13N/9W-17L1—Reference point—hole in pump base, elevation 1,388.7 feet. 0.13 mile north and 0.47 mile east of south-to-west right angle bend in Highland Springs Road.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
11/ 3/48	16.3	6/ 2/49	7.9	1/ 3/50	18.3	11/ 6/52	5.0
11/30/48	17.4	7/ 6/49	12.3*	2/ 1/50	5.2	3/17/53	5.8
1/ 3/49	11.7	8/ 2/49	14.0	3/ 1/50	4.7	10/19/53	16.7
2/ 2/49	8.8	9/ 2/49	18.7*	4/ 4/50	4.8		
3/ 3/49	3.7	10/ 3/49	17.0	4/26/50	5.0		
4/ 5/49	4.7	11/ 2/49	18.5	3/29/51	5.4		
5/ 3/49	5.7	12/ 2/49	18.3	4/ 8/52	5.0		

13N/9W-17N1—Reference point—top of casing, elevation 1,388.9 feet. 0.11 mile south and 0.16 mile east of south-to-west right angle bend of Highland Springs Road.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
11/ 1/48	12.9	3/31/50	+0.2	4/ 8/52	+0.3		
3/21/49	+0.8	11/ 2/50	12.9	11/ 6/52	15.1		
10/26/49	14.9	3/29/51	0.1	3/11/53	+0.1		
11/15/49	15.3	11/ 5/51	15.1	10/19/53	13.1		

13N/9W-20D1—Reference point—top of casing, elevation 1,394.7 feet. 0.60 mile north and 0.18 mile east of intersection of Highland Springs Road and Bell Hill Road.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
3/21/49	0.7	11/ 2/50	11.7	11/ 6/52	7.0		
10/26/49	16.4	3/29/51	1.0	3/17/53	1.0		
11/15/49	14.9	11/ 5/51	6.4	10/19/53	14.5		
3/31/50	0.7	4/ 8/52	0.2				

13N/9W-20D2—Reference point—top of casing, elevation 1,395 feet. 1.1 mile south of Merritt Road and 0.25 mile east of Highland Springs Road.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
11/15/49	6.1	11/ 2/50	3.1	11/ 6/52	2.8		
1/31/50	Flowing	3/29/51	Flowing	3/17/53	Flowing		
3/31/50	Flowing	4/ 8/52	Flowing	10/19/53	12.8		

DEPTHS TO GROUND WATER AT MEASUREMENT WELLS IN CLEAR LAKE AREA—Continued

(DEPTHS TO WATER IN FEET MEASURED FROM REFERENCE POINT)

13N/9W-20E1—Reference point—base of flange of discharge pipe outside south side of wood crib, elevation 1,400.3 feet. 0.39 mile north and 0.15 mile east of intersection of Bell Hill Road and Highland Springs Road.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
11/ 3/48	17.3	3/31/50	3.5	11/ 6/52	16.3		
3/21/49	2.8	11/ 2/50	13.4	3/17/53	3.6		
10/26/49	17.7	3/29/51	3.8	10/19/53	17.1		
11/15/49	17.6	4/ 8/52	3.5				

13N/9W-20E2—Reference point—top of casing, elevation 1,402.0 feet. 0.32 mile north and 0.17 mile east of intersection of Bell Hill Road and Highland Springs Road.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
3/21/49	3.3	3/31/50	3.8	4/ 8/52	5.0	10/19/53	16.9
10/26/49	9.3	11/ 2/50	10.0	11/ 6/52	19.1		
11/15/49	12.1	3/29/51	4.9	3/17/53	5.0		

13N/9W-20F1—Reference point—top of flooring, elevation 1,405.9 feet. 0.02 mile north and 0.08 mile west of right angle from north to east of Bell Hill Road.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
11/ 4/48	13.6	3/31/50	7.1	4/ 8/52	7.5		
3/21/49	5.3	11/ 1/50	14.9	11/ 6/52	14.6		
10/28/49	15.8	3/28/51	7.6	3/17/53	7.5		
11/15/49	15.1	11/ 5/51	14.9	10/19/53	14.7		

13N/9W-20P1—Reference point—top of casing, elevation 1,414.0 feet. 0.02 mile south and 0.08 mile east of intersection of Bell Hill Road and Adobe Creek Drive.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
11/ 1/48	12.7	6/ 2/49	8.2	1/ 3/50	13.5	11/ 5/51	16.9
11/30/48	12.5	7/ 6/49	10.2	2/ 1/50	9.6	4/ 8/52	5.3
1/ 3/49	9.3	8/ 2/49	12.4	3/ 1/50	7.1	11/ 6/52	15.3
2/ 1/49	8.8	9/ 2/49	13.5	4/ 4/50	6.1	3/17/53	5.8
3/ 1/49	7.8	10/ 3/49	13.9	4/26/50	6.0	10/19/53	13.6
4/ 5/49	8.6	11/ 2/49	14.7	11/ 1/50	11.4		
5/ 3/49	6.0	12/ 2/49	15.6	3/28/51	4.2		

13N/9W-22F1—Reference point—top of casing, elevation 1,444.8 feet. 0.11 mile south and 0.43 mile west of intersection of Gold Dust Drive and Staheli Drive.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
11/ 4/48	46.4	10/28/49	45.8	3/28/51	43.9		
11/30/48	45.6	11/16/49	45.9	11/ 5/51	45.6		
1/ 3/49	45.7	3/31/50	45.8	11/ 6/52	45.9		
8/17/49	45.5	11/ 1/50	46.7				

13N/9W-22K1—Reference point—top of flooring, north side elevation 1,461.4 feet. 0.30 mile south of intersection of Gold Dust Drive and Staheli Drive.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
11/ 4/48	58.5	11/15/49	61.3	11/ 6/52	53.6		
3/21/49	59.0	3/31/50	59.6	3/17/53	52.0		
10/28/49	62.4	3/28/51	57.6	10/20/53	53.6		

13N/9W-22J1—Reference point—hole in pump base, elevation 1,419.9 feet. 0.39 mile south and 0.02 mile west of intersection of Kelsey Creek Drive and Gold Dust Drive.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
11/ 2/48	36.6	5/ 2/49	49.1*	12/ 2/49	40.2	11/ 5/51	46.6
11/30/49	35.9	6/ 2/49	52.6*	1/ 3/50	40.5	11/ 6/52	48.3
1/ 3/49	34.9	7/ 1/49	44.9	2/ 1/50	36.3	3/17/53	36.8
2/ 1/49	34.9	8/ 2/49	56.7*	3/ 1/50	35.2	10/20/53	45.0
3/ 1/49	33.7	9/ 2/49	47.8	4/ 4/50	34.9	3/23/54	33.8
4/ 5/49	32.7	10/ 3/49	44.6	4/26/50	35.4		
4/12/49	53.2*	11/ 2/49	44.6	11/ 1/50	43.3		

13N/9W-23D1—Reference point—hole in pump base, elevation 1,408.0 feet. East side of Kelsey Creek Drive, 0.07 mile north of Gold Dust Drive.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
11/ 1/48	25.0	3/31/50	23.6	4/ 8/52	19.5		
3/21/49	20.8	11/ 1/50	31.6	11/ 6/52	35.0		
10/28/49	29.7	3/28/51	24.1	3/17/53	22.1		
11/15/49	28.8	11/ 5/51	33.8	10/20/53	34.2		

13N/9W-23D2—Reference point—top of casing, elevation 1,406.6 feet. East side of Kelsey Creek Drive. 0.08 mile north of Gold Dust Drive.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
11/30/48	23.2	7/ 6/49	31.6	2/ 1/50	23.5	11/ 6/52	33.6
1/ 3/49	22.2	8/ 2/49	39.8	3/ 1/50	22.8	3/17/53	23.5
2/ 1/49	22.2	9/ 2/49	36.8	4/ 4/50	22.6	10/20/53	30.6
3/ 1/49	21.0	10/ 3/49	33.2	11/ 1/50	25.2	3/23/54	22.2
4/ 5/49	20.2	11/ 2/49	28.1	3/28/51	22.6		
5/ 2/49	24.3	12/ 2/49	27.1	11/ 6/51	32.3		
6/ 2/49	27.3	1/ 3/50	25.2	4/ 8/52	20.7		

13N/9W-23C1—Reference point—flange at top of discharge pipe, elevation 1,416.5 feet. 0.05 mile east of Liveoak Road and 0.5 mile south of Konocti Drive.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
11/ 2/48	33.7	8/ 2/49	43.8	12/ 2/49	35.4	10/20/53	42.0
5/ 3/49	33.5	10/ 3/49	41.7	4/ 3/50	32.1		
6/ 2/49	35.5	11/ 2/49	38.1	3/17/53	33.7		

13N/9W-29L1—Reference point—top of wood casing 0.09 feet above concrete, elevation 1,447.6 feet. 0.75 mile south and 0.06 mile east of intersection of Adobe Creek Drive and Bell Hill Road.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
11/ 4/48	20.0	3/31/50	11.9	4/ 8/52	11.8		
3/21/49	9.0	11/ 1/50	19.5	11/ 6/52	19.3		
10/26/49	20.6	3/28/51	12.9	3/17/53	15.0		
11/16/49	19.9	11/ 5/51	19.6	10/19/53	19.1		

13N/9W-30A1—Reference point—top of concrete casing, elevation 1,419.8 feet. 0.42 mile south and 0.03 mile west of intersection of Highland Springs Road and Bell Hill Road.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
11/ 3/48	12.5	3/29/51	5.3	3/17/53	6.0		
3/21/49	2.3	4/ 8/52	5.2	10/19/53	13.6		
10/26/49	14.4	11/ 6/52	14.0				

14N/9W-31E1—Reference point—top of casing, elevation 1,330.6 feet. 0.21 mile north and 0.02 mile east of intersection of State Highway 29 and Hopland Road.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
11/ 5/48	6.8	3/28/50	1.4	4/ 3/52	0.6		
3/ 9/49	1.9	10/31/50	7.6	3/18/53	1.0		
10/26/49	7.7	3/27/51	0.4	10/19/53	6.2		
11/15/49	7.5	11/ 2/51	6.4				

14N/9W-31N1—Reference point—pump base, elevation 1,335.7 feet. Intersection of 0.13 mile north of State Highway 29 and Ackley Drive.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
11/ 3/48	10.9	3/28/50	0.9	4/ 3/52	0.9		
3/ 9/49	1.3	10/30/50	12.2	11/ 7/52	11.1		
10/26/49	16.3	3/27/51	0.8	3/18/53	1.9		
11/15/49	16.8	11/ 2/51	9.5	10/19/53	10.6		

14N/9W-32M1—Reference point—pump base hole, elevation 1,335.9 feet. 0.06 mile north and 0.15 mile west of intersection of Soda Bay Road and Mission Lane.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
10/28/48	11.8	3/28/50	6.7	4/ 7/52	4.5		
3/12/49	7.9	10/30/50	13.2	11/ 7/52	11.7		
10/26/49	14.2	3/27/51	2.6	3/18/53	4.8		
11/16/49	12.4	11/ 2/51	11.6	10/19/53	12.0		

14N/9W-32K1—Reference point—top of casing, elevation 1,340.1 feet. North side of Soda Bay Road, 0.07 mile west of intersection of Reeves Lane and Soda Bay Road, approximately ¾ mile north of town of Finley.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
10/28/48	14.1	6/ 1/49	13.1	2/ 1/50	13.3	11/ 6/52	17.0
11/30/48	13.5	8/ 1/49	17.2	3/ 1/50	10.6	3/18/53	4.2
1/ 3/49	13.0	9/ 1/49	15.3	4/ 4/50	9.4	10/19/53	16.4
2/ 1/49	12.3	10/ 1/49	16.6	4/26/50	9.5		
3/ 2/49	11.3	11/ 2/49	16.1	10/30/50	16.2		
4/ 4/49	8.7	12/ 1/49	15.1	3/27/51	3.4		
5/ 3/49	22.5	1/ 4/50	14.7	11/ 2/51	14.8		

DEPTHS TO GROUND WATER AT MEASUREMENT WELLS IN CLEAR LAKE AREA—Continued

(DEPTHS TO WATER IN FEET MEASURED FROM REFERENCE POINT)

14N/9W-32N1—Reference point—top of boards around discharge pipe, elevation 1,340.2 feet. 0.21 mile north and 0.11 mile east of intersection of Highland Springs Road with State Highway 29.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
4/21/49	6.4	12/ 1/49	14.6	11/ 2/51	15.0	10/21/53	14.1
5/ 3/49	7.4	3/28/50	7.3	4/ 7/52	3.8		
8/ 1/49	16.2	10/30/50	15.4	11/ 7/52	15.0		
9/ 1/49	16.0	3/27/51	4.0	3/17/53	4.8		

14N/9W-33E1—Reference point—hole inside of pump, elevation 1,332.8 feet. 0.42 mile north and 0.10 mile east of intersection of Soda Bay Road and Stone Drive, approximately ¾ mile north of town of Finley.

Date	Depth to water	Date	Depth to water	Date	Depth to water
10/28/48	9.8	3/28/50	5.6	4/ 7/52	2.0
3/12/49	5.7	10/30/50	11.5	11/ 6/52	10.0
10/26/49	12.9	3/27/51	1.7	3/18/53	2.3
11/16/49	10.9	1/ 2/51	9.5	10/19/53	9.9

14N/9W-33M1—Reference point—top of casing, elevation 1,338.3 feet. North side of Soda Bay Road, 0.16 mile east of intersection of Soda Bay Road and Stone Drive, approximately ¾ mile north of town of Finley.

Date	Depth to water	Date	Depth to water	Date	Depth to water
10/28/48	13.7	3/28/50	8.1	4/ 7/52	3.8
3/12/49	7.9	10/31/50	14.4	11/ 6/52	14.4
10/26/49	16.4	3/27/51	4.3	3/17/53	3.8
11/16/49	15.3	11/ 2/51	14.9	10/19/53	13.9

14N/9W-33L1—Reference point—base of pump, elevation 1,339.7 feet. 0.03 mile north and 0.31 mile east of intersection of Soda Bay Road and Stone Drive, approximately ¾ mile north of town of Finley.

Date	Depth to water	Date	Depth to water	Date	Depth to water
3/12/49	8.0	3/28/50	9.1	11/ 6/52	15.1
10/26/49	17.9	10/30/50	16.5	3/18/53	7.5
11/15/49	16.3	11/ 2/51	15.9	10/19/53	14.7

14N/9W-33K1—Reference point—base of pump at edge, elevation 1,337.4 feet. North side of Soda Bay Road, 0.58 mile east of intersection of Soda Bay Road and Stone Drive, approximately ¾ mile north of town of Finley.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
10/28/48	13.1	6/ 1/49	13.3	1/ 4/50	13.6	11/ 2/51	13.8
11/30/48	12.4	7/ 5/49	30.5*	2/ 1/50	10.9	4/ 7/52	6.5
1/ 3/49	11.5	8/ 2/49	16.3	3/ 1/50	8.2	11/ 6/52	16.0
2/ 1/49	10.4	9/ 1/49	13.8	4/ 4/50	7.2	3/18/53	7.9
3/ 2/49	9.3	10/ 1/49	15.5	4/26/50	7.3	10/19/53	12.9
4/ 4/49	6.4	11/ 2/49	15.1	10/30/50	15.2		
5/ 3/49	8.0	12/ 1/49	14.2	3/27/51	4.6		

14N/9W-33J1—Reference point—base of flange above discharge column in pit, elevation 1,332.1 feet. North of Soda Bay Road, 0.10 mile west of east-to-south right angle bend in Soda Bay Road.

Date	Depth to water	Date	Depth to water	Date	Depth to water
10/28/48	6.0	3/28/50	+1.0	4/ 7/52	+1.0
3/12/49	+1.5	10/30/50	7.4	11/ 6/52	12.0
10/26/49	8.0	3/27/51	+3.0	3/18/53	+1.8
11/16/49	7.3	11/ 2/51	13.6	10/19/53	3.2

14N/9W-33P1—Reference point—top of casing, elevation 1,334.3 feet. 0.23 mile south and 0.37 mile east of intersection of Soda Bay Road and Stone Drive, on east side of Adobe Creek.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
10/28/48	15.7	9/ 1/49	17.9	6/ 2/50	10.5	3/17/53	6.2
3/16/49	7.9	10/ 1/49	20.8	7/ 1/50	23.8	10/19/53	17.1
4/12/49	7.5	11/ 2/49	18.6	8/ 1/50	32.1		
5/ 3/49	9.6	12/ 1/49	17.2	10/31/50	18.5		
6/ 2/49	21.8	3/28/50	8.4	3/27/51	5.1		
7/ 1/49	28.4*	4/10/50	8.2	11/ 2/51	17.5		
8/ 1/49	28.7*	4/25/50	8.4	11/ 6/51	17.0		

14N/9W-34E1—Reference point—top of casing, elevation 1,333.6 feet. 0.56 mile north, and 0.25 mile west of the intersection of Soda Bay Road and Park Drive.

Date	Depth to water	Date	Depth to water	Date	Depth to water
10/25/48	8.6	11/16/49	10.1	11/ 2/51	9.6
11/18/48	8.2	3/28/50	2.7	4/ 7/52	0.9
3/16/49	1.7	10/31/50	9.8	3/17/53	1.5
10/26/49	10.4	3/27/51	0.7	10/20/53	8.5

14N/9W-34G1—Reference point—base of flange at top of discharge column, elevation 1,336.8 feet. 0.54 mile north and 0.04 mile east of intersection of Park Drive and Soda Bay Road.

Date	Depth to water	Date	Depth to water	Date	Depth to water
10/19/48	11.3	3/28/50	4.4	11/ 7/52	21.4*
3/18/49	3.1	10/31/50	12.8	3/17/53	3.0
10/26/49	13.4	11/ 2/51	13.0	10/20/53	12.7
11/16/49	13.1	4/ 8/52	2.0		

14N/9W-34G2—Reference point—top of casing in pit, elevation 1,331.9 feet. 0.52 mile north and 0.18 mile east of intersection of Park Drive and Soda Bay Road.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
10/19/48	6.4	11/16/49	13.5	3/27/51	2.5	3/17/53	3.4
3/18/49	3.2	3/28/50	4.7	11/ 2/51	13.0		
10/26/49	14.0	10/30/50	12.4	4/ 8/52	2.2		

14N/9W-34H1—Reference point—base of flange over hole in pit, elevation 1,337.3 feet. 0.51 mile north and 0.37 mile east at intersection of Park Drive and Soda Bay Road.

Date	Depth to water	Date	Depth to water	Date	Depth to water
10/19/48	8.0	3/28/50	0.8	4/ 8/52	+1.7
3/18/48	+0.7	10/31/50	9.1	3/17/53	+0.8
10/26/49	10.7	3/27/51	+1.8	10/20/53	11.9
11/16/49	10.0	11/ 2/51	12.9		

14N/9W-34L3—Reference point—top of casing, elevation 1,336.9 feet. West side of Park Drive, 0.50 mile north of intersection of Soda Bay Road and Park Drive.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
9/ 1/49	26.8	2/ 1/50	7.9	2/27/51	2.2	10/20/53	11.5
10/ 1/49	27.0*	3/ 1/50	5.4	11/ 2/51	12.6		
11/ 2/49	27.0*	4/ 4/50	4.5	4/ 7/52	2.5		
12/ 1/49	13.1	4/26/50	24.2*	11/ 7/52	13.2		
1/ 4/50	12.0	10/31/50	12.7	3/17/53	3.0		

14N/9W-34J1—Reference point—concrete floor at pit, elevation 1,335.4 feet. 0.30 mile north and 0.04 mile west of east-to-south right angle bend in Soda Bay Road.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
10/19/48	9.5	11/16/49	11.7	3/27/51	+0.8	3/17/53	0.1
3/18/49	+0.3	3/28/50	1.6	11/ 2/51	17.3		
10/27/49	12.0	10/31/50	10.6	4/ 8/52	+1.0		

14N/9W-34N3—Reference point—top of casing in pit, elevation 1,348.5 feet. 0.19 mile north and 0.36 mile west of intersection of Soda Bay Road and Park Drive.

Date	Depth to water	Date	Depth to water
4/ 7/49	2.6	6/ 1/49	7.9
5/ 3/49	4.4	7/ 1/49	12.3

14N/9W-34Q1—Reference point—edge of concrete pit, elevation 1,348.1 feet. North side of Soda Bay Road, 0.12 mile east of intersection of Soda Bay Road and Park Drive.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
3/15/49	9.8	3/28/50	11.2	11/ 2/51	24.7	10/20/53	22.3
10/ 4/49	24.0	11/ 2/50	21.0	4/ 8/52	9.2		
11/16/49	23.8	3/27/51	9.0	3/17/53	10.6		

14N/9W-34R1—Reference point—base of flange at top of discharge column in pit, elevation 1,339.8 feet. North side of Soda Bay Road, 0.27 mile east of intersection of Soda Bay Road.

Date	Depth to water	Date	Depth to water
10/19/48	12.5	3/15/49	1.1

DEPTHS TO GROUND WATER AT MEASUREMENT WELLS IN CLEAR LAKE AREA—Continued

(DEPTHS TO WATER IN FEET MEASURED FROM REFERENCE POINT)

4N 9W-35L1—Reference point—base of pump, elevation 1,339.9 feet. 0.33 mile north and 0.13 mile west of intersection of Soda Bay Road and Soda Bay Drive, on the north side of Kelsey Creek.

Date	Depth to water	Date	Depth to water	Date	Depth to water
/19/48	15.7	3/28/50	8.3	11/ 7/52	16.7
/27/49	18.4	10/31/50	16.0	3/17/53	6.2
/14/49	18.2	11/ 2/51	16.5	10/20/53	16.3

4N/9W-35N1—Reference point—hole in pump base, elevation 1,342.9 feet. 0.15 mile north and 0.14 mile east of right angle bend in Soda Bay Road.

Date	Depth to water	Date	Depth to water	Date	Depth to water
/19/48	17.3	3/28/50	8.8	4/ 8/52	6.6
3/21/49	6.8	10/31/50	17.8	11/ 7/52	19.6
/27/49	19.8	3/27/51	6.8	3/17/53	8.1
1/14/49	19.5	11/ 2/51	20.0	10/20/53	18.9

4N/9W-35P1—Reference point—top of casing, elevation 1,345.2 feet. 0.04 mile north and 0.14 mile west of intersection of Soda Bay Road and Soda Bay Drive on north side of Kelsey Creek.

Date	Depth to water	Date	Depth to water	Date	Depth to water
0/19/48	20.0	3/28/50	11.1	4/ 8/52	10.0
3/21/49	9.3	10/31/50	19.1	11/ 7/52	21.0
/21/49	22.6	3/27/51	10.2	3/17/53	11.6
1/14/49	22.2	11/ 2/51	21.7	10/20/53	20.1

4N/9W-35Q1—Reference point—hole in pump base, elevation 1,342.5 feet. On north bank of Kelsey Creek. 0.19 mile north and 0.03 mile east of intersection of Soda Bay Road and Soda Bay Drive.

Date	Depth to water	Date	Depth to water	Date	Depth to water
/19/48	17.8	11/14/49	19.9	3/17/53	9.7
3/18/49	8.5	4/ 4/50	10.3		
/27/49	20.5	3/27/51	9.0		

4N/9W-36M1—Reference point—top of wood casing on south side, elevation 1,332.7 feet. On north bank of Kelsey Creek, 0.62 mile north and 0.9 mile west side of intersection of Soda Bay Road and the road along Cold Creek.

Date	Depth to water	Date	Depth to water	Date	Depth to water
/19/48	10.7	4/ 4/50	5.8	3/18/53	5.9
/27/49	12.5	3/27/51	5.1		
1/14/49	12.4	11/ 7/52	11.9		

4N/10W-2N1—Reference point—top of flange on gate valve, elevation 1,415.7 feet. Southeast of two buildings and north of property (section) line. 0.11 mile east of main Scott Valley Road.

Date	Depth to water	Date	Depth to water	Date	Depth to water
/23/49	Flowing	11/ 2/50	Flowing	11/ 5/52	Flowing
/28/49	Flowing	3/27/51	Flowing	3/17/53	Flowing
/18/49	Flowing	10/31/51	Flowing	10/20/53	Flowing
/ 5/50	Flowing	4/ 2/52	Flowing		

4N/10W-3M1—Reference point—top of casing elevation 1,405.1 feet. West side of Hendricks Creek, 0.47 mile south and 0.06 mile west of intersection of main Scotts Valley Road and Foothill Road.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
/ 5/48	7.3	1/ 3/50	6.5	3/27/51	0.5	3/23/54	+0.1
3/23/49	0.0	2/ 1/50	Flowing	10/31/51	9.5		
/ 1/49	8.1	3/ 1/50	1.0	4/ 2/52	0.4		
/ 1/49	7.8	4/ 5/50	1.1	11/ 5/52	8.3		
1/ 3/49	8.0	4/26/50	3.5	3/17/53	0.3		
2/ 1/49	7.5	11/ 2/50	3.6	10/20/53	6.7		

14N/10W-10G1—Reference point—cannot be measured, elevation 1,419.4 feet. 0.24 mile north and 0.13 mile east of right angle bend from north-to-west of Foothill Road.

Date	Depth to water	Date	Depth to water	Date	Depth to water
10/28/49	Flowing	11/ 2/50	Flowing	3/17/53	Flowing
11/18/49	Flowing	3/27/51	Flowing		
4/ 5/50	Flowing	4/ 2/52	Flowing		

14N/10W-10J1—Reference point—top of flange on gate valve, elevation 1,427.1 feet. 0.39 mile north and 0.10 mile west of intersection of main Scotts Valley Road and dirt road east to Gruwell place.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
3/23/49	Flowing	4/ 5/50	Flowing	4/ 2/52	Flowing	10/20/53	Flowing
10/28/49	Flowing	11/ 2/50	Flowing	11/ 5/52	Flowing		
11/18/49	Flowing	3/27/51	Flowing	3/17/53	Flowing		

14N/10W-10P1—Reference point—top of casing, elevation 1,424.4 feet. 0.14 mile south and 0.19 mile west of north-to-west right angle bend in Foothill Road.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
11/ 8/48	Flowing	7/ 5/49	Flowing	2/ 1/50	Flowing	4/ 2/52	Flowing
12/ 1/48	Flowing	8/ 1/49	Flowing	3/ 1/50	Flowing	3/17/53	Flowing
2/ 2/49	Flowing	9/ 1/49	1.3	4/ 5/50	Flowing	10/20/53	5.0
3/ 3/49	Flowing	10/ 1/49	1.5	4/26/50	Flowing		
4/ 4/49	Flowing	11/ 3/49	1.4	11/ 2/50	Flowing		
5/ 3/49	Flowing	12/ 1/49	1.2	3/27/51	Flowing		
6/ 1/49	Flowing	1/ 3/50	Flowing	10/31/51	2.5		

14N/10W-10Q1—Reference point—hole in side of casing, elevation 1,425.2 feet. 0.10 mile south and 0.12 mile east of north-to-west right angle bend in Foothill Road.

Date	Depth to water	Date	Depth to water	Date	Depth to water
11/ 5/48	5.2	11/ 2/50	6.9	11/ 5/52	8.6
3/23/49	3.6	3/27/51	0.0	3/17/53	0.0
10/28/49	7.1	10/31/51	7.7	10/20/53	6.6
11/18/49	6.7	4/ 2/52	0.0		

14N/10W-11G1—Reference point—top of casing, elevation 1,422.0 feet. East side of Scotts Creek, 0.63 mile north and 0.60 mile east of intersection of main Scotts Valley Road and dirt road east to Gruwell place.

Date	Depth to water	Date	Depth to water	Date	Depth to water
11/ 8/48	9.4	12/ 1/49	9.3	4/26/50	4.2
3/23/49	2.4	1/ 3/50	9.0	11/ 2/50	10.4
9/ 1/49	8.8	2/ 1/50	4.9	3/27/51	3.6
10/ 1/49	9.5	3/ 1/50	3.5	10/31/51	9.9
11/ 3/49	9.7	4/ 5/50	3.5	10/20/53	7.5

14N/10W-11N2—Reference point—top of casing, elevation 1,435.1 feet. 50 feet west of house near west side of Scotts Creek at end of dirt road east from main Scotts Valley Road along south side of section.

Date	Depth to water	Date	Depth to water	Date	Depth to water
3/23/49	Flowing	4/ 5/50	Flowing	3/17/53	Flowing
10/28/49	3.4	3/27/51	Flowing	10/20/53	Flowing
11/18/49	4.0	4/ 2/52	Flowing		

DEPTHS TO GROUND WATER AT MEASUREMENT WELLS IN CLEAR LAKE AREA—Continued

(DEPTHS TO WATER IN FEET MEASURED FROM REFERENCE POINT)

14N/10W-14D2—Reference point—pump base hole, elevation 1,441.0 feet. 0.25 mile north and 0.11 mile east of intersection of two primary Scotts Valley roads on west side of Scotts Creek, 6 feet northwest of well number 14N/10W-14A1.

Date	Depth to water	Date	Depth to water	Date	Depth to water
5/ 6/49	4.9	10/ 1/49	10.0	4/ 2/52	2.4
6/ 1/49	31.3*	11/ 3/49	9.4	11/ 5/52	9.7
7/ 1/49	8.8	4/ 5/50	3.5	3/17/53	3.6
8/ 1/49	9.6	11/ 2/50	7.2	10/20/53	9.7
9/ 1/49	8.7	3/27/51	2.9	3/23/54	1.4

14N/10W-14E1—Reference point—pump base hole, elevation 1,443.8 feet. 0.10 mile north and 0.06 mile west of southwest corner Scotts Valley Fruit Exchange sheds.

Date	Depth to water	Date	Depth to water	Date	Depth to water
10/28/48	9.9	4/ 5/50	5.7	4/ 2/52	5.9
3/23/49	4.0	11/ 2/50	10.1	11/ 5/52	12.6
10/28/49	11.8	3/27/51	5.2	3/17/53	5.9
11/18/49	12.0	10/31/51	11.5	10/20/53	12.0

14N/10W-14E2—Reference point—pump base hole, elevation 1,442.6 feet. Just north of fence line north of Scotts Valley Fruit Exchange sheds.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
10/28/48	8.7	7/ 1/49	9.7	3/ 1/50	4.6	3/27/51	3.9
12/ 1/48	9.2	8/ 1/49	9.8	4/ 5/50	4.3	10/31/51	10.3
1/ 4/49	5.2	9/ 1/49	9.0	4/10/50	4.0	4/ 2/52	3.6
2/ 2/49	5.4	10/ 1/49	10.7	4/25/50	4.5	11/ 5/52	10.7
3/ 3/49	4.1	11/ 3/49	10.5	6/ 2/50	5.5	3/17/53	4.6
4/ 4/49	4.1	12/ 1/49	10.5	7/ 1/50	24.2*	10/20/53	10.6
5/ 3/49	6.3	1/ 3/50	9.7	8/ 1/50	11.4		
6/ 1/49	8.6	2/ 1/50	4.9	11/ 2/50	8.7		

14N/10W-14G3—Reference point—top of casing, elevation 1,443.6 feet. East side of dirt road to Pacheco place, 0.09 mile north of main Scotts Valley Road.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
7/14/49	15.6	1/ 3/50	15.2	3/27/51	7.8	3/23/54	5.7
7/21/49	15.8	2/ 1/50	14.7	10/31/51	8.9		
9/ 1/49	14.2	3/ 1/50	13.7	4/ 6/52	9.0		
10/ 1/49	15.7	4/ 5/50	10.3	11/ 5/52	13.7		
11/ 3/49	15.4	4/26/50	10.9	3/17/53	7.8		
12/ 1/49	15.8	11/ 2/50	15.8	10/20/53	13.3		

14N/10W-14L1—Reference point—pump base hole, elevation 1,442.5 feet. 0.01 mile south and 0.24 mile east of southeast corner Scotts Valley Fruit Exchange sheds.

Date	Depth to water	Date	Depth to water	Date	Depth to water
10/28/48	9.9	4/ 5/50	5.7	4/ 2/52	3.9
3/23/49	4.2	11/ 2/50	10.2	11/ 5/52	12.0
10/28/49	12.6	3/27/51	4.7	3/16/53	4.9
11/18/49	11.9	10/31/51	10.4	10/20/53	11.5

14N/10W-14N1—Reference point—top of casing, elevation 1,460.3 feet. 0.38 mile south and 0.23 mile west of southeast corner Scotts Valley Fruit Exchange sheds.

Date	Depth to water	Date	Depth to water	Date	Depth to water
3/23/49	16.8	11/ 2/50	24.6	11/ 5/52	28.7
11/18/49	27.5	3/27/51	18.8	3/17/53	19.4
4/ 5/50	19.1	4/ 2/52	24.6	10/20/53	27.1

14N/10W-22A1—Reference point—pump base hole, elevation 1,464.4 feet. East of house at end of dirt road near east side of Scotts Creek.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
11/ 8/48	27.6	6/ 1/49	22.5	1/ 3/50	33.8	10/31/51	35.3
12/ 1/48	27.9	7/ 5/49	25.7	2/ 1/50	22.2	11/ 5/52	33.4
1/ 4/49	21.3	8/ 1/49	28.1	3/ 1/50	21.0	3/17/53	22.9
2/ 2/49	21.6	9/ 1/49	32.9	4/ 5/50	20.8	10/20/53	33.5
3/ 3/49	20.1	10/ 1/49	31.8	4/26/50	21.0	3/23/54	19.7
4/ 4/49	20.7	11/ 3/49	36.3	11/ 2/50	31.5		
5/ 2/49	21.8	12/ 1/49	31.1	3/27/51	21.3		

14N/10W-22H1—Reference point—top of board flooring, elevation 1,457.9 feet. At edge of Scotts Creek 0.30 mile south and 0.26 mile west of northeast corner of section.

Date	Depth to water	Date	Depth to water	Date	Depth to water
3/23/49	29.8	11/18/49	31.8	3/17/53	9.4
10/28/49	22.6	4/ 5/50	9.0		

14N/10W-25Q1—Reference point—top of casing, elevation 1,341.2 feet. 0.06 mile north and 0.15 mile west of State Highway 29 and road to west, 1 mile south of town of Lakeport.

Date	Depth to water	Date	Depth to water	Date	Depth to water
11/11/48	5.5	4/ 3/50	1.4	4/ 3/52	0.0
3/ 9/49	4.4	10/31/50	7.8	11/ 6/52	5.9
10/26/49	8.2	3/27/51	0.0	3/18/53	0.0
11/15/49	7.9	11/ 2/51	8.6	10/19/53	10.4

15N/9W-5E1—Reference point—top of casing, elevation 1,375.2 feet. Between Alley Creek and road 0.32 mile east and 0.11 mile north of northeast-to-east angle bend in road approximately ¼ mile northeast of Alley Creek bridge.

Date	Depth to water	Date	Depth to water	Date	Depth to water
11/10/48	1.8	4/ 4/50	Flowing	4/ 9/52	Flowing
3/18/49	Flowing	11/ 2/50	1.2	11/ 6/52	3.9
10/31/49	3.1	3/26/51	Flowing	3/16/53	Flowing
11/17/49	2.2	11/ 1/51	3.3	10/19/53	2.7

15N/9W-5E2—Reference point—top of casing, elevation 1,377.3 feet. Between Alley Creek and road 0.32 mile east and 0.11 mile north of northeast-to east angle bend in road approximately ¼ mile northeast of Alley Creek bridge.

Date	Depth to water	Date	Depth to water	Date	Depth to water
8/10/49	3.2	10/31/49	3.0	4/ 9/52	Flowing
8/11/49	3.2	11/17/49	2.2	11/ 6/52	2.7
8/12/49	3.2	4/ 4/50	Flowing	3/16/53	Flowing
8/15/49	3.2	11/ 2/50	0.9	10/19/53	2.4
8/17/49	3.1	3/27/51	Flowing	3/22/54	Flowing

15N/9W-5F1—Reference point—top of casing, elevation 1,379.4 feet. Near south edge of Alley Creeek, 0.12 mile north and 0.43 mile east of northeast-to-east angle bend in road, approximately ¼ mile northeast of Alley Creek bridge.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
11/10/48	5.3	11/17/49	6.0	11/ 1/51	6.7	3/16/53	1.8
3/13/49	0.8	4/ 4/50	1.9	4/ 9/52	1.0		
10/31/49	7.0	11/ 2/50	5.0	11/ 6/52	7.3		

15N/9W-5L1—Reference point—floor of pit, elevation 1,382.0 feet. Near lower end of Clover Valley, 0.08 mile south and 0.07 mile west of southeast-to-south angle bend in Alley Creek Road.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
10/24/48	5.9	6/ 1/49	2.7	1/ 3/50	6.5	11/ 1/51	8.5
12/ 1/48	5.3	7/ 5/49	10.4*	2/ 1/50	1.7	4/ 4/52	1.8
1/ 4/49	2.3	8/ 1/49	11.0*	3/ 1/50	1.4	11/ 6/52	7.4
2/ 3/49	1.9	9/ 1/49	7.7	4/ 4/50	1.1	3/16/53	2.2
3/ 1/49	1.3	10/ 1/49	12.7*	4/26/50	1.5	10/18/53	5.9
4/ 4/49	1.4	11/ 3/49	7.6	11/ 2/50	5.2		
5/ 2/49	1.9	12/ 1/49	7.0	3/26/51	1.5		

15N/9W-5L2—Reference point—top of casing cap, elevation 1,383.7 feet. Near lower end of Clover Valley, 0.16 mile south and 0.14 mile west of southeast-to-south angle bend in Alley Creek Road.

Date	Depth to water	Date	Depth to water	Date	Depth to water
10/ 2/48	4.2	3/26/51	Flowing	10/18/53	4.1
3/18/49	2.3	4/ 4/52	Flowing		
10/31/49	4.6	3/16/53	Flowing		

15N/9W-5P1—Reference point—top of casing, elevation 1,389.3 feet. West of private road across lower end of Clover Valley just north of bridge over Clover Creek.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
8/18/49	6.0	11/17/49	7.9	4/13/51	3.6	10/18/53	7.4
8/24/49	6.1	4/ 4/50	2.9	4/ 9/51	3.1		
8/25/49	6.2	11/ 2/50	6.6	11/ 6/52	8.7		
10/31/49	7.9	3/26/51	2.9	3/16/53	2.5		

15N/9W-5R1—Reference point—top of casing, elevation 1,404.8 feet. North of Clover Creek approximately ¼ mile east of U. S. Corps of Engineers gaging station on Clover Creek.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
3/18/49	2.3	4/ 4/50	4.5	11/ 1/51	16.7	10/19/53	14.7
10/31/49	16.4	11/ 2/50	10.8	4/ 4/52	4.3		
11/17/49	16.4	3/26/51	4.7	3/16/53	4.5		

DEPTHS TO GROUND WATER AT MEASUREMENT WELLS IN CLEAR LAKE AREA—Continued

(DEPTHS TO WATER IN FEET MEASURED FROM REFERENCE POINT)

5N/9W-6K1—Reference point—top of casing in pit, elevation 1,359.8 feet. 0.10 mile north and 0.07 mile east of intersection of East Middle Valley Road and Alley Creek Road.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
/24/48	5.6	8/ 1/49	28.9*	4/10/50	+1.7	11/ 6/52	7.1
2/ 1/48	4.4	9/ 1/49	20.0*	4/25/50	+0.7	3/16/53	0.0
1/ 4/49	3.1	10/ 1/49	20.8*	6/ 2/50	22.4*	10/19/53	7.6
2/ 3/49	3.3	11/ 3/49	21.2*	7/ 1/50	25.0*	3/22/54	0.6
3/ 1/49	1.8	12/ 1/49	5.6	8/ 1/50	12.7		
4/ 4/49	+1.3	1/ 3/50	5.2	11/ 2/50	5.3		
5/ 3/49	4.4	2/ 1/50	5.3	3/26/51	0.8		
6/ 1/49	41.7*	3/1 /50	0.9	11/ 1/51	10.0		
7/ 1/49	21.8*	4/ 4/50	+0.8	4/ 4/52	+2.0		

5N/9W-6R1—Reference point—top of casing, elevation 1,361.5 feet. 0.29 mile north and 0.04 mile west of northwest corner of Upper Lake Union High School.

Date	Depth to water	Date	Depth to water	Date	Depth to water
/25/48	10.9	4/ 4/50	6.9	11/ 6/52	11.7
3/18/49	5.4	3/26/51	5.8	10/19/53	12.0
/17/49	11.2	4/ 4/52	5.4		

5N/9W-7G1—Reference point—top of casing, elevation 1,346.8 feet. 0.07 mile north and 0.08 mile east of northwest corner of Upper Lake Union High School.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
/27/48	16.5	7/ 5/49	26.5	3/ 1/50	5.3	3/16/53	4.6
2/ 1/48	8.6	8/ 1/49	27.0	4/ 4/50	5.6	10/18/53	11.0
/ 4/49	7.8	9/ 1/49	16.9	4/26/50	5.6	3/22/54	2.0
2/ 3/49	7.3	10/ 1/49	27.3	11/ 3/50	10.0		
3/ 1/49	4.7	11/ 3/49	12.6	3/26/51	5.0		
4/ 4/49	5.1	12/ 1/49	10.1	11/ 1/51	10.6		
5/ 2/49	15.3	1/ 3/50	9.4	4/ 4/52	2.9		
6/ 1/49	12.2	2/ 1/50	6.9	11/ 7/52	11.3		

N/9W-7K1—Reference point—top of casing, elevation 1,340.8 feet. 0.07 mile south and 0.18 mile east of southwest corner of Upper Lake Union High School.

Date	Depth to water	Date	Depth to water	Date	Depth to water
/11/48	4.6	11/17/49	4.5	4/ 4/52	2.9
/18/49	0.6	3/28/50	0.6	11/ 7/52	4.5
/ 4/49	6.4	3/26/51	1.5	3/16/53	Flowing

N/9W-7R1—Reference point—top of casing, elevation 1,331.5 feet. 0.23 mile south and 0.07 mile east of first intersection of State Highway 20 and old highway east of town of Upper Lake.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
/11/48	12.3	3/28/50	6.6	4/ 4/52	4.1	3/22/54	5.7
/23/49	Flowing	11/ 3/50	11.5	11/ 7/52	9.8		
/31/49	12.5	3/26/51	4.2	3/16/53	5.8		
/17/49	11.8	11/ 1/51	8.9	10/19/53	7.7		

N/9W-8D1—Reference point—lower edge or rim on elbow on discharge pipe above well, elevation 1,360.8 feet. 0.60 mile east and 0.23 mile north of southwest corner of Upper Lake Union High School.

Date	Depth to water	Date	Depth to water	Date	Depth to water
/11/48	12.4	3/28/50	6.1	11/ 1/51	11.2
/18/49	4.7	11/ 3/50	13.4	11/ 6/52	13.5
/ 4/49	13.0	3/26/51	6.3	10/19/53	11.5
/17/49	13.1	4/13/51	7.1		

N/9W-9L1—Reference point—hole under safety valve pipe, elevation 1,431.4 feet. 1.21 miles southeast of U. S. Corps of Engineers gaging station on Clover Creek.

Date	Depth to water	Date	Depth to water	Date	Depth to water
/25/48	26.2	11/17/49	29.9	11/ 6/52	29.5
/18/49	2.1	4/ 4/50	3.4	3/16/53	4.9
/31/49	29.2	4/13/51	4.1	10/19/53	24.0

N/9W-18H1—Reference point—top of casing, elevation 1,326.2 feet. Near south edge of slough, 0.05 mile north and 0.40 mile west of junction of dirt road west of State Highway 20, approximately 1.6 miles southeast of Upper Lake junction.

Date	Depth to water	Date	Depth to water	Date	Depth to water
/11/48	8.0	11/17/49	8.7	3/26/51	1.4
/23/49	2.6	3/28/50	3.5	11/ 1/51	7.5
/31/49	10.0	11/ 2/50	8.3	10/18/53	6.1

15N/9W-28F2—Reference point—top of casing, elevation 1,327.8 feet. North side of State Highway 20 and 1.94 miles due east of State Highway 29.

Date	Depth to water	Date	Depth to water
12/ 9/49	7.2	3/26/51	0.0
4/ 3/50	5.4	10/19/53	4.8

15N/10W-1R1—Reference point—hole in casing, elevation 1,356.1 feet. 0.8 mile north and 0.4 mile east of intersection of State Highway 29 and State Highway 20.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
10/24/48	6.3	7/ 5/49	13.1	1/ 3/50	6.0	3/26/51	1.4
1/ 5/49	3.3	8/ 1/49	14.1	2/ 1/50	4.1	11/ 1/51	6.5
3/ 1/49	2.3	9/ 1/49	12.3	3/ 1/50	2.3	3/16/53	3.7
4/ 4/49	1.3	10/ 1/49	11.4	4/ 5/50	1.8	10/18/53	7.9
5/ 2/49	6.9	11/ 3/49	9.6	4/26/50	3.1		
6/ 1/49	7.7	12/ 1/49	7.9	11/ 3/50	5.6		

15N/10W-2N1—Reference point—top of casing, elevation 1,341.7 feet. On north-south State Highway 20, 0.5 mile south and 0.8 mile east of Witter Springs Post Office.

Date	Depth to water	Date	Depth to water
11/12/48	12.4	11/ 6/49	13.5
3/23/49	3.0	11/17/59	13.8

15N/10W-3D1—Reference point—top of casing, elevation 1,362.2 feet. 0.38 mile north and 0.17 mile west of Witter Springs Post Office.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
11/12/48	6.7	4/ 5/50	3.4	4/ 4/52	3.7	3/22/54	2.5
5/23/49	3.1	11/ 3/50	7.6	11/ 5/52	8.8		
11/ 6/49	7.1	3/26/51	3.4	3/17/53	3.9		
11/17/49	7.1	11/15/51	9.0	10/20/53	7.3		

15N/10W-3F1—Reference point—top of casing, elevation 1,348.3 feet. Across road due north of Witter Springs Post Office.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
11/12/48	8.3	5/ 2/49	4.2	11/ 3/49	9.1	4/26/50	3.9
12/ 6/48	8.0	6/ 1/49	6.1	12/ 1/49	8.5		
1/ 5/49	7.3	7/ 5/49	9.6*	1/ 3/50	8.0		
2/ 3/49	6.4	8/ 1/49	10.3	2/ 1/50	3.0		
3/ 1/49	2.8	9/ 1/49	9.5	3/ 1/50	3.1		
4/ 4/49	2.9	10/ 1/49	10.9*	4/ 5/50	2.9		

15N/10W-3K1—Reference point—top of casing, elevation 1,334.2 feet. 0.35 mile south and 0.36 mile east of Witter Springs Post Office.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
11/12/48	8.3	9/ 1/49	8.3	11/ 3/50	7.6	3/17/53	2.0
3/23/49	1.5	10/ 1/49	9.7	3/27/51	1.3	10/20/53	7.7
6/ 1/49	2.9	11/ 3/49	9.1	11/ 1/51	9.4		
7/ 1/49	6.4	11/17/49	9.0	4/ 3/52	1.0		
8/ 1/49	10.4	4/ 5/50	1.9	11/ 5/52	10.1		

15N/10W-3K2—Reference point—top of casing, elevation 1,334.2 feet. 0.35 mile south and 0.36 mile east of Witter Springs Post Office.

Date	Depth to water	Date	Depth to water	Date	Depth to water
6/ 1/49	2.9	10/ 1/49	9.1	4/25/50	1.8
7/ 1/49	6.4	11/ 3/49	9.1	6/ 2/50	3.7
8/ 1/49	10.4	11/17/49	9.0	7/ 1/50	5.3
9/ 1/49	8.3	4/10/50	1.5	8/ 1/50	6.1

15N/10W-3N1—Reference point—top of wooden block around pipe, elevation 1,335.8 feet. East side of road 0.69 mile south of Witter Springs Post Office.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
11/12/48	11.2	7/ 5/49	9.9	3/ 1/50	4.7	3/17/53	5.0
12/ 6/48	11.1	8/ 1/49	11.3	4/ 5/50	4.6	10/20/53	13.0
1/ 5/49	8.4	9/ 1/49	12.7	4/26/50	5.0	3/22/54	3.5
2/ 3/49	7.2	10/ 1/49	12.5	11/ 3/50	9.8		
3/ 1/49	4.8	11/ 3/49	12.7	3/26/51	4.8		
4/ 4/49	4.5	12/ 1/49	12.3	11/ 1/51	12.9		
5/ 2/49	5.3	1/ 3/50	12.4	4/ 4/52	4.6		
6/ 1/49	5.9	2/ 1/50	7.1	11/ 5/52	10.7		

DEPTHS TO GROUND WATER AT MEASUREMENT WELLS IN CLEAR LAKE AREA—Continued

(DEPTHS TO WATER IN FEET MEASURED FROM REFERENCE POINT)

15N/10W-4B1—Reference point—top of casing, elevation 1,373.9 feet. 0.5 mile west and 0.5 mile north on west side of road from Witter Springs Post Office.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
11/11/48	12.8	6/ 1/49	8.5	1/ 3/50	14.8	11/ 1/51	14.1
12/ 6/48	12.7	7/ 5/49	11.6*	2/ 1/50	10.3	4/ 3/52	4.6
1/ 5/49	11.5	8/ 1/49	12.1	3/ 1/50	5.6	3/17/53	5.1
2/ 3/49	10.8	9/ 1/49	13.1	4/ 5/50	4.6	10/20/53	14.0
3/ 1/49	7.5	10/ 1/49	13.9	4/26/50	6.0		
4/ 4/49	4.9	11/ 3/49	14.4	11/ 3/50	14.0		
5/ 2/49	7.1	12/ 1/49	14.4	3/27/51	5.2		

15N/10W-4H1—Reference point—base of wind mill pump, elevation 1,361.6 feet. North side of road, 0.4 mile west of Witter Springs Post Office.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
11/11/48	8.6	4/ 5/50	5.6	4/ 4/52	5.3	3/22/54	3.4
3/23/49	4.6	11/ 3/50	9.1	11/ 5/52	9.6		
11/ 6/49	9.1	3/27/51	5.6	3/17/53	6.4		
11/17/49	10.0	11/ 1/51	9.2	10/20/53	7.2		

16N/9W-31C1—Reference point—top of casing, elevation 1,415.1 feet. East side of Lake Pillsbury Road, approximately 2.7 miles north of town of Upper Lake.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
10/24/48	29.4	5/ 3/49	22.8	11/ 3/49	31.1	4/26/50	18.7
12/ 1/48	28.9	6/ 1/49	25.5	12/ 1/49	31.4	11/ 2/50	24.1
1/ 4/49	19.5	7/ 5/49	26.9	1/ 3/50	3.6	3/26/51	15.8
2/ 3/49	24.8	8/ 1/49	27.5	2/ 1/50	13.1	4/13/51	21.5
3/ 1/49	12.3	9/ 1/49	28.3	3/ 1/50	17.3	11/ 1/51	30.6
4/ 4/49	9.8	10/ 1/49	29.1	4/ 4/50	10.7	4/ 4/52	15.3

16N/9W-31C2—Reference point—top of casing, elevation 1,409.2 feet. West side of Lake Pillsbury Road, approximately 2.5 miles north of town of Upper Lake.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
10/24/48	28.5	4/ 4/50	18.3	11/ 1/51	23.8	10/18/53	24.1
3/18/49	16.5	11/ 2/50	20.1	4/ 4/52	18.9	3/22/54	17.8
10/31/49	25.1	3/26/51	17.9	11/ 6/52	26.3		
11/17/49	25.9	4/13/51	19.3	3/16/53	17.1		

16N/9W-31F1—Reference point—top of casing, elevation 1,400.1 feet. West of Lake Pillsbury Road, approximately 2.2 miles north of town of Upper Lake.

Date	Depth to water	Date	Depth to water	Date	Depth to water
10/24/48	14.9	11/ 2/50	13.3	11/ 1/51	16.7
3/18/49	9.2	3/26/51	12.1	4/ 4/52	12.6
4/ 4/50	11.4	4/13/51	13.0		

16N/9W-31M1—Reference point—top of wooden block around pipe, elevation 1,394.6 feet. 0.55 mile west of Lake Pillsbury Road, approximately 2.3 miles north of town of Upper Lake.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
11/ 9/48	16.2	4/ 5/50	17.1	11/ 1/51	16.2	10/18/53	17.0
11/ 4/49	17.5	11/ 3/50	17.5	11/ 6/52	17.3		
11/17/49	17.3	3/26/51	16.8	3/17/53	16.2		

16N/9W-31K1—Reference point—top of casing, elevation 1,387.1 feet. 0.2 mile west of Lake Pillsbury Road, approximately 2.2 miles north of town of Upper Lake.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
10/24/48	10.0	9/ 1/49	6.4	11/ 2/50	4.5	11/ 6/52	10.4
3/18/49	5.8	10/ 1/49	8.5	3/26/51	2.1	3/16/53	2.0
6/ 1/49	8.0	11/ 3/49	7.9	4/13/51	3.7	10/18/53	7.3
7/ 1/49	26.4*	11/17/49	7.9	11/ 1/51	7.5		
8/ 1/49	8.1	4/ 4/50	2.5	4/ 4/52	1.8		

16N/9W-31Q1—Reference point—top of casing, elevation 1,385.5 feet. 0.15 mile west of Lake Pillsbury Road, approximately 2 miles north of town of Upper Lake.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
10/24/48	6.0	9/ 1/49	6.6	4/25/50	3.2	11/ 1/51	9.7
3/23/49	0.6	10/ 1/49	17.9*	6/ 2/50	7.9	11/ 6/52	10.2
6/ 1/49	5.0	11/ 3/49	7.9	7/ 1/50	14.8*	3/16/53	2.4
7/ 1/49	8.5	11/17/49	7.9	8/ 1/50	14.4*	10/14/53	9.3
7/ 1/49	18.1*	4/ 4/50	2.6	11/ 2/50	7.0		
8/ 1/49	18.0*	4/14/50	2.6	3/26/51	5.1		

16N/9W-31R1—Reference point—top of casing, elevation 1,385.6 feet. On east side of Lake Pillsbury Road, approximately 1.9 miles north of town of Upper Lake.

Date	Depth to water	Date	Depth to water	Date	Depth to water
10/24/48	13.7	3/ 1/49	7.2	7/ 5/49	12.0
12/ 1/48	11.5	4/ 4/49	7.6	8/ 1/49	12.4
1/ 4/49	9.9	5/ 2/49	8.5	9/ 1/49	12.3
2/ 3/49	9.9	6/ 1/49	48.6*	1/ 3/50	17.3

16N/10W-33E1—Reference point—top of casing, elevation 1,418.1 feet. West side of road, 1.3 miles north of and 1.05 miles west of Witter Springs Post Office.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
11/11/48	12.3	7/ 5/49	5.3	1/ 3/50	12.7	4/ 4/52	0.5
12/ 6/48	9.8	7/ 5/49	13.5*	2/ 1/50	2.5	11/ 5/52	12.5
1/ 5/49	3.7	8/ 1/49	8.6	3/ 1/50	2.7	3/17/53	3.1
2/ 3/49	2.8	9/ 1/49	12.9	4/ 5/50	2.3	10/20/53	7.7
3/ 1/49	2.3	9/ 1/49	19.4*	4/26/50	2.6	3/22/54	1.7
4/ 4/49	2.4	10/ 1/49	13.7	11/ 3/50	6.0		
5/ 2/49	3.0	11/ 3/49	17.3	3/26/51	2.4		
6/ 1/49	3.4	12/ 1/49	15.8	11/ 1/51	12.7		

16N/10W-33J1—Reference point—top of casing, elevation 1,389.9 feet. 0.45 mile west and 0.94 mile north on east side of road from Witter Springs Post Office.

Date	Depth to water	Date	Depth to water
11/11/48	11.7	3/23/49	2.7

16N/10W-34N1—Reference point—rim of wooden cover of well, elevation 1,397.1 feet. 0.9 mile north of Witter Springs Post Office.

Date	Depth to water	Date	Depth to water	Date	Depth to water	Date	Depth to water
11/12/48	24.3	6/ 1/49	10.8	1/ 3/50	25.5	11/ 1/51	24.2
12/ 6/48	23.9	7/ 5/49	15.8	2/ 1/50	6.3	4/ 4/52	6.5
1/ 5/49	17.3	8/ 1/49	19.7	3/ 1/50	8.6	11/ 5/52	24.3
2/ 3/49	19.4	9/ 1/49	22.5	4/ 5/50	8.1	3/17/53	9.9
3/ 1/49	8.0	10/ 1/49	24.3	4/26/50	9.0	10/20/53	22.4
4/ 4/49	8.4	11/ 3/49	25.1	11/ 3/50	19.4		
5/ 3/49	9.4	12/ 1/49	25.6	3/26/51	9.0		

16N/10W-36J1—Reference point—top of 2″ x 6″ covering of abandoned well, elevation 1,418.7 feet. West side of road in northeast ½ of southeast ¼ of section.

Date	Depth to water	Date	Depth to water	Date	Depth to water
11/ 9/48	22.1	4/ 5/50	2.2	11/ 6/51	24.0
3/18/49	0.6	11/ 3/50	14.1	3/16/53	4.6
11/ 4/49	24.5	3/26/51	3.0	10/18/53	22.1
11/17/49	24.2	11/ 1/51	23.2		

* Operating.

APPENDIX G

RECORDS OF MINERAL ANALYSES OF WATERS IN CLEAR LAKE AREA

TABLE OF CONTENTS

TABLE 1

COMPLETE MINERAL ANALYSES OF REPRESENTATIVE SURFACE WATERS OF CLEAR LAKE AND UNITS OF CLEAR LAKE AREA

Source of sample	Date of sample	Conductance, $Ec \times 10^6$ at 25° C.	Boron, in parts per million	Per cent sodium	Mineral constituents, in equivalents per million						
					Ca	Mg	Na	$HCO_3 + CO_3$	Cl	SO_4	NO_3
Clear Lake											
liddle of lake	7/15/48	330	1.42	22	1.4	1.5	0.8	3.1	0.3	0.3	----
hore line, SE ¼ Sec. 12, T. 14 N., R. 10 W., M.D.B. & M.	10/13/49	350	1.40	42	1.1	----	----	1.1	0.5	0.2	--
nd of pier at Lakewood Resort on Soda Bay	4/14/50	290	1.24	18	1.4	1.77	0.68	3.1	0.3	0.3	0.014
hore line, SE ¼ Sec. 31, T. 15 N., R. 9 W., M.D.B. & M.	4/17/50	290	1.15	19	1.4	1.76	0.71	2.9	0.3	0.39	0.132
Big Valley Unit											
elsey Creek near Kelseyville	3/22/49	147	0.0	17	0.37	1.31	0.35	1.71	0.09	0.03	0
elsey Creek at Soda Bay Road	4/14/50	200	0.04	10	0.7	1.71	0.27	2.2	0.1	0.2	0
dobe Creek at Bell Hill Road	3/22/49	143	0.06	21	0.63	0.94	0.41	1.59	0.11	0.11	0
dobe Creek at Soda Bay Road	4/14/50	230	0.25	13	1.05	1.53	0.37	2.55	0.1	0.16	0.003
Scott Valley Unit											
cott Creek near Lakeport	3/22/49	116	0.0	25	0.65	0.50	0.39	1.21	0.10	0.12	0.0
cott Creek at bridge south of Bachelor Valley	4/11/50	190	0.05	20	1.2	0.95	0.53	1.9	0.1	0.16	0.014
Upper Lake Unit											
liddle Creek near Upper Lake	3/22/49	98	0.02	28	0.55	0.39	0.36	0.93	0.06	0.12	0.00
liddle Creek at bridge south of Upper Lake	4/11/50	140	0.11	13	0.90	0.73	0.29	1.4	0.1	0.21	0.017
lover Creek near Upper Lake	3/22/49	112	0.0	29	0.61	0.51	0.46	1.12	0.11	0.15	0.00
lley Creek junction with Clover Creek	3/22/49	106	0.0	26	0.52	0.57	0.38	1.09	0.08	0.13	0.00

TABLE 2

COMPLETE MINERAL ANALYSES OF GROUND WATERS IN UNITS OF CLEAR LAKE AREA

Well location or number	Date of sample	pH	Conductance, Ec × 10^6 at 25° C.	Boron, in ppm	Mineral constituents, in equivalents per million												Per cen sodium
					Ca	Mg	Na	K	Total	CO_3	HCO_3	Cl	SO_4	NO_3	F	Total	
Big Valley Unit																	
12N/7W-1J2	3/ 6/52	7.80	396	0.15	1.50	2.14	0.96	0.02	4.62	------	2.92	1.29	0.34	0.15	0.00	4.70	21
13N/9W-1N1	9/18/47	6.00	707	2.48	1.50	4.90	1.30	------	7.70	------	6.90	0.80	------	------	------	7.70	17
13N/9W-2K1	7/ 6/48	7.45	400	0.24	1.00	2.80	0.60	------	4.40	------	3.90	0.30	0.20	------	------	4.40	14
13N/9W-2K2	8/ 8/52	8.20	556	0.09	1.50	4.36	0.48	0.03	6.37	------	5.51	0.40	0.34	0.07	0.00	6.32	8
13N/9W-2K3	1/31/48	8.30	436	0.12	1.10	3.40	0.30	------	4.80	------	4.30	0.30	0.20	------	------	4.80	6
13N/9W-4D1	8/ 8/52	7.80	762	0.14	2.69	5.18	0.70	0.02	8.59	------	6.46	1.02	0.96	0.13	0.00	8.57	8
13N/9W-4H1	8/ 8/52	8.00	438	0.05	1.15	3.45	0.38	0.02	5.00	------	4.46	0.21	0.18	0.13	0.00	4.98	8
13N/9W-4P1	7/ 1/49	7.22	382	0.06	1.23	2.64	0.57	------	4.44	------	3.91	0.12	0.14	0.00	------	4.17	12
13N/9W-4P1	8/ 8/52	8.00	480	0.41	1.90	3.04	0.52	0.01	5.47	------	4.65	0.48	0.25	0.04	0.00	5.42	10
13N/9W-5C1	8/ 8/52	8.10	528	0.17	1.60	3.78	0.65	0.03	6.06	------	5.70	0.11	0.14	0.09	0.00	6.04	11
13N/9W-5K2	8/ 8/52	8.60	416	0.16	1.30	2.88	0.61	0.02	4.81	0.37	3.95	0.29	0.16	0.02	0.01	4.80	13
13N/9W-5Q1	7/30/45	6.60	398	0.18	1.00	2.90	0.50	------	4.40	------	4.30	0.10	------	------	------	4.40	11
13N/9W-6F1	7/20/50	7.70	250	0.08	1.10	0.90	0.70	------	2.70	0.50	1.80	0.20	0.20	------	------	2.70	26
13N/9W-8B1	6/18/47	7.10	316	0.21	1.10	1.90	0.40	------	3.40	------	3.10	0.20	0.10	------	------	3.40	12
13N/9W-8B1	8/ 8/52	8.00	329	0.16	1.10	2.06	0.44	0.02	3.61	------	3.26	0.15	0.12	0.11	0.01	3.64	12
13N/9W-8G1	8/11/47	7.20	340	0.47	0.90	2.60	0.40	------	3.90	------	3.50	0.40	------	------	------	3.90	10
13N/9W-8	8/ 3/50	7.00	320	0.28	1.30	2.30	0.40	------	4.00	------	3.20	0.30	0.50	------	------	4.00	10
13N/9W-8	8/ 3/50	7.30	350	0.36	1.40	2.60	0.40	------	4.40	------	3.40	0.50	0.50	------	------	4.40	9
13N/9W-8	8/ 3/50	7.50	330	0.16	1.20	2.00	0.40	------	3.60	------	2.90	0.50	0.20	------	------	3.60	10
13N/9W-8N1	6/27/49	7.47	738	1.80	1.38	5.71	1.63	------	8.72	------	8.03	0.67	0.03	0.00	------	8.73	19
13N/9W-8N1	8/ 8/52	7.40	600	1.30	1.25	3.95	1.30	0.07	6.57	0.00	5.41	0.56	0.02	0.55	0.00	6.54	20
13N/9W-8	9/23/50	7.40	500	0.04	0.60	5.40	0.30	------	6.30	------	5.90	0.40	0.10	------	------	6.40	5
13N/9W-9J1	10/16/46	8.60	351	0.24	2.10	0.90	0.40	------	3.40	0.60	2.40	0.20	0.20	------	------	3.40	12
13N/9W-9J2	10/16/46	8.75	486	0.08	1.60	3.20	0.50	------	5.30	0.90	4.10	0.30	------	------	------	5.30	9
13N/9W-9Q1	8/ 8/52	7.60	530	0.07	0.80	4.85	0.42	0.02	6.09	0.00	5.72	0.28	0.05	0.01	------	6.06	7
13N/9W-10Q1	11/20/46	8.30	328	0.21	1.10	2.00	0.60	------	3.70	------	3.50	0.20	0.00	------	------	3.70	16
13N/9W-10Q1	8/ 8/52	8.00	278	0.08	0.75	1.97	0.26	0.03	3.01	------	2.79	0.16	0.12	0.01	0.00	3.08	9
13N/9W-10	8/18/50	8.00	270	0.00	0.70	2.30	0.20	------	3.20	0.50	2.30	0.50	0.30	------	------	3.20	6
13N/9W-11K1	6/17/50	6.90	200	0.52	0.50	1.00	0.90	------	2.40	0.00	1.70	0.70	0.00	------	------	2.40	37
13N/9W-12M1	3/24/48	8.05	427	0.92	1.00	2.80	1.10	------	4.90	0.00	4.10	0.80	------	------	------	4.90	22
13N/9W-12M1	8/ 8/52	7.60	420	1.00	0.80	3.12	0.65	0.13	4.70	0.00	4.06	0.51	0.02	0.01	0.00	4.60	14
13N/9W-14F1	11/17/48	6.20	1,250	7.28	3.60	6.10	4.00	------	13.70	------	11.80	1.90	------	------	------	13.70	29
13N/9W-14F1	8/ 8/52	7.60	263	0.08	0.75	1.81	0.28	0.03	2.87	------	2.69	0.11	0.07	0.01	0.02	2.90	10
13N/9W14P1	6/19/47	6.75	347	0.18	0.90	1.70	1.30	------	3.90	------	3.50	0.40	------	------	------	3.90	33
13N/9W-14	10/16/44	6.60	516	0.18	1.00	4.10	0.70	------	5.80	------	4.80	0.80	0.20	------	------	5.80	12
13N/9W-16D1	2/19/48	7.40	426	0.12	1.10	3.40	0.50	------	5.00	------	4.70	0.30	------	------	------	5.00	10
13N/9W-16M1	5/29/50	7.10	900	0.00	1.50	7.20	0.80	------	9.50	------	9.90	0.60	0.00	------	------	10.50	7
13N/9W-16J1	10/ 6/48	7.50	680	0.25	0.80	8.30	1.30	------	10.40	0.40	7.20	0.50	------	------	------	8.10	14
13N/9W-17A1	11/15/46	6.85	1,210	0.51	2.90	11.80	1.90	------	16.60	0.60	14.30	0.60	------	------	------	15.50	11
13N/9W-17A1	7/ 1/49	7.42	1,117	0.41	2.07	11.07	1.40	------	14.54	------	13.61	0.47	0.02	trace	------	14.10	9
13N/9W-20E2	10/28/49	7.30	330	0.20	1.10	1.70	0.80	------	3.60	------	3.20	0.40	0.00	------	------	3.60	22
13N/9W-20P1	3/22/50	6.90	500	0.40	1.40	2.50	1.50	------	5.40	------	4.60	0.80	------	------	------	5.40	28
13N/9W-22J1	10/30/44	7.05	572	0.09	0.20	8.20	------	------	------	------	5.90	0.50	0.30	------	------	6.70	------
13N/9W-22J1	10/30/44	7.20	801	0.10	1.20	8.20	------	------	------	------	6.80	1.40	0.50	------	------	8.80	------
13N/9W-23C1	1/ 7/44	6.40	418	0.18	1.30	2.50	1.00	------	4.80	0.00	4.30	0.50	trace	------	------	4.80	41
14N/9W-31N1	8/ 8/52	7.20	846	0.92	1.95	6.83	1.17	0.04	9.99	0.00	9.18	0.51	0.04	0.00	0.00	9.73	12
14N/9W-31P1	8/13/49	6.60	800	0.64	1.60	5.40	1.60	------	8.60	------	8.00	0.60	------	------	------	8.60	19
14N/9W-31Q1	6/ 4/45	6.90	797	0.72	1.00	8.20			------	------	8.40	0.40	------	------	------	8.80	0
14N/9W-32K1	2/ /53	6.70	750	0.17	2.15	4.69	0.61	0.63	7.75	0.00	7.92	0.01	0.17	0.01	0.01	8.12	8
14N/9W-32K1	4/16/53	6.80	625	0.12	2.45	4.11	0.61	0.62	7.19	0.00	6.90	0.01	0.19	0.02	0.01	7.13	8
14N/9W-32K2	12/10/49	6.35	610	0.20	2.20	4.10	0.50	------	6.80	------	6.40	0.40	------	------	------	6.80	7
14N/9W-32J1	8/ 8/52	7.00	539	0.48	2.25	3.37	0.61	0.03	6.26	0.00	5.90	0.06	0.15	0.02	0.01	6.14	10
14N/9W-32R1	7/16/47	6.70	493	0.24	1.40	3.40	0.50	------	5.30	------	5.00	0.20	0.10	------	------	5.30	9
14N/9W-33K1	8/ 8/52	7.50	581	0.14	2.25	3.70	0.61	0.02	6.58	------	6.00	0.21	0.25	0.07	0.01	6.54	9
14N/9W-33M1	8/ 8/52	7.40	508	0.24	1.75	3.45	0.57	0.02	5.79	0.00	5.34	0.12	0.23	0.03	0.01	5.73	10
14N/9W-33P1	7/ 7/53	7.40	428	0.10	1.25	3.04	0.48	0.03	4.80	0.00	4.46	0.11	0.09	0.01	------	4.67	10
14N/9W-34M1	8/ 8/52	7.90	801	0.10	1.95	6.91	0.52	0.03	9.41	------	7.87	1.25	0.25	0.09	0.01	9.47	6
14N/9W-34Q1	8/ 3/52	8.00	302	0.08	0.80	2.14	0.28	0.02	3.24	------	2.87	0.14	0.21	0.07	0.01	3.30	9
Near Soda Bay on Mt. Konocti	7/ 8/49	6.30	810	5.56	2.40	3.70	2.30	------	8.40	------	7.10	1.30	------	------	------	8.40	27
Sulphur Bank Mine	11/25/47	7.70	1,410	25.70	4.30	6.70	5.20	------	16.20	------	6.80	1.10	8.30	------	------	16.20	32
Scott Valley Unit																	
14N/10W-11N1	8/ 7/52	7.40	230	0.26	1.25	0.76	0.42	0.02	2.45	0.00	2.10	0.19	0.14	0.01	0.01	2.45	17
14N/10W-14E2	7/ 8/49	7.50	220	0.07	1.18	0.30	0.68	------	2.16	------	2.01	0.15	0.17	trace	------	2.33	31
14N/10W-14P1	8/ 7/52	7.10	208	0.24	1.48	0.65	0.36	0.02	2.18	0.00	1.84	0.19	0.14	0.01	0.01	2.18	16
14N/10W-14	1/12/50	7.80	600	0.12	3.00	1.80	2.20	------	6.80	0.60	5.90	0.30	0.00	------	------	6.80	29

TABLE 2—Continued

COMPLETE MINERAL ANALYSES OF GROUND WATERS IN UNITS OF CLEAR LAKE AREA

Well location or number	Date of sample	pH	Conductance, Ec × 10[6] at 25° C.	Boron, in ppm	Mineral constituents, in equivalents per million												Per cent sodium
					Ca	Mg	Na	K	Total	CO_3	HCO_3	Cl	SO_4	NO_3	F	Total	
Upper Lake Unit																	
4N/9W-6D1	7/1/49	7.45	939	1.68	2.68	5.42	2.90	------	------	------	8.19	1.64	0.71	0.24	------	------	0
5N/9W-5R1	8/7/52	7.10	213	0.13	1.10	0.82	0.30	0.02	2.24	0.00	1.98	0.15	0.11	0.02	0.00	2.27	13
5N/9W-7M1	8/7/52	7.00	346	0.44	1.00	2.06	0.70	0.02	3.77	------	3.51	0.10	0.08	0.01	0.00	3.70	18
5N/9W-20N	------	------	573	2.48	2.12	2.69	1.35	------	6.16	------	5.81	0.22	0.69	trace	------	6.72	22
5N/9W-31L1	2/10/44	7.70	174	------	------	------	2.20	------	2.20	------	1.90	0.30	------	------	------	2.20	0
5N/9W-31P1	7/18/49	7.40	630	0.10	1.10	2.00	3.20	------	6.30	------	5.00	1.30	------	------	------	6.30	51
5N/10W-31B1	8/7/52	7.90	1,290	0.54	3.44	7.81	3.96	0.02	15.23	------	11.37	3.06	0.79	0.03	0.03	15.28	26
5N/10W-3	8/14/50	8.20	470	3.12	1.80	2.80	1.00	------	5.60	1.00	4.00	0.50	0.10	------	------	5.60	18
5N/10W-4B1	8/7/52	7.10	455	0.24	1.55	2.47	0.91	0.01	4.94	0.00	3.82	0.31	0.51	0.19	0.00	4.84	19
5N/10W-9H1	10/18/45	6.20	2,270	14.36	16.00	8.90	3.50	------	28.40	------	27.00	1.30	0.10	------	------	28.40	12
6N/9W-31K2	7/5/49	7.37	323	0.00	1.67	1.34	0.73	------	3.74	------	3.22	0.28	0.10	0.00	------	3.56	19

TABLE 3

PARTIAL MINERAL ANALYSES OF GROUND WATERS IN UNITS OF CLEAR LAKE AREA

Well number	Date and analysis of sample					
	May 20, 1949		July 25, 1949		September 20, 1949	
	Conductance, Ec × 10^6 at 25° C.	Chlorides, in epm	Conductance, Ec × 10^6 at 25° C.	Chlorides, in epm	Conductance, Ec × 10^6 at 25° C.	Chlorides, in epm
Big Valley Unit						
13N/9W-2C1	530	0.3	------	------	470	0.8
13N/9W-2E1	360	0.3	------	------	------	------
13N/9W-2J3	370	0.3	260	0.6	310	0.3
13N/9W-2L3	530	0.3	440	0.6	430	0.6
13N/9W-3B1	340	0.3	290	0.3	------	------
13N/9W-3C1	300	0.3	------	------	------	------
13N/9W-3E2		----	310	0.6	------	------
13N/9W-3L1	380	0.3	380	0.3	260	0.3
13N/9W-4G1	540	0.3	340	0.3	340	0.3
13N/9W-4N1	540	0.3	480	0.3	500	0.3
13N/9W-4P1	430	0.3	350	0.3	------	------
13N/9W-5M3	410	0.3	310	0.3	------	------
13N/9W-6C1			690	0.8	------	------
13N/9W-7A1	210	0.3	190	0.3	------	------
13N/9W-8D2	380	0.3	330	0.6	------	------
13N/9W-8E1	460	0.3	360	0.6	390	0.3
13N/9W-8L3	350	0.3	260	0.3	------	------
13N/9W-8R2	300	0.3	240	0.3	------	------
13N/9W-9A1	460	0.3	330	0.6	------	------
13N/9W-9A3	330	0.3	290	0.3	------	------
13N/9W-10G1	230	0.3	230	0.3	210	0.3
13N/9W-11E1	400	0.3	270	0.6	290	0.3
13N/9W-12A1	410	0.3	370	0.8	360	0.3
13N/9W-12J2	380	0.3	340	0.6	------	------
13N/9W-15C2	300	0.3	380	0.6	260	0.3
13N/9W-16C1	650	0.3	510	0.6	530	0.8
13N/9W-16F1	500	0.3	450	0.6	510	0.6
13N/9W-16F2	------	------	410	0.8	------	------
13N/9W-16J1	------	------	780	0.6	------	------
13N/9W-19D1	280	0.6	340	0.6	360	0.3
13N/9W-22D1	------	------	290	0.6	------	------
13N/9W-23B1	770	0.6	390	0.6	370	0.3
13N/9W-22M1	------	------	480	0.6	410	0.3
13N/9W-28N1	870	0.6	1,190	1.7	1,200	1.4
14N/9W-32J2	490	0.3	430	0.3	------	------
14N/9W-32M1	510	0.3	430	0.3	500	0.6
14N/9W-32N1	460	0.3	390	0.6	430	0.6
14N/9W-33J1	560	0.3	490	0.6	490	0.8
14N/9W-33L1	340	0.3	------	------	------	------
14N/9W-33M1	670	0.6	290	0.6	------	------
14N/9W-34K3	360	0.3	330	0.3	340	0.3
14N/9W-34N3	------	------	400	0.6	------	------
14N/9W-34R1	280	0.3	260	0.3	240	0.3
14N/9W-34Q1	------	------	240	0.3	240	0.3
14N/9W-35N1	530	0.6	360	0.3	340	0.3
Scott Valley Unit						
14N/10W-10M1	220	0.3	197	0.3	186	0.3
14N/10W-10P1	270	0.3	220	0.3	240	0.3
14N/10W-14K1	250	0.3	220	0.6	------	------
14N/10W-14N2	220	0.3	174	0.3	------	------
Upper Lake Unit						
15N/9W-5K1	260	0.3	220	0.3	210	0.3
15N/9W-6A1	------	------	163	0.3	171	0.3
15N/9W-6L1	164	0.3	140	0.3	143	0.3
15N/10W-3N1	710	0.3	610	0.8	770	0.8
16N/9W-31R1	440	0.3	147	0.3	------	------
16N/9W-31R2	------	------	------	------	157	0.3
16N/9W-31J3	190	0.3	163	0.6	186	0.3
16N/10W-34N1	380	0.3	390	0.8	340	0.8

APPENDIX H

APPLICATIONS TO APPROPRIATE WATER IN CLEAR LAKE AREA

(Filed With State Water Rights Board Under Provisions of Water Code, State of California, as of May 5, 1955)

APPLICATIONS TO APPROPRIATE WATER IN CLEAR LAKE AREA

(Filed With State Water Rights Board Under Provisions of Water Code, State of California, as of May 5, 1955)

Application number	Date filed	Name of applicant	Source of water supply	Location of diversion point, referenced to Mt. Diablo base and meridian					Diversion, in second-feet	Storage, in acre-feet	Purpose	Status
				¼	¼	Section	Township	Range				
26	4/14/15	W. H. Hill	Alder Creek		SE	8	11N	8W	0.08		Domestic	License
1036	8/ 2/18	M. A. Murphy	Unnamed creek	SE	SW	22	12N	7W	0.175		Irrigation	License
1472	10/ 4/19	S. M. Websler	Unnamed creek	SE	NE	17	12N	7W	1/80		Irrigation and domestic	License
3858	2/19/24	U. S. Mendocino National Forest	Grouse Springs	NW	SE	36	17N	10W	0.013		Domestic and stockwater	License
6904	3/ 9/31	G. M. Haycock	Middle Creek	NW	SW	31	16N	9W	0.21		Irrigation	License
6927	3/31/31	P. V. Pendroncini	Two unnamed springs	NW	SW	11	15N	11W	0.1		Irrigation and domestic	License
7108	10/30/31	E. V. Baldwin	Unnamed spring	SW	SE	32	15N	8W	0.01		Domestic	License
8135	10/18/34	Division of Highways	Unnamed spring	Lot	2	35	14N	8W	1,000 g.p.d.		Recreational	License
9868	4/ 5/50	M. F. Dorst	Unnamed creek	SE	NE	12	13N	11W		150	Irrigation	License
0398	3/12/42	U. S. Mendocino National Forest	Unnamed spring	NW	SE	3	16N	10W	1,000 g.p.d.		Domestic	License
1499	8/ 6/46	J. Walter Petray	Scott Creek	NW	NE	29	15N	10W	0.39		Irrigation	License
1766	3/10/47	C. J. Pine	Unnamed spring	NW	SE	17	15N	10W	1,000 g.p.d.		Domestic	License
1879	5/14/47	W. I. Larmer	Unnamed spring	SW	SE	6	12N	8W	0.022		Domestic	License
2389	3/ 8/48	Big Valley Soil Conservation District	Kelsey Creek			34	13N	9W	100.00	41,000	Domestic and irrigation	Application
3258	7/25/49	County of Lake	Middle Creek		SE	34	13N	9W		132,000	Domestic and irrigation	Application
			Scott Creek	SE	SW	25	16N	10W				
			Kelsey Creek	NE	SW	22	14N	10W				
4158	2/13/51	J. Walter Petray	Unnamed spring	SW	SW	21	15N	10W		160	Irrigation	Permit
5697	1/21/54	Edith S. Allen	Unnamed stream tributary to Kelsey Creek	SE	NE	33	13N	9W		100	Irrigation	Application
5294	3/31/55	Albert E. Oliver	Kelsey Creek	NW	NE	10	11N	8W	0.06		Irrigation	Application

APPENDIX I

COURT DECREES RELATING TO OPERATION OF CLEAR LAKE

TABLE OF CONTENTS

IN THE SUPERIOR COURT OF THE STATE OF CALIFORNIA, IN AND FOR THE COUNTY OF MENDOCINO

M. M. GOPCEVIC, and THE HOTALING ESTATE CO., a corporation, and GEORGE T. RUDDICK, *Plaintiffs,* vs. YOLO WATER AND POWER COMPANY, a corporation, and YOLO WATER AND POWER CORPORATION, a corporation, *Defendants,* COUNTY OF LAKE and LISLE STUBBS et al. *Intervenor*	DECREE

Pursuant to the stipulation of all parties herein reduced to writing and filed in open court on the 7th day of October, 1920, agreeing and consenting that the following judgment and decree be entered in the above entitled action, and upon evidence taken; and finding being waived in open court by all parties;

It is Hereby Ordered Adjudged and Decreed as Follows:

That the defendant herein be perpetually enjoined and restrained from excavating or deepening the outlet of Clear Lake, being the Clear Lake mentioned in the pleadings herein, to any depth greater than four feet below the zero mark on the Rumsey gauge at Lakeport, County of Lake, State of California, which said gauge is hereinafter more particularly referred to; and from widening straightening or otherwise interfering with said outlet, except as may be necessary to carry out the provisions of this decree, all of such work to be with the approval first obtained and under the supervision of the State Railroad Commission of California, or the members thereof; and this injunction shall include the said defendants, their and either of their, officers, agents, servants, employees successors and assigns, and each and all officers and agents of either of them, and all persons acting under or in aid of them or either of them.

That the agents, servants, employees, successors and assigns of the said defendants and the said defendants and each of them, and all persons acting under or in aid of them or either of them be perpetually enjoined and restrained from at any time, or in any way raising the level of said lake in excess of 7.56 feet above zero on said Rumsey Gauge, and from at any time or at any way lowering the level of said lake below zero on said Rumsey Gauge; provided, however, that the rise of said Clear Lake, by reason of storm or flood conditions beyond the control of said defendants, or either of them, to a level in excess of 7.56 feet above zero on said Rumsey Gauge, but in no event to a level in excess of 9.00 feet above zero on said Rumsey Gauge, for any period not exceeding ten successive days, shall not be deemed a violation hereof:

The zero mark on said Rumsey Gauge is 20.1 feet below center of large concrete star in northeast corner of court house yard at said Lakeport, and 21.56 feet below iron step at front entrance to Bank of Lake Building at southeast corner of Main Street and Second Street, in said Lakeport;

That said defendants, and each of the, their officers, agents, employees, successors and assigns and all persons acting under or in aid of them or either of them, be perpetually enjoined and restrained from drawing off from said Clear Lake an amount of water which, inclusive of evaporation and other losses, will at any time reduce the level of said lake below zero on said Rumsey Gauge, and the said defendants, and each of them, their officers, agents, employees, successors and assigns, be perpetually enjoined and commanded to draw off from said lake an amount of water which, inclusive of evaporation and other losses will reduce the level of the lake so that the elevation thereof on the following dates shall not exceed the following percentages of the actual level on April 15th of each year;

May 1, 97%, June 1, 89%, July 1, 79%, August 1, 69% and September 1, 58%.

That said defendants and each of them, their officers, agents, employees, successors and assigns, be perpetually enjoined and restrained from drawing off from said lake, during the irrigation season an amount of water which, inclusive of evaporation and other losses shall lower the level of said lake more than two feet in any one month;

It is hereby specially adjudged and decreed that notwithstanding the limits of depression of said lake waters hereinabove described the said defendants, and each of them, their agents, employees, successors and assigns, shall not draw off or allow, and they and each of them are enjoined and restrained from drawing off or allowing the waters of said lake to flow out of said lake at any time at such a rate as that, taking into account evaporation and other losses, the water of said lake shall at the lowest of any year be below zero on said Rumsey Gauge;

It is further adjudged and decreed that the said defendants, or either of them, shall at or about the specific dates last hereinabove mentioned, notify in writing, through the mails or otherwise, the parties hereto and as well such owners or occupants of land on the rim of said lake as shall register their names and addresses with the defendant, Yolo Water and Power Company, at its office in Woodland, Yolo County, California, of the then existing and respective levels of the said lake.

The drawing off of the water of said lake under the conditions aforesaid, shall be by and through the dam and gates mentioned in the pleadings herein, and the administration conduct and operation of said dam and gates shall be responsive to and in full and fair execution of such conditions, and shall at all times be by and under the State Railroad Commission of California, or the members thereof;

If at any time the injunctive provisions of this decree shall be violated, or departed from in matter of substance and all the provisions of this decree are for this purpose taken to be injunctive then and in such events the said defendants and each of them are hereby enjoined and commanded forthwith thereupon, in the manner and to the extent hereinafter provided, or in default thereof it shall be competent to the plaintiffs or any or either of them, or in default of action in the promises by the plaintiffs or any or either of them, it shall be competent to the interveners, or any or either of them, and said parties are accordingly hereby authorized, at the expense of defendants, their successors and assigns to restore and maintain at the "Grigsby Riffle" mentioned in the complaint herein, but above the present mouth of "Seigler Creek" a suitable and substantial structure or barrier, the crest of which shall not exceed one foot above zero on said Rumsey Gauge except as hereinafter provided;

But it is further and specifically decreed that if at any time, for any physical reason, or otherwise, said dam should cease in any substantial sense, to function in respect to the operation of the same as hereinabove referred to, then and in that event the crest of the aforesaid structure or barrier may be increased and maintained to an elevation of two feet above zero on said Rumsey Gauge, said structure and barrier shall exist and be maintained at all times when a dam shall cease to function as provided in this decree for the operation of the same; provided however that the failure of the defendants or either of them to comply substantially with the terms of this decree, due to temporary, unavoidable causes shall not be deemed a violation of this decree;

It is further adjudged that this decree does not adjudicate upon the extent of the several riparian or littoral rights of any of the parties hereto in the said Clear Lake or the land adjacent thereto nor upon any rights or claims of any of said parties to water rights therein, nor in or over such adjacent lands, and that the injunctive relief hereby granted and provided for is not based upon a waiver by any of said parties of any such substantive rights of claims aforementioned but is subject to full reservations on the part of all and each of said parties of all said substantive rights or claims aforesaid;

It is further ordered adjudged and decreed that the said dam and the operation thereof shall at all times be subject to reasonable access and inspection by the parties hereto as well as any person owning land riparian or littoral to said Clear Lake and their duly authorized agents or attorneys; but if any question should arise in respect to the right of any such person or persons to such access and inspection, the same shall be remitted to the state railroad commission of California, or the members thereof for final determination.

That all claims for damages involved in this action or on account of the issuance of the temporary restraining order or preliminary injunction herein are waived and adjudged to be fully settled;

That each party to this action shall pay his own costs.

The signing and filing of this decree shall be deemed to be noticed of the terms thereof and effective as service of any injunctive process consequent thereon.

Done in open Court the 7th day of October, 1920.

A. B. McKenzie
Judge.

Certified: October 7th, 1920, by the Clerk of said Court to be a full, true and correct copy of the original on file and of record in his office.

Endorsed: Filed Oct. 7, 1920, Hale Prather, Clerk
by W. H. Prather, Deputy

Recorded: October 8th, 1920, in vol. 60 of Deeds, at page 49. Records of Lake County, California.

C. C. McDonald,
Attorney for Plaintiffs,
Woodland, California.

THE SUPERIOR COURT OF THE STATE OF CALIFORNIA, IN AND FOR THE COUNTY OF YOLO

ARY E. BEMMERLY and AGNES H. EMMERLY, *Plaintiffs*,

vs.

IE COUNTY OF LAKE, a Political Subvision of the State of California, E. L. ERRICK, W. E. REICHERT, L. D. RKPATRICK, L. L. BURGER and J. S. ELSAY, as and comprising the Board of pervisors of the County of Lake, State of lifornia, THE BOARD OF SUPERVISORS THE COUNTY OF LAKE, STATE OF ALIFORNIA, E. L. HERRICK, individually d as a member of the Board of Supervisors the County of Lake, State of California, RANK W. NOEL, individually, W. E. EICHERT, as a member of the Board of pervisors of the County of Lake, State of lifornia, W. T. SMITH, individually, L. D. RKPATRICK, as a member of the Board Supervisors of the County of Lake, State California, L. L. BURGER, individually and a member of the Board of Supervisors of the unty of Lake, State of California, J. S. ELSAY, individually and as a member of the ard of Supervisors of the County of Lake, ate of California, FRANK B. JOHNSON, lividually and as a County Surveyor of the unty of Lake, State of California, FRANK CLARK as Director of the Department of blic Works of the State of California, EAR LAKE WATER COMPANY, A RPORATION, J. R. REEVES, JOHN DE DREDGING COMPANY, RICHARD DE DREDGING CO., FIRST DOE, SECD ROE AND THIRD ROE, *Defendants*.

No. 8812

JUDGMENT

This cause having been regularly called and tried the Court, and the findings of fact and conclusions law, and the decision thereon in writing, having en rendered, wherein judgment was ordered in vor of the plaintiffs and against the defendants reinafter named as prayed for in the complaint d for costs,

IT IS, BY THE COURT, ORDERED, ADJUDGED AND CREED that the defendants, The County of Lake, a litical Subdivision of the State of California, E. L. Herrick, W. E. Reichert, L. D. Kirkpatrick, L. L. Burger and J. S. Kelsay, as and comprising the Board of Supervisors of the County of Lake, State of California, the Board of Supervisors of the County of Lake, State of California, E. L. Herrick, individually and as a member of the Board of Supervisors of the County of Lake, State of California, Frank W. Noel, individually, W. E. Reichert as a member of the Board of Supervisors of the County of Lake, State of California, W. T. Smith, individually, L. D. Kirkpatrick as a member of the Board of Supervisors of the County of Lake, State of California, L. L. Burger, individually and as a member of the Board of Supervisors of the County of Lake, State of California, J. S. Kelsay, individually and as a member of the Board of Supervisors of the County of Lake, State of California, Frank B. Johnson, individually and as County Surveyor of the County of Lake, State of California, Frank W. Clark, as Director of the Department of Public Works of the State of California, and Clear Lake Water Company, a corporation, and each and all of them, and their, and each of their attorneys, agents, servants and employees and any and all persons acting under said defendants, or any of them, be, and they and each and all of them are hereby forever enjoined and restrained from in any manner widening, deepening, or enlarging the arm or slough which constitutes the outlet of the waters of and from Clear Lake into Cache Creek and from in any manner changing the said outlet so as to increase the flow of waters of and from Clear Lake into Cache Creek. The Clear Lake herein referred to is the Clear Lake described in the plaintiffs' complaint and which is located in the County of Lake, State of California.

IT IS FURTHER ORDERED, ADJUDGED AND DECREED that plaintiffs have judgment for their costs taxed at Dollars ($).

Judgment rendered December 18, 1940.

DAL M. LEMMON
Judge of the Superior Court.

6—57411

APPENDIX J

DAMS UNDER STATE SUPERVISION IN LAKE COUNTY

DAMS UNDER STATE SUPERVISION IN LAKE COUNTY

Name	Owner	Stream	Location, M.D.B.&M. Section	Township	Range	Type	Crest length, in feet	Height, in feet	Elevation of crest, in feet above sea level	Reservoir capacity, in acre-feet	Date constructed
ear Lake Impounding	Clear Lake Water Company	Cache Creek	6	12N	7W	Gravity, straight	260	32	1,328	420,000	1914
etert Lake	W. F. Detert Estate	Bucksnort Creek	9	10N	6W	Earth	1,000	40	1,082	1,700	1928
ters	Margaret F. Dorst	Tributary to Ben Moore Creek	12	13N	11W	Earth	465	32	2,521	112	1940
ott (Lake Pillsbury)	Pacific Gas and Electric Company	South Eel River	14 and 23	18N	10W	Gravity, straight	815	120	1,920	93,720	1921

APPENDIX K

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service, Research

IRRIGATION PRACTICES AND CONSUMPTIVE USE OF WATER IN LAKE COUNTY, CALIFORNIA

By
Harry F. Blaney, Principal Irrigation Engineer
and
Paul A. Ewing, Senior Irrigation Economist

(A report based on data gathered under cooperative agreement between the Division of Water Resources, Department of Public Works, State of California, and the Soil Conservation Service, United States Department of Agriculture.)

Los Angeles, California
June, 1951

(Slightly revised December, 1953)

TABLE OF CONTENTS

TABLES

APPENDIX

PLATE K1

Follows text of appendix, page 169

IRRIGATION PRACTICES AND CONSUMPTIVE USE OF WATER IN LAKE COUNTY, CALIFORNIA

By
Harry F. Blaney, Principal Irrigation Engineer
and
Paul A. Ewing, Senior Irrigation Economist

INTRODUCTION

This report is a contribution to an investigation carried on by the Division of Water Resources, California State Department of Public Works, involving the whole subject of the utilization of the water supply of the principal irrigated areas of Lake County.

Because of experience accumulated by the Division of Irrigation and Water Conservation [1] (of U. S. Soil Conservation Service), in other typical irrigated areas of California, its entry into the investigation was brought about under the provisions of a formal agreement of long standing between the two agencies. By this arrangement, the Division of Irrigation and Water Conservation [1] undertook to ascertain the amounts of water artificially applied to irrigated crops in the Lake County areas, under current practices, and to calculate the amounts consumptively used by those crops and by the native or natural vegetation.

In the study of irrigation practices and in an associated examination of the soils of the areas, the Division of Irrigation and Water Conservation had the assistance of field personnel of the Operations Division, Soil Conservation Service, through the Lakeport technical staff headed by Sheldon A. Bell, Work Unit Conservationist, and working under the general direction of John Barnes, State Conservationist for California. This party, already familiar with general farming methods in the areas, obtained water information from the operators of 23 farms, selection of which was intended to reflect the different soil conditions as well as the irrigation practices typifying the growing of the principal crops. The interviews thus produced data indicative of the growing season, the number of irrigations and the irrigation season, amounts of water applied (measured or estimated) and other pertinent information. The form used in these interviews appears in the Appendix.

Since the areas surveyed comprised two Soil Conservation Districts—*Big Valley* and *Scotts Valley-Upper Lake*—to which Mr. Bell and his staff provide technical assistance, the support of the boards of directors was requested and freely given, to the effect of suggesting farmers who were well capable of supplying the needed information and informing the community generally as to the objectives of the investigation. This assistance proved to be helpful in expediting the field work and was greatly appreciated by those heading the investigation.

Responsibility for the irrigation-practice study was assigned to Paul A. Ewing, Senior Irrigation Economist, while Harry F. Blaney, Principal Irrigation Engineer, was placed in charge of the consumptive-use determinations. This being their progress report, it is inconclusive; a final report is planned, in which basic data from the field work, analyses of results, and conclusions derived from them will be set out. At this writing some of the basic data are not available.

Statement of the Problem

A cooperative agreement effective December 17, 1948, entered into by the California State Water Resources Board, the County of Lake, and the Department of Public Works, State of California, provided for the making of an investigation and report on the underground water supplies of Big Valley within the Big Valley Soil Conservation District, and those of the Scotts Valley and Upper Lake areas within the Scotts Valley-Upper Lake Soil Conservation District, including their water quality, utilization and replenishment, and, if possible, a method or methods of solving the problems involved. A major problem in Big Valley is the apparent shortage of ground water in the latter part of the irrigation season occasioned by the inadequacy of the ground water storage to support the present development. Problems in the Scotts Valley-Upper Lake area are associated with damage from floods, poor subsoil drainage in some sections, high water table in a limited section, and a shortage of irrigation and domestic water in some parts during the late irrigation season.

THE SURVEYED AREAS

The areas surveyed in the investigation are in the central part of Lake County, which lies in the Coast Range of mountains, some 70 miles north of San Francisco Bay and about midway between the Pacific Ocean and Sacramento Valley. They include lands adjacent to Clear Lake on north, west and south, and comprise most of the agricultural portion of the county. Big Valley and Scotts Valley-Upper Lake Soil Conservation Districts (Figures 1 and 2) include these lands.

Clear Lake, in times of high water, drains through Cache Creek into Sacramento River. It is about 17 miles long from east to west and varies in width from about one mile to six miles. Mount Konocti rises abruptly from the southern shore of the lake to attain

[1] Transferred to the Western Soil and Water Management Section, Soil and Water Conservation Research Branch, Agricultural Research Service, U. S. Department of Agriculture, January 1, 1954.

an elevation of more than 4,100 feet. Spurs of the Coast Range hem in the lake on all sides, and drainage ways issuing from the mountains have built alluvial fans and terraces which rise with increasing gradients or successive steps to meet the foothills or the steeper mountain slopes.

To the west of Mount Konocti, sediments from Cold Creek, Kelsey Creek and Adobe Creek have built up the alluvial plain known as Big Valley. Scotts Valley, west of Clear Lake, is another important agricultural valley. Middle Creek, Bachelor Valley Creek, and Clover Valley Creek drain the area known generally as the Upper Lake area, joining near the town of Upper Lake to enter Clear Lake through Robinson slough. They likewise have built up an alluvial plain bordering the lake.

Clear Lake lies at an elevation of about 1,300 feet, but its water level fluctuates somewhat from season to season, partly owing to varying releases of its water to Cache Creek for irrigation in Sacramento Valley. The valley lands lie generally from 1,350 to 1,400 feet above sea level; the neighboring mountainous areas attain elevations ranging from 2,000 feet to more than 4,000 feet.

Natural drainage of the surveyed areas is mainly into Clear Lake through Scott, Middle, Cold, and Kelsey creeks. Throughout the neighboring mountainous areas there are a number of small lakes which accumulate from several inches to a foot or more of water soon after the rainy season begins and retain some of this moisture until nearly mid-summer. Drainage is poor in parts of Big Valley and near the mouths of Middle and Scott creeks. The water table in these localities is likely to be high during the rainy season, but drops rapidly by mid-summer when pumping from wells for irrigation reaches its peak. Most of the streams in the mountainous areas are swift-flowing, but before reaching Clear Lake they fan out over the bottom lands, and drainage reaches the lake as sheet water or through shallow channels.

Lakeport is the county seat of Lake County and is its principal town, having a 1950 population of 1,947. Upper Lake provides schools, churches, banks and trading points for the northern part of the surveyed area, while Lower Lake has a comparable position on the southern side of the lake. Kelseyville is the main business and social center of the Big Valley area. Smaller towns or summer settlements border Clear Lake; others, in the mountains, are near the numerous hot springs. These resorts, as well as the Clear Lake region in general, have great popularity during the summer vacation season and attract vistors from all over northern California.

No railroad operates in the Clear Lake area. The Northwestern Pacific Railroad, running between San Francisco Bay and Eureka, passes up Russian River, and paved roads connect the area with this railroad at Hopland and Ukiah. A good road leads eastward to Sacramento Valley and its major highways and railroads, while southern outlets are by highways, now undergoing extensive improvement, leading to Vallejo and Eastbay metropolitan centers. The area itself is well served with secondary paved roads. Other communications are modern, and electricity, essential in the conduct of the agriculture of the area, is everywhere available.

CLIMATE

The climate of the general area is mild, although during the summer some extremely hot days may occur. However, hot spells are short. The summers are dry and the winters mild with moderate rainfall.

The rainy season begins in October and continues until late in May. More than half of the annual precipitation falls in December, January and February. During the summer and early autumn, little or no rain falls; the skies are cloudless and temperatures uniformly warm. The winter rains are generally accompanied by southeast winds which may continue for several days, then being succeeded by clear, warm weather. The mean annual precipitation at Upper Lake, 28.51 inches, is fairly representative of rainfall of the valley areas. At higher elevations the rainfall is correspondingly heavier. Light snowfalls occur during most winters, but usually the snow melts as it falls or remains only a few days. Fogs occur infrequently, mostly during the winter.

The mean annual temperature at Upper Lake is 57.1 degrees F. In the mountains, the summer temperatures are lower, and the days are tempered by breezes; during the summer a cool breeze blows from the ocean during the afternoons until sundown. Heavy winds, although rare, blow occasionally for short periods during the spring and fall.

The average date of the last killing frost at Upper Lake is April 6; date of the first killing frost is October 31. These average dates mark an average frost-free period of 208 days. However, frosts have been recorded as late as May 23 and as early as September 25; and early and late frosts sometimes do considerable damage, especially in spring when the fruit buds may be killed. Many orchardists practice orchard heating to prevent frost damage. Wind machines are now becoming popular. Pears and walnuts are well suited to the climate, as are also the general farm crops, including alfalfa and the grains.

Table 1 sets out the normal monthly, seasonal, and annual temperature and precipitation for a representative station in the surveyed area.

LAND CONDITIONS [1]

Most of the irrigated lands of Lake County are in the Big Valley, Scotts Valley and Upper Lake areas. The soils in these irrigated sections may be classified

[1] By Richard C. Huff, Soil Scientist, Soil Conservation Service.

TABLE 1. Normal monthly, seasonal, and annual temperature and precipitation at Upper Lake, California
(Elevation 1,343 feet)

Month	Temperature			Precipitation		
	Mean (35 years through 1945) °F.	Absolute maximum (26 years through 1940) °F.	Absolute minimum (27 years through 1940) °F.	Mean (43 years through 1945) Inches	Total amount for the driest year (1898) Inches	Total amount for the wettest year (1940) Inches
ecember	44.4	78	11	5.84	1.34	16.01
anuary	43.9	84	13	7.12	.93	12.30
ebruary	46.6	83	13	5.27	4.57	14.35
Winter	45.0	84	11	18.23	6.84	42.66
arch	49.8	90	22	4.00	.36	7.12
pril	54.3	93	25	1.91	.43	1.36
ay	59.3	102	29	1.23	1.90	2.46
Spring	54.5	102	22	7.14	2.69	10.94
ne	66.1	109	35	0.31	.58	0.24
ly	73.1	111	40	0.02	.00	0.00
ugust	72.0	109	37	0.02	[1]	0.00
Summer	70.4	111	35	0.35	.58	0.24
ptember	66.3	106	28	0.38	.60	0.66
ctober	58.9	101	23	1.61	1.01	3.26
ovember	50.3	90	20	3.33	1.66	2.20
Fall	58.5	106	20	5.32	3.27	6.12
Year	57.1	111	11	31.04	13.38	59.96

race

s bottomlands, valley lands, and terrace and foothill nds; the bottomlands being distinguished from other alley lands by relatively poor drainage conditions.

Soils in the bottomlands (poorly drained) are very eep (60 inches or more), heavy to very heavy texured (elay loams to elay adobe) and moderately to owly permeable. Slopes are nearly level and the eroon problem is not serious. The greater part of this nd has a wetness problem during at least a portion f the year owing to flooding or high water table. ver half of the area is subjeet to deposition erosion om flood waters, whieh in general is not seriously amaging to the soil profile.

The valley lands inelude the alluvial flood plains f Big Valley, Seotts Valley and Upper Lake areas. oils in the valley lands are for the most part very eep (60 inches or more), medium to heavy textured, d rapidly to moderately permeable. However, they elude some impermeable hardpan soils and some roughty soils underlain by porous sand and gravels. he two soils last mentioned oecupy a relatively small reage of the valley lands. Slopes are nearly level d the erosion problem is not serious. About 15 pernt of the area is subject to overflow and flooding. he amount of deposition varies with the storm innsity, but serious damage is eaused where eoarse nds and gravels are deposited.

The terrace and foothill lands inelude alluvial fans, old elevated river terraees, and some residual soils on sandstone and shale bedroek. These terraees and foothill lands are higher elevations around the edge of the valley areas. Most soils on the terrace and foothill areas are shallow (16 to 18 inches) to moderately deep (18 to 36 inches), medium textured, and lie over bedroek or dense to nearly impermeable elaypan. The slopes are gentle to steep and the erosion problem is moderate to severe. In general, the steeper the slope the more serious the erosion problem. The soils inelude deep (36 to 60 inches) and very deep (60 inches or more), medium textured, moderately permeable soils over semi-consolidated materials. The terrace soils are not as fertile as the younger bottom and valley land soils. They are also more subject to erosion owing to slower permeability, steeper slopes, and poor physieal condition of the surface soils.

The land-capability elasses show the adaptability of the lands in each area for agricultural use; the larger land areas inelude all the land-capability elasses. There are eight of these elasses which fall into two broad groups: (1) Land suitable for cultivation (Classes I-IV) and (2) land not suitable for eultivation, but for grazing, wildlife or watershed protection (Classes V-VIII).

Class I and II lands are adapted to irrigation. Class III is suitable for irrigation if the use limitation is not due to steepness of slope. Class IV is limited to dryland pasture and hay. Classes V to VII are suitable for grazing and Class VIII for wildlife, recreation, or wathershed protection.

The bottomlands are usually Class II or III, depending on degree of the wetness problem. Very wet, or permanently wet lands are in Class V. The bottomlands may be farmed intensively without danger of erosion. This is reflected in the erops grown: lima beans, corn, root crops, alfalfa, and grain. However, all these bottomlands need drainage, irrigation and soil management to maintain high production.

Most of the land in the valley areas is Class I or II. There are no limitations in use of Class I land, except that ordinary good farming methods must be followed. Limitations in use of Class II land are usually due to wetness, gravels, or soil depth, all of which affect irrigation practiee. Class III land in the valley areas has use limitations owing to soil depth (less than 36 inches to porous gravels) or wetness. The erosion problem in general is not serious and land ean be farmed intensively with good soil, irrigation and drainage management.

The cultivated lands in the terrace and foothill areas fall generally into Classes III and IV. Soil depth (less than 36 inches to elaypan or bedrock), erosion, steepness of slope alone or in combination, are limitations affecting the use of this land. Class IV land is usually too steep and shallow to be irrigated without causing serious soil erosion.

A brief outline of the land conditions in each of the areas—Big Valley, Scotts Valley and Upper Lake—is given below.

Big Valley Area

The valley land includes a wide variety of soils varying from shallow, light-textured soils over porous sands and gravels, to very deep, very heavy-textured (clay adobe), slowly permeable soils. These soils are developed on the alluvial flood plains of Manning, Adobe, Hill, Kelsey and Cold Creeks.

In general, soils of the valley land are very deep (60 inches or more), medium to heavy textured, rapidly permeable soils underlain by slightly heavier, moderately to slowly permeable subsoils. Typical bodies of these soils are found on the alluvial fans of Manning, Adobe, and Kelsey Creeks north of Kelseyville. Slopes are nearly level and erosion is slight, confined to streambank cutting and overflow and deposition at rare intervals. Surface and subsoil drainage is well developed. The land is Class I or Class II with inherently fertile soils having a high available moisture capacity and few or no limitations of use. However, a plowpan has been formed under large parts of the area, which greatly reduces infiltration rate and permeability. Breaking up of the plowpan should be followed by arranging tillage, spraying, and trucking to avoid over-packing the soil. This is especially true in the spring and following irrigations when soil moisture conditions are unfavorable for general farming practices followed in the area.

Included in the above-mentioned soils are numerous small areas of gravelly, light-textured soils underlain by porous sands and gravels. They usually occur as long, narrow fills of previous drainage ways. The largest areas, however, are best developed on the alluvial flood plains in the upper drainages of Adobe and Kelsey creeks.

In general, the soils are moderately deep (18 to 36 inches), gravelly, light-textured, rapidly permeable soils underlain by porous sand and gravel. Deposition erosion and stream-bank cutting in these areas is severe during storms of high intensity.

Inherent fertility is low and the available moisture capacity is very low.

The land is mostly Classes III and IV, and is not adapted to orchards, alfalfa and other deep-rooted crops.

Soil fertility can be maintained or improved by crop rotations and addition of either organic matter or inorganic fertilizers. The land needs protection from overflow and bank cutting. Proper irrigation methods and improved water application are needed to avoid water loss and soil leaching.

Bordering Clear Lake and extending into Big Valley at two places are the poorly drained soils of the valley area. One large body of soil extends from the lake south along Hill Creek for about three miles. The other extends south for about 2½ miles between Kelsey Creek and Cold Creek. These soils are very deep (60 inches or more), heavy (clays) and very heavy (clay adobe), moderately to slowly permeable. Slopes are nearly flat and overflow and flooding combined with poor drainage severely limit their use. Available moisture capacity is moderately high to high, and the soils are inherently fertile.

Most of the land is Classes III and V and not adapted to agricultural use without proper drainage and protection from overflow and flooding. At present, the very wet or permanently wet land is in native or permanent pasture which receives some supplemental irrigating during the driest part of the year. The moderately wet areas are devoted to grain, permanent pasture, alfalfa, and pears. Correction of the wetness problem and proper irrigation methods to avoid waterlogging and high water table would bring these soils to their potential capability for agricultural use.

One other important body of soil in the valley area lies just east and north of Kelseyville. Soils in this area are deep (36 to 60 inches), gravelly, medium-textured, underlain by nearly impervious incipient hardpan. The surface in undulating and erosion is slight. Surface and subsoil drainage is poor, water standing in surface depressions during the wetter periods of the year.

The soils are low in organic matter with low inherent fertility and available moisture capacity. Surface soils are slowly permeable and puddle badly when irrigated or worked wet. Shallow disking or plowing has resulted in the formation of a plowpan at a depth of 6 to 8 inches.

The soil needs drainage followed by fertilization and additions of organic matter to improve soil tilth and available moisture capacity. The latter can be accomplished by using crop rotations, green manure crops, and manure. Subsoiling or deep tillage would also increase infiltration rate and permeability.

The land is now used for grain, prunes, alfalfa and for grazing.

Limitations in use due to soil depth and poor drainage place most of this land in Class III.

The terrace and foothill lands of the Big Valley area lie principally south and southwest of Kelseyville and extend along the west side of the valley northwards to Lakeport. The two extensive soils of this area are developed on old alluvial deposits which occupy terraces lying from 50 to 100 feet or more above the valley lands. In general, they are moderately deep (18 to 36 inches), medium textured, gravelly, moderately permeable soils over claypan, and deep (36 to 60 inches) to very deep (60 inches or more), medium textured, occasionally gravelly, moderately permeable soils over semi-consolidated material. The land ranges from undulating to rolling with some flat-topped ridges and a few gently sloping anlike areas. Sheet and gully erosion is moderate n the gentler slopes to severe on the rolling to hilly inds.

The soils are low in organic matter and inherent ertility is low to moderate.

The shallower (12 to 18 inches) and moderately eep (18 to 36 inches) claypan soils on steeper slopes re not suitable for cultivation, falling in land Classes 'I and VII. The moderately deep claypan soils on entler slopes are Class III land and suitable for ultivation but only for shallow-rooted crops.

The deep and very deep soils fall mostly into land 'lasses II and III and are suitable for most crops rown in the area.

Little or none of the land is now irrigated. The ultivated areas are planted to walnuts, prunes, rapes, and grains. Uncultivated areas are in brush r oak-grass range.

Most of the last-mentioned land is subject to severe rosion hazards unless its limitations in use are recognized. The soils puddle badly and a plowpan has leveloped from continued shallow plowing and disking. Additions of organic matter in the form of nanure, green manure crops, and crop residues, vould maintain or improve soil tilth fertility and noisture-holding capacity. Contour or cross-slope ultivation, and cover crops, are needed to protect he sloping lands during the rainy season.

Under irrigation, water loss and erosion will take lace unless proper land preparation and irrigation nethods are followed. Sprinkler systems or short runs n gentle slopes on the contour would accomplish the noisture objectives on the sloping lands adapted to rrigation.

Over-irrigation on the claypan soils will result in erched water tables and water-logging. On the areas f gravelly or excessively gravelly soils, leaching and vater losses will result.

cotts Valley Area

The soils of the valley lands of the Scotts Valley rea are similar to those of the Upper Lake area. They re very deep (60 inches or more), light to medium extured, rapidly permeable soils with an intermittent igh water table. In general, the soils are light-extured, sandy loams and fine sandy loams. Available oisture capacity is moderately high and inherent ertility is moderate. Surface drainage is fair to good, ut subdrainage is poor during the wetter months of he year. Erosion is slight with some streambank cuting and deposition during periods of flood waters. 'he latter has been damaging to the soil profile where oarse sand and gravels were deposited.

On the south and east side of Scotts Valley, there s a large body of very deep, light-textured, well-rained soil. Scattered throughout the valley are umerous small bodies of heavy-textured soils and oils underlain by porous sands and gravels.

The land falls mostly into Classes I and II and is adapted to orchard, hops, vegetable crops, alfalfa, and grain.

The light-textured soils of the valley need additions of organic matter to maintain or improve the moisture-holding capacity. Irrigation waters should be applied carefully to avoid excessive leaching. Some of the land needs protection from overflow and streambank erosion.

Soils of the foothill and terrace lands are the same as those in the Upper Lake area with one exception—that the soils underlain by sandstone and shale bedrock are not adapted to agricultural use. Also included in the Scotts Valley area are deep (36 to 54 inches), to very deep (60 inches or over), medium-textured, rapidly permeable soils with heavier subsoils. The substratum is semi-textured, rapidly permeable soils with heavier subsoils. The substratum is semi-consolidated old alluvial deposit. The surface soils are moderately permeable and the subsoils are moderately to slowly permeable.

The claypan soils are moderately deep (18 to 36 inches) and moderately permeable soils containing some gravels. These soils are developed on the old alluvial terrace on the eastern and southern sides of the valley. None of the land at present is irrigated but on much of it walnuts, pears, grapes, and grain are grown. The steeper, shallower soils are used for grazing.

The deeper soils on gentle slopes are adapted to irrigation.

Inherent fertility and available moisture capacity are low to moderate.

Surface soils are low in organic matter and puddle easily. Additions of organic matter as green manure crops, manure, or crop residue are needed to maintain fertility and increase permeability and available moisture capacity.

Sprinkler systems on short runs on the contour should be used to prevent irrigation erosion and water loss. Winter protection can be maintained with contour or cross-slope cultivation and winter cover crops.

Upper Lake Area

The bottom land soils (poorly drained) occupy the overflow lands of Clover, Middle, Bachelor and Scott Creeks, comprising about 25 percent of the irrigable lands of the Upper Lake area. The soils are very deep (60 inches or more), heavy textured and moderately permeable. Most of the soils are underlain by a high water table at least part of the year. Adequate drainage of these lands is accomplished by means of diking and pumping. In the reclaimed areas bordering Clear Lake the water table may be regulated to provide subirrigation.

Soil erosion is slight with deposition erosion from flood waters being most important. The amount of soil deposited varies with the intensity of the storm, but in general, it is not seriously damaging to the soil profile.

The soils are inherently fertile and have high available-moisture capacity. However, owing to the wetness problem, most of the land is in Class II or III and is best adapted to shallow-rooted crops. At present, the bottomlands are chiefly devoted to vegetable crops, alfalfa and grain. Continued high productivity in this area will depend on proper land, drainage and irrigation management.

The valley land includes the alluvial flood plains of Clover, Middle, Bachelor and Scott Creeks. Soils are for the most part very deep, light to medium textured, and rapidly permeable. Available moisture capacity is moderately high to very high. Surface drainage is good to fair, but subdrainage is poor during the wetter parts of the year. The erosion problem in general is not serious, but about 25 percent of the area is subject to deposition erosion from the creeks. This deposition causes serious damage where gravel and coarse sand are deposited.

Also included in the valley land classification are small acreages of the following soils:

Very deep, heavy-textured, moderately permeable soils with intermittent high water table. Small bodies of these soils are scattered throughout the area.

Very deep, very heavy-textured (clay adobe), slowly permeable soils with slow surface and subsoil drainage. These areas are flat and have a high water table during most of the year, with water standing on the surface during the rainy season. The largest body of this soil lies one-quarter mile east of Upper Lake.

Very shallow to moderately deep (6 to 36 inches), gravelly, medium-textured soils underlain by gravels and coarse sand. The shallow soils (6 to 18 inches) are adapted only to grazing. The moderately deep (18 to 36 inches) are adapted only to shallow-rooted crops. The water-holding capacity is low, and, under irrigation, small amounts of water must be used with more frequent applications than in the irrigation of deep and very deep soils (60 inches or more). These shallow soils occupy an important acreage along the upper parts of Middle and Clover Creeks.

The deeper, better-drained soils are inherently fertile and suitable for all crops adapted to the area, including orchard, alfalfa, vegetable crops, and grain. These are the Class I and II lands of the area.

The wetter, poorly drained soils are mostly Classes II and III land and are adapted to crops which are tolerant of excessive moisture during part of the year.

Use of irrigation water in the valley area could be improved by:

(1) Additions of organic matter such as green manure crops, crop residues or manure, to maintain fertility, increase permeability and improve water holding capacity—the last especially on lighter textured and gravelly soils.

(2) Not working the soils when too wet, to prevent puddling and development of plow pan.

(3) Subsoiling and deep tillage, to break existing plow pans and increase infiltration rate and permeability.

The soils of the terrace and foothill lands are for the most part shallow to moderately deep (12 to 36 inches), medium texture soils over sandstone and shale bedrock. Included are some small bodies of moderately permeable soils underlain by nearly impermeable claypan subsoil. These soils are developed on old alluvial deposits which are of limited extent in the Upper Lake area. The land is almost entirely devoted to grazing, for which use it is best adapted. Owing to steepness of the slopes, shallow soils and low available-moisture capacity, the land is not adapted to agricultural crops even under irrigation. However, small bodies with less slope and deeper soils may be found throughout the area.

AGRICULTURAL HISTORY [1]

Hunters and trappers of the Russo-American Fur Company were the first white men to invade the area adjacent to Clear Lake, where wild game abounded. Hunters and trappers were attracted to the region as early as 1811.

About 1849 Salvador Vallejo took over much of what is now known as Big Valley and started agricultural activities.[2] It was not until about 1850, however, that settlement began in earnest. By 1854 settlers were arriving in numbers, and it was not long until the valley parts of the county were in private ownership, mainly large holdings. Lake County was organized May 20, 1861, and Lakeport was made the county seat.

The early settlers came largely from the Central and Eastern States, and most of the present population are American-born and of Anglo-Saxon extraction. A number of Indian tribes roamed the country in the early days, but such of them as remain are segregated on Indian rancherias. The valley sections are somewhat thickly populated, especially in the vicinity of Lakeport, Kelseyville, and Upper Lake.

Following occupation of the valley lands the dairy industry began to assume importance; barley and corn were produced largely in connection with it. Because of the difficulty of transporting bulky products, several flour mills were built, and wheat was milled for both local consumption and outside sale. The fruit industry began to assume some importance as early

[1] See "Soil Survey of the Clear Lake Area, California," by E. J. Carpenter, R. Earl Storie and Stanley W. Cosby. U. S. Dept. of Agri., Bureau of Chemistry and Soils. Series 1927, No. 13. (5)

[2] Palmer, L. L. "History of Napa and Lake Counties, California, and Biographical Sketches." 600 291 p., illus. San Francisco. 1881. (7)

TABLE 2. Results of 1949 cultural survey, Lake County (California) areas, as compiled June 15, 1950, in acres

Land use	Irrigated crops												Dry-farmed crops				All crops			
	From ground water				From creeks and/or lake				From ground water, creeks and/or lake											
	Big Valley	Scotts Valley	Upper Lake Area	Total	Big Valley	Scotts Valley	Upper Lake Area	Total	Big Valley	Scotts Valley	Upper Lake Area	Total	Big Valley	Scotts Valley	Upper Lake Area	Total	Big Valley	Scotts Valley	Upper Lake Area	Total
Alfalfa	393		207	600	84		495	579	477		702	1,179	43	82	568	693	520	82	1,270	1,872
Pasture	1,191	37	178	1,406	61	29	494	584	1,252	66	672	1,990	2,976	473	1,205	4,654	4,228	539	1,877	6,644
Sudan grass															98	98			98	98
Native grass													2,182	213	2,021	4,416	2,182	213	2,021	4,416
Beans			83	83			204	204			287	287			320	320			607	607
Corn	53		9	62			9	9	53		18	71		7	230	237	53	7	248	308
Grain, small	30			30			42	42	30		42	72	214	31	916	1,161	244	31	958	1,233
Pears	2,760	227	154	3,141			23	23	2,760	227	177	3,164	213	450	270	933	2,973	677	447	4,097
Young pears	45			45					45			45	36			36	81			81
Pears with permanent cover crop	279			279					279			279					279			279
Prunes	112			112					112			112	638	11	3	652	750	11	3	764
Vineyards	17			17					17			17	53	28	20	101	70	28	20	118
Walnuts	446	36	31	513					446	36	31	513	1,563	195	570	2,328	2,009	231	601	2,841
Young walnuts	21			21					21			21	92		54	146	113		54	167
Walnuts and alfalfa	39			39					39			39					39			39
Young walnuts and alfalfa	40			40					40			40					40			40
Walnuts and pasture														9		9		9		9
Young walnuts and corn															38	38			38	38
Walnuts and grain													27		56	83	27		56	83
Young walnuts and grain	16			16					16			16	26		81	107	42		81	123
Walnuts and pears	29			29					29			29					29			29
Walnuts and prunes													30			30	30			30
Walnuts and vineyards													23	5		28	23	5		28
Mixed orchard														4		4		4		4
Almonds															71	71			71	71
Truck crops	3		15	18					3		15	18			16	16	3		31	34
Hops		113		113						113		113						113		113
Strawberries			3	3							3	3							3	3
No crop													306	93	103	502	306	93	103	502
Subtotal	5,474	413	680	6,567	145	29	1,267	1,441	5,619	442	1,947	8,008	8,422	1,601	6,640	16,663	14,041	2,043	8,587	24,671

Land use	Native vegetation				Land use	Miscellaneous				Total area surveyed			
	Big Valley	Scotts Valley	Upper Lake area	Total		Big Valley	Scotts Valley	Upper Lake area	Total	Big Valley	Scotts Valley	Upper Lake area	Total
Swamp and tules	313		339	652	Cemeteries	7		5	12				
Heavy brush	2,446	117		2,563	Levees			23	23				
Light brush	158	34	268	460	Town lots	725	51	440	1,216				
Sparse brush	586	51	180	817	Water surfaces	698	138	459	1,295				
					Waste land	141		3	144				
					Country roads and farm lots	431	64	217	712				
Subtotal	3,503	202	787	4,492	Subtotal	2,002	253	1,147	3,402	19,546	2,498	10,521	32,565

as 1868. Prunes, planted extensively during the early 20's, were not profitable; many of the trees were removed, and prunes are now of minor importance. Bartlett pears, for which the region is now best known, were first grown about 1885. The present importance of this crop is indicated by table 2, which summarizes the complete results of the 1949 cultural survey. Walnut culture has grown in area and importance, and the total acreage of walnut trees is now about three-fourths that of pears.

Pear orchards are plowed or disked early in May, or as soon as moisture conditions are favorable. Most of them are then given clean cultivation throughout the summer. During the rainy season weeds and volunteer grasses cover the soil and are turned under in the spring. Some better cared for orchards are planted to cover crops, which are plowed under to increase organic matter. The pears are picked early in August and hauled to packing plants, where they are graded and packed. Slightly more than half the 1949 crop was shipped out of the county fresh, mainly to eastern markets and export points. Slightly less than half was canned. The remainder, about 5 percent, was dried. (See table 3.) The fruit ranches are typically small, averaging about 50 acres. By far the greater number are operated by their owners.

TABLE 3. Disposal of pears harvested in Lake County, California, in recent specified years
(Authority: Lake County Agricultural Commissioner.)

Disposal	1944 Tons	1945 Tons	1946 Tons	1947 Tons	1948 Tons	1949 Tons
Shipping	7,950	23,061	17,040	16,594	10,343	19,832
Canning	880	9,427	7,774	13,586	20,738	17,160
Drying	3,313	1,801	2,151	1,412	1,263	1,882
Total	12,143	34,289	26,965	31,592	32,344	38,874

Land to be seeded to wheat, oats, or barley is plowed as soon in the fall as moisture conditions are favorable, and seed is sown in the same fall. Harvesting is done with combines during the early summer, after which the fields are pastured. Alfalfa fields are pastured during the winter, but as soon as the crop begins to make rapid growth in the spring, the livestock are turned out and the fields are permitted to grow hay. Life of the alfalfa stand is about five or six years, at the end of which it is replaced by grain for a year or two; alfalfa is then restored.

Present Development

While now representing only some 8,000 acres, irrigation in Lake County has advanced rapidly, especially during the last five years. Federal census figures show only 1,107 acres irrigated in 1919. The corresponding figure for 1929 was 1,916 acres on 110 farms. In 1939, 141 irrigated farms and 3,281 acres were reported. In 1944, irrigated farms were 156 and irrigated acres 4,148. The 8,008 acres totaled in the three areas surveyed in 1949, if considered to include all irrigation in the country, therefore indicate almost a doubling of the 1944 irrigated acreage, and go far to explain why a water problem now exists.

Irrigation census figures for 1950, when available, may change the significance of various statistics obtained in 1940 because of this relatively drastic change, but perhaps the 1940 averages have not lost their import. Then the investment in irrigation systems, per acre under ditch, was $54.54. Cost of annual maintenance and operation, including fuel or power, repairs and attendance, was $5.94 per acre irrigated. Water deliveries averaged 1.9 acre-feet per acre irrigated in 1939. The average size of the irrigation units was 39 acres. There were 133 pumped wells and 147 pumping plants; capacity per plant was 408 gallons per minute, and the average acreage served per plant was 18.3. The average pumping lift was 33 feet.

The discrepancy between number of pumped wells and number of pumping plants is attributable to a number of pump diversions from creeks or lakes. The acreage served from these open water sources is almost entirely in the Upper Lake area (table 2), and is represented mainly by alfalfa and pasture, with beans third in line. In the total, however, Big Valley accounts for more than four-fifths of the irrigated area; pears grown alone and in combinations are the most important irrigated crop in acreage as well as in other respects; and the acreage devoted to irrigated pears is far greater (nearly six times) than that of irrigated walnuts. Walnuts grown without irrigation are, in fact, substantially more important than those irrigated (in point of acreage). The total area in pears is about 1,000 acres more than that in walnuts.

As measured by acreage, the irrigated crops stand as follows in relative importance: First, pears; second, pasture; third, alfalfa; fourth, walnuts. The acreage in other nuts and deciduous fruits other than pears, while not significant, is of relative unimportance.

Ignoring the irrigation feature, the cropped acreages rate as follows: Pasture, native grass, pears, walnuts, alfalfa, small grain.

The following paragraphs have to do with current irrigation practices:

Pears. Water is applied almost entirely by the border strip method, the strips being called "panels." The trees are planted in squares, with trees 22 to 25 feet apart, and border strips are either one or two to the tree row.

Orchardists who do not irrigate after harvest give 3 or 4 irrigations; if after-harvest irrigation is practiced, applications are 4 or 5. The average is thus about 3 to 5, depending on the after-harvest practice; about one-third of the growers prefer to irrigate after vest. Applications are at the rate of about 6 or 7 nes each, which does not involve much waste. st and post-harvest applications, however, are ter than the others; heaviest demand on the und water therefore falls in July and August. irrigation is preferred, but some growers irrigate night; the average irrigation day is 12 to 15 hours. st irrigation is in June, and later applications are ced at 3-week intervals.

ength of panels is limited to length of the orchards nselves, running, say, 800 to 900 feet, but some as long as 1,320 feet. While some pipe distribu- es are being installed, the total length of such roved lines is still only a small proportion of the l.

Walnuts. The same system of irrigation described above for pears applies to walnuts, with a few exceptions. Basins and contour checks are more common than is the case with pears. Three irrigations are customary, but their total is about 2 feet because lighter soils are involved. Recommendation by University of California authorities that no irrigation be made after midsummer is not followed by some growers for reasons affecting nut-filling.

Common approximate dates of irrigation are June 15; July 15; third week in August. Post-harvest applications are not made.

Walnut trees are spaced 50 feet apart—some 60—or 18 trees to the square. Length of runs is about the same as for pears.

TABLE 4. Water use and irrigation efficiency of each operator interviewed in Lake County, California, Irrigation Practice Studies, 1949

Crop	Location	Operator	Method of irrigation	Water application: Irrigations	Water application: Total amount	Estimated irrigation efficiency	Mean irrigation efficiency
				Number	Inches	Per cent	Per cent
(clean)	Big Valley	Bazzell	Border	--	--	60	
		Field		--	--	55	
		Fraser		4	25.5	50	
		Hill		-	(shallow)	65	
		Henderson, R.		2	22.6	55	
		Holdenreid, E.		4	34.2	59	
		Morrison, D.		--	(Test= 60%)	35	52
		Olson		4	29.7	48	
		Sanderson, R.		--	--	--	
		Slattery		5	33.2	45	
		Sweeney	(No irrigation—	water table =	3 feet)		
		Gross	Basin	11	47.7	40	
		Scherphius		4	25	65	
	Scotts Valley	Patton, B.	Border	3	16.1	55	
		Proctor, Geo.		1	9.1	55	
(cover crop)	Big Valley	Benson	Border	--	--	55	55
		Mauldin		8	129.9	23	
		Hamilton		6	80.8	35	
					(1948- 1949)		
		Henderson, H.		5	30.4 (58% 76%)	67	
		Wheeler		5	65.8	50	
ts (old)	Big Valley	Davis	Border	3	15.0	60	65
		Fraser		1	9.0	65	
		Mulhauser		2	5.5 (shallow)	70	
	Scotts Valley	Patton, B.		3	16.1	55	55
ts (young)	Big Valley	Fraser	Border	2	23.2	60	63
		Mulhauser		7	21.8 (shallow)	65	
	Upper Lake	Santos	Sprinkler	2	18.3	65	65
					(1948- 1949)		
nent pasture	Big Valley	Bradbrook	Sprinkler	13	56.3 (80% 40%)	60	
		Gross	Basin	19	46.4	55	
		Holdenreid, E.	Border	7	57.1	54	59
		Holdenreid, R.		8	39.3	45	
		Mulhauser		3	8.4 (shallow)	80	
	Upper Lake	Foutch	Sprinkler	8	39.3	78	78
a	Big Valley	Gross	Basin	11	30.7	45	
		Fraser	Border	2	23.2	55	
		Garrett		--	--	60	
		Holdenreid, R.		6	41.5	35	50
		Mulhauser		7	21.8 (shallow)	65	
		Olson		6	48.5	43	
	Scotts Valley	Patton, B.	Border	5	29.8	50	
	Upper Lake	Alley	Border	6	42.0	55	
		Foutch	Sprinkler	4	19.4	80	
		Santos		2	18.3	65	67
le	Big Valley	Holdenreid, R.	Border	9	20.9	65	
p	Scotts Valley	Proctor	Basin	4	Av. 12.5	55	
with walnuts)	Upper Lake	Santos	Sprinkler	1	9.2	60	
otal		46 fields 28 farms					Average 55.4

—57411

Leveling and releveling in both pear and walnut groves is a gradual but continuing process.

Alfalfa. Irrigation is by border-strips. About 5 are customary, per season, but a casual enumeration showed applications ranging all the way from 2 (totalling 18 inches) to 11 (30 inches). (The heaviest total was 48 inches in 6 applications.)

Table 4 summarizes irrigation-practice data obtained from the 1949 canvass of farms by the Operations Division, Soil Conservation Service.

CONSUMPTIVE USE OF WATER

Consumptive use (evapo-transpiration) includes combined loss of water from soils by evaporation and plant transpiration. A large portion of irrigation water applied to farm crops is used in evaporation and transpiration. The remainder is lost by surface runoff from the fields and deep percolation below the root zone.

Many factors operate singly or in combination to influence the amounts of water consumed by plants. Their effects are not necessarily constant, but may differ with locality and fluctuate from year to year. Some involve the human factor, others are related to the natural influences of the environment.

The more important of the natural influences are climate, water supply, soils, and topography. The climatic factors that particularly affect consumptive use are precipitation, temperature, humidity, wind movement, and growing season.

The amount and rate of precipitation may have a pronounced effect on the amount of water consumptively used during any summer. Under certain conditions, precipitation may be a series of frequent, light showers during the hot summer. Such showers may add little or nothing to the soil moisture for use by the plants through transpiration. The precipitation may be largely lost by evaporation directly from the surface of the plant foliage and the land surface. Some of the precipitation of heavy storms may be lost by surface runoff. Other storms may be of such intensity and amount that a large percentage of their precipitation will enter the soil and become available for plant transpiration. Such a condition may materially reduce the amount of irrigation water needed and the consumptive use.

The growing season, which is tied rather closely to temperature, has a major effect on the seasonal use of water by plants. It is frequently considered to be the period between killing frosts, but for many annual crops it is shorter than the frost-free period, as such crops are usually planted after frosts are past and mature before they recur. For most perennial crops, growth starts as soon as the maximum temperature stays well above the freezing point for an extended period of days, and continues throughout the season in spite of later freezes.

Irrigation requirements of crops vary with su climatic factors as temperature, rainfall, evaporatio and length of growing season; with the quantity ar cost of the available irrigation supply; with the ef ciency of irrigation; with crop characteristics su as rate of growth and rooting habits; and accordi to soil type. Both fast-growing and shallow-root crops require excess water and mature trees use mo water than young trees. Sandy soils need irrigati more frequently than the heavier types. Ground w ter close enough to the surface to supply capilla moisture to plant roots, decreases the irrigation r quirement and adequate drainage increases it. T results of a cultural survey in Lake County for 19 are shown in table 2 (see page 161).

Various methods have been used by engineers determine consumptive use by agricultural crops an natural vegetation under field conditions. Regardle of the method, the problems encountered are nume ous. The source of water used by plant life, wheth from precipitation alone, irrigation plus rainfall, ground water plus precipitation, is a factor infl encing selection of method. The methods most widel used in engineering investigations are: (a) soi moisture studies on plots, (b) tank or lysimeter e periments, (c) ground-water fluctuations, (d) inflo outflow measurements, (e) integration, (f) ''effecti heat,'' (g) correlation of water use, climatologic and other data, and (h) analysis of irrigation an precipitation records.

At various times during 1948-50 the Californ Division of Water Resources conducted irrigation an soil moisture studies in several areas of Lake Count The number of irrigations, the amount of water a plied and the irrigation efficiency were observed c 28 farms for alfalfa, pasture, pears, walnuts an other crops. The results of the 1949 studies are sun marized in Table 4. A review of these data indicat a wide variation in irrigation practices. The resul indicate that the moisture stored in the root zo from winter precipitation and/or ground water a available for use by crops during the frost-free peri or growing season. Therefore it is doubtful that t data can be used for computing normal consumpti use. It is believed that more reliable rates of wat consumption can be estimated by transposing co sumptive-use measurements already made in oth areas to Lake County by the method of correlati rates of water use with climatological data (*1*).

Procedure

The procedure is to correlate existing consumpti use data for different crops with monthly temper ture, percent of daytime hours, precipitation, fros free (growing) period, or irrigation season. T coefficients so developed are used to transpose t consumptive-use data for a given area to other are for which only climatological data are available.

nsumptive-use formula

Disregarding the unmeasured factors, consumptive e varies with the temperature, daytime hours, and ilable moisture (precipitation, irrigation water or tural ground water). By multiplying the mean nthly temperature (t) by the monthly percent of ytime hours of the year (p), there is obtained a nthly consumptive-use factor (f). It is assumed it the consumptive use varies directly as this factor en an ample water supply is available. Expressed thematically, $U = KF =$ sum of kf where

$U =$ Consumptive use of crop (or evapo-transpiration) in inches for any period.

$F =$ Sum of the monthly consumptive-use factors f for the period (sum of the products of mean monthly temperature and monthly percent of daytime hours of the year).

$K =$ Empirical consumptive-use coefficient (irrigation season or growing period).

$t =$ Mean monthly temperature, in degrees Fahrenheit.

$p =$ Monthly percent of daytime hours of the year.

$$f = \frac{t \times p}{100} = \text{monthly consumptive-use factor.}$$

$k =$ Monthly consumptive-use coefficient.

$u = kf =$ monthly consumptive use in inches.

'he consumptive-use factor (F) for any period ı be computed for areas for which monthly temature records are available. Then by knowing the ısumptive-use coefficient (K) for a particular crop some locality, an estimate of the use by the same) in some other area may be made by application the formula $U = KF$.

atological Records

he climate of Lake County is described in the seca on irrigation practices. At various times precipin and temperature records have been kept at per Lake, Lakeport and Kelseyville. The Upper e station records were selected for the Scotts ley-Upper Lake Soil Conservation District and the seyville station records for the Big Valley Soil servation District.

able 5 shows the normal monthly temperatures n precipitation, percent of day-time hours of the e and calculated consumptive use factor, Upper ae. Similar data given in Table 6 are for Kelville.

ited Crops

ıvestigations of use of water by irrigated crops a been conducted at various times for many years y he Division of Irrigation and Water Conservation ı ooperation with the State Division of Water Reoces or the California Agricultural Experiment tion (8). These studies indicate that the use of water varies for different crops not only in total amount but also in seasonal distribution. These consumptive-use values (U) and the results of other investigations in the West, and the calculated consumptive use factor (F) have been employed to compute the crop coefficients (K) by the formula $K = \frac{U}{F}$.

Consumptive use of water for crops in Lake County are estimated from the local consumptive-use factors for the growing or irrigation season and the coefficient for the crop, with allowance for local conditions. The irrigation season on Lake County usually starts in

TABLE 5. Normal monthly temperatures and precipitation, percent of daytime hours and calculated consumptive use factor, Upper Lake, California

Month	Mean temperature[1] (t) °F	Daytime hours (p) Per cent	Consumptive use factor (f)	Normal precipitation [1 2] (r) Inches
January	43.9	6.80	2.98	7.12
February	46.6	6.75	3.14	5.27
March	49.8	8.33	4.15	4.00
April	54.3	8.94	4.85	1.91
May	59.3	9.98	5.92	1.23
June	66.1	10.04	6.64	0.31
July	73.1	10.18	7.44	0.02
August	72.0	9.52	6.85	0.02
September	66.3	8.38	5.56	0.38
October	58.9	7.77	4.58	1.61
November	50.3	6.76	3.40	3.33
December	44.4	6.57	2.92	5.84
Annual	57.1	100.00	58.43	31.04

[1] Thirty-five years through 1945.
[2] Forty-three years ending 1945.
t = Mean monthly temperature.
p = Monthly percent of daytime hours of the year.
$f = \frac{t \times p}{100} =$ Monthly consumptive use factor.

TABLE 6. Normal monthly temperatures and precipitation, percent of daytime hours and calculated consumptive use factor, Kelseyville, California

Month	Mean temperature[1] (t) °F	Daytime hours (p) Per cent	Consumptive use factor (f)	Normal precipitation [1 2] (r) Inches
January	43.0	6.81	2.93	4.33
February	44.7	6.76	3.02	4.53
March	47.3	8.33	3.94	3.15
April	54.8	8.93	4.89	1.67
May	59.3	9.97	5.91	.78
June	66.8	10.02	6.69	.43
July	75.3	10.16	7.65	.29
August	74.9	9.51	7.12	.01
September	68.3	8.38	5.72	.11
October	58.3	7.77	4.53	1.40
November	50.8	6.77	3.44	2.26
December	44.8	6.59	2.95	4.77
Annual	57.4	100.00	58.79	23.73

[1] Computed from ratio of Kelseyville to Upper Lake 1947 records.
[2] Mean of record 1932-48.
t = Mean monthly temperature.
p = Monthly percent of daytime hours of the year.
$f = \frac{t \times p}{100} =$ Monthly consumptive use factor.

April or May and continues through September, depending upon the crop and distribution and amount of precipitation. After reviewing the available data it was decided to divide the year into two periods, April 1 to September 30 and October 1 to March 31.

Table 7 shows the computed normal unit consumptive use by the principal irrigated crops[1] in the Scotts Valley-Upper Lake and Big Valley soil conservation districts for the period April 1 to September 30, and Table 8 gives the computed normal monthly rates of consumptive use for alfalfa and cover crops during the period October 1 to March 31.

[1] See Table 2, page 161, for crop acreage in 1949.

TABLE 7. Computed normal unit consumptive use of water by irrigated crops for the period April 1 to September 30 in the Scotts Valley-Upper Lake and Big Valley Soil Conservation Districts, Lake County, California

Crop	Period	Consumptive use coefficient (K)[1]	Scotts Valley-Upper Lake (F)[2]	Scotts Valley-Upper Lake (U) Inches	Big Valley (Kelseyville) (F)[3]	Big Valley (Kelseyville) (U) Inches
Alfalfa	4/1-9/30	0.80	37.26	29.8	37.98	30.4
Beans	4/1-6/30	.65	17.41	11.3	17.49	11.4
Corn	4/1-7/31	.75	24.85	18.6	25.14	18.9
Grain, spring	4/1-6/30	.70	17.41	12.2	17.49	12.2
Hops	4/1-9/30	.70	37.26	26.1	37.98	26.6
Pasture	4/1-9/30	.80	37.26	29.8	37.98	30.4
Pears	4/1-9/30	.60	37.26	22.4	37.98	22.8
Pears with cover crop	4/1-9/30	.80	37.26	29.8	37.98	30.4
Prunes	4/1-9/30	.60	37.26	22.4	37.98	22.8
Truck	4/1-6/30	.60	17.41	10.4	17.49	10.5
Walnuts, young	4/1-9/30	.60	37.26	22.4	37.98	22.8
Walnuts, young alfalfa	4/1-9/30	.80	37.26	29.8	37.98	30.4
Walnuts grain	4/1-9/30	.80	37.26	29.8	37.98	30.4
Walnuts alfalfa	4/1-9/30	.90	37.26	33.5	37.98	34.2
Walnuts	4/1-9/30	.70	37.26	26.1	37.98	26.6
Vineyard	4/1-8/31	.60	31.70	19.0	32.26	19.4

U = KF = Consumptive use for period.
[1] Based on data in other areas.
[2] From table 5.
[3] From table 6.

TABLE 8. Computed normal monthly rates of consumptive use for crops growing during the period October 1 to March 31, Lake County, California

Month	Scotts Valley Upper Lake Soil Conservation District (f)	(u)[1] Inches	(u)[2] Inches	(r) Inches	Big Valley Soil Conservation District (f)	(u)[1] Inches	(u)[2] Inches	(r) Inches
October	4.58	2.7	2.3	1.61	4.53	2.7	2.3	1.40
November	3.40	2.0	1.7	3.33	3.44	2.1	1.7	2.26
December	2.92	1.8	1.5	5.84	2.95	1.8	1.5	4.77
January	2.89	1.7	1.4	7.12	2.93	1.8	1.5	4.33
February	3.14	1.9	1.6	5.27	3.02	1.8	1.5	4.53
March	4.15	2.5	2.1	4.00	3.96	2.4	2.0	3.15
Total	--	12.6	10.6	27.17	---	12.6	10.5	20.44

u = kf = Monthly consumptive use.
k = Crop coefficient.
$f = \frac{t \times p}{100}$ = Monthly consumptive use factor.
r = Monthly precipitation.
[1] Monthly consumptive use (u) for alfalfa or planted cover crop with coefficient k = 0.60.
[2] Monthly consumptive use (u) for light cover crop or native grass with coefficient k = 0.50.

Evaporation from Water Surface

No long-period evaporation measurements ar available in Lake County. Monthly records kept b the U. S. Geological Survey at Lakeport, Octobe 1901 to December 1905 are shown in Table 9. (9 These have been used with temperature records t

TABLE 9. Observed monthly evaporation from a square land pan an mean temperature and computed coefficients for lake evaporation Lakeport, California

Month	Mean temperature[1] (t)	Daytime hours (p)	Consumptive use factor (f)	Mean pan evaporation[2] Inches	Mean lake surface evaporation[3] Inches	Consumptive use coefficient (k)
October	61.0	7.77	4.74	2.52	2.22	0.47
November	52.3	6.77	3.54	1.09	.96	.27
December	45.5	6.59	3.00	.80	.70	.23
January	44.0	6.81	3.00	.72	.63	.20
February	45.1	6.76	3.05	.62	.54	.18
March	47.1	8.33	3.92	.96	.84	.21
Subtotal			21.25	6.71	5.89	-----
April	54.2	8.93	4.84	2.41	2.12	.44
May	59.9	9.97	5.97	4.55	4.00	.67
June	69.4	10.02	6.95	6.76	5.95	.86
July	73.9	10.16	7.51	8.32	7.32	.98
August	74.8	9.51	7.11	7.25	6.38	.90
September	70.9	8.38	5.94	5.30	4.66	.78
Subtotal	----		38.32	34.59	30.43	-----
Total	-------	-------	59.57	41.30	36.32	-----

[1] Near Lakeport, California, for period October, 1901, to December, 1905.
[2] At Lakeport, California, on Clear Lake. Square pan 3 x 3 feet, 18 inches dee with top of pan flush with ground surface. From Table 85, Bulletin 54-A, Cal fornia Division of Water Resources.
[3] Reduced to lake evaporation by pan coefficient 0.88 (see page 36, California Di sion of Water Resources Bulletin No. 5).

TABLE 10. Computed normal monthly lake evaporation in Lake Count California (based on 1901-1905 Lakeport pan records)

Month	Coefficient[1] (k)	Consumptive use factor (f) Upper Lake	Consumptive use factor (f) Kelseyville	Lake evaporation[2] Upper Lake Inches	Upper Lake Feet	Kelseyville Inches	Kelseyville Feet
October	0.47	4.58	4.53	2.14	0.18	2.12	0.1
November	.27	3.40	3.44	.92	.08	.93	.0
December	.23	2.92	2.95	.68	.06	.69	.0
January	.21	2.98	2.93	.62	.05	.62	.0
February	.18	3.14	3.02	.56	.05	.53	.0
March	.21	4.15	3.94	.89	.07	.84	.0
Subtotal	-------	21.17	20.81	5.81	.49	5.73	.4
April	.44	4.85	4.89	2.12	.18	2.14	.1
May	.67	5.92	5.91	3.97	.33	3.96	.3
June	.86	6.64	6.69	5.68	.47	5.73	.4
July	.98	7.44	7.65	7.25	.60	7.46	.6
August	.90	6.85	7.12	6.14	.51	6.39	.5
September	.78	5.56	5.72	4.36	.36	4.48	.3
Subtotal	-------	37.26	37.98	29.52	2.45	30.16	2.5
Total	-------	58.43	58.79	35.39	2.94	35.89	2.9

[1] k based on Colorado Land Pan observations at Lakeport by U. S. Geological Su vey, October, 1901, to December, 1905. (9)
[2] Computed evaporation = k × f.

etermine monthly coefficients (k) in the formula: $= \frac{u}{f} = \frac{\text{evaporation}}{\text{consumptive use factor}}$. Computations of ormal monthly evaporation from water surfaces at pper Lake and Kelseyville are shown in Table 10.

Similar computations based on two-year Weather ureau pan records (1948-49) at Lakeshore on Shasta ake are shown in Appendix table 14. It is notable at the computed normal annual evaporation for pper Lake and Kelseyville from the available pan d temperature records at Lakeport and Lakeshore e almost the same.

ative Vegetation on the Valley Floor

At various times during the past 23 years the Divi-on of Irrigation, in cooperation with the California ivision of Water Resources, has investigated the nsumptive use of water by native vegetation (*2*)) (*4*). Some of the results for California and other estern states have been summarized in one report *0*), according to which, the relation of plant com-unities to moisture supply is one of the outstanding aracteristics of the growth of natural vegetation. hile individual species are largely restricted to vorable physical environments, the principal condi-on that governs the distribution of vegetative groups the amount of available moisture. Each species re-onds to specific water conditions for its most favor-le growth and its widest distribution.

Natural vegetation grows under moisture conditions at are always changing. Plants that do not subsist ground water but depend upon moisture held by e soil particles may have another. Ground water ctuates and roots in contact with it are alternately t and dry. Soil moisture is dependent upon precipi-tion, but evaporation, transpiration, percolation, d runoff cause its uneven distribution in the soil.

In arid areas moisture is retained in the upper soil rizon, and the vegetation is confined to those species at are adapted to extreme economy of water. In eas of greater precipitation, deeper penetration re-ts in plant roots drawing upon a greater volume of l moisture. In low places a concentration of mois-e takes place and ground-water areas support those nts which use more water than dry-land plants. nally the water-loving plants, living with their roots water, are large consumers of it.

No measurements have been made of evapo-trans-ation by native vegetation in Lake County. The ults of evapo-transpiration studies in San Luis y Valley (*6*) and other areas made by the Division Irrigation and Water Conservation in cooperation h the California State Division of Water Resources used to estimate consumptive use of water in Lake unty by the method previously described.

Native vegetation on the floor of Lake County was pped by the Division of Water Resources as sparse brush, light brush, heavy brush, and swamp. (See Table 2.)

Swamp areas

The results of observations in San Luis Rey Valley (*6*) on consumptive use of water by tules growing in a tank (six feet in diameter and six feet deep, located in a swamp) are shown in Table 11, together with computed monthly consumptive-use factors and coefficients. By applying these coefficients to the consumptive-use factors in Lake County, estimates have been made of monthly consumptive use of water by swamp vegetation, as shown in Table 11.

TABLE 11. Estimated normal monthly consumptive use of water by swamp areas in Lake County, California

Month	Coefficient (swamp)[1] (k)	Consumptive use: Upper Lake (U) Inches	Upper Lake (U) Feet	Kelseyville (U) Inches	Kelseyville (U) Feet
April	0.89	4.32	0.36	4.35	0.36
May	1.14	6.75	.56	6.74	.56
June	1.16	7.70	.64	7.76	.65
July	1.26	9.75	.81	9.64	.80
August	1.16	7.95	.66	8.26	.69
September	1.16	6.45	.54	6.64	.55
Subtotal		42.92	3.57	43.39	3.61
October-March[2]		5.81	0.48	5.73	0.48
Total		48.73	4.05	49.12	4.09

[1] Developed from San Luis Rey Valley, California, measurements. (6)
[2] October to March period consumptive use is estimated to be same as evaporation from a free water surface.

Brush-tree-grass areas

Some areas in Lake County are covered with growths consisting of brush intermingled with trees and grasses of varying density, the variation being governed by the available water supply. In those areas underlain by a high water table the growths are dense, and as the terrain rises toward the hills and distance to the water table increases, vegetation usually becomes less dense and changes to a species having roots developed for obtaining water from greater depths. This arrangement results in zones of vegetation that are irregular according to the ability of the roots to obtain moisture. Exceptions occur in some places as a result of soil types. In the valley, there are areas where ground water is near enough to the ground surface to support luxuriant growths of vegetation, but, owing to lack of fertility in the soil, the vegetation is sparse.

In mapping areas of native brush, trees and grass the growths were classified by the State Division of Water Resources as heavy, light and sparse brush and grass. Although deciduous vegetation such as willows and cottonwoods drop their leaves and become dormant during the frost period, consumptive use continues during the winter in some areas they occupy, owing to growths of grasses, weeds, and underbrush. Until more information is available on ground water areas the following estimates of rates of consumptive use shown in Table 12, based on formula $U = KF$, may be employed to compute total water consumption in areas of high water table.

TABLE 12. Estimates of normal annual consumptive use of water rates for native vegetation on valley floors, Lake County, California

Classification	Annual co-efficient (K)	Scotts Valley		Big Valley	
		(F)[1]	(U) Inches	(F)[2]	(U) Inches
With high water table					
Trees-brush-grass (heavy)	1.00	58.43	58.4	58.79	58.8
Brush-grass (light)	0.70	58.43	40.9	58.79	41.2
Grass-brush (sparse)	0.50	58.43	29.2	58.79	29.4

[1] See Table 5.
[2] See Table 6.

The monthly estimates of use of water by native grass areas without a high water table for the period October to March, inclusive, are shown in Table 8. In areas with high water tables the use of water will continue during the summer months. The water consumption by grasses in areas without a high water table will probably not exceed 5 inches during the period April to September, depending upon the amount of winter rainfall stored in the soil root zone.

Other Classifications

Other water-using areas which have not heretofore been discussed include areas mapped as "dry-farmed crops," which include pasture, grasses, beans, fallow land, deciduous trees, walnuts and other crops; and "miscellaneous" which includes cemeteries, levees, town lots, water surfaces, waste land, country roads and farm lots. (See Table 2.)

Dry-farmed crops

The use of water by dry-farm areas in Lake County, where no underground water is available for plant growth, is dependent upon the amount and distribution of rainfall. Considering information from studies in other areas and the distribution of precipitation in Lake County, the normal annual unit consumptive use of dry-farmed pasture and orchards is estimated to be 21 inches in Scotts Valley-Upper Lake district and 18 inches in Big Valley district. Normal annual use by other dry-farmed crops in these districts is estimated at 18 inches and 15 inches, respectively.

Miscellaneous areas

Town and farm lots and cemeteries. Areas mapped as "town lots", "farm lots" and "cemeteries" are assigned a consumptive use of 24 inches. This allows for an actual use of 1.5 feet with 0.5 foot lost b evaporation after rains. It is estimated that 30 pe cent of the use occurs during the six-month wint period and 70 percent during the period April 1 t September 30.

Water surfaces. These areas include lakes, rese voirs and lagoons. The normal annual loss of water b evaporation from free water surfaces is estimated a 36 inches. (See Table 10 for monthly evaporation.)

Waste land. Areas placed under "waste land" ar bare and consist of sandy or rocky soils. In som cases they are subject to overflow from the river o tributary streams during periods of high water. Th normal annual unit consumptive use is estimated t be 12 inches. Areas mapped as "levees" are include in this classification.

Although no acreages for river channels are show by the State survey, some of the waste land may in clude river channels that are subject to alternatel wet and dry periods or intermittent streamflow. A narrow, constricted places, the water-table is hel closer to the ground surface and consequently surfac

TABLE 13. Summary of estimated normal unit consumptive use o water rates for irrigated, dry-farmed, native vegetation and misce laneous areas in Lake County, California

Classification or crop	Consumptive use of water, feet					
	Scotts Valley Upper Lake			Big Valley (Kelseyville)		
	Oct. 1 to Mar. 31	Apr. 1 to Sept. 30	Annual	Oct. 1 to Mar. 31	Apr. 1 to Sept. 30	Annual
Irrigated crops						
Alfalfa	1.00	2.48	3.48	1.00	2.53	3.53
Beans	.50	.94	1.44	.50	.95	1.45
Corn	.50	1.55	2.05	.50	1.58	2.08
Grain (spring)	.50	1.02	1.52	.50	1.02	1.52
Hops	.50	2.18	2.68	.50	2.22	2.72
Pasture	1.00	2.48	3.48	1.00	2.53	3.53
Pears	.50	1.87	2.37	.50	1.90	2.40
Pears (with cover crop)	.90	2.48	3.38	.90	2.53	3.43
Prunes	.50	1.87	2.37	.50	1.90	2.40
Truck	.50	.87	1.37	.50	.88	1.38
Walnuts (young)	.50	1.87	2.37	.50	1.90	2.40
Walnuts (young) and alfalfa	.90	2.48	3.38	.90	2.53	2.43
Walnuts and grain	.50	2.48	2.98	.50	2.53	3.03
Walnuts and alfalfa	1.00	2.79	3.79	1.00	2.85	3.85
Walnuts	.50	2.18	2.68	.50	2.22	2.72
Vineyard	.50	1.58	2.08	.50	1.62	2.12
Dry-farmed crops						
Pasture and orchards	------	------	1.75	------	------	1.50
Other crops	------	------	1.50	------	------	1.25
Native vegetation[1]						
Swamp (tules)	0.48	3.57	4.05	0.48	3.61	4.09
Trees-brush (heavy)	------	------	4.87	------	------	4.90
Brush-grass (light)	------	------	3.41	------	------	3.43
Grass-brush (sparse)	------	------	2.43	------	------	2.45
Miscellaneous areas						
Town-farm lots-cemeteries	0.6	1.4	2.0	0.6	1.4	2.0
Water surface	.5	2.5	3.0	.5	2.5	3.0
Waste land	------	------	1.0	------	------	1.0
River channel	------	------	2.0	------	------	2.0
County roads	------	------	.8	------	------	.8

[1] In areas of high water table.

ater here appears earlier in the winter and lasts nger in the spring. At a few places, flowing water ay occur the year around. The normal annual unit nsumptive use of river channel is estimated to be 4 inches.

County roads. All county and improved roads are cluded under this classification. The loss of water om these areas is primarily by evaporation after ins. An annual unit consumptive use of 9 inches is signed to these areas.

ımmary of Estimated Unit Consumptive Use

Estimated normal unit consumptive-use values for inter, summer and annual periods for irrigated ops, dry farmed crops, native vegetation and mis- llaneous areas are summarized in Table 13.

The unit consumptive-use values shown in Table 13 ay be applied to acreage shown in Table 2 to com- ute the total amount of water consumed for various eas in Lake County.

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APPENDIX

TABLE 14. Computed normal manthly lake evaparatian in Lake County, California (based on Lakeshore 1948-1949 Weather Bureau pan records)

Month	Coefficient[1] (k)	Consumptive use factor (f)		Evaporation[2]					
				Upper Lake			Kelseyville		
		Upper Lake	Kelseyville	Pan	Lake		Pan	Lake[3]	
				Inches	Inches	Feet	Inches	Inches	Feet
ober	0.68	4.58	4.53	3.11	2.18	0.18	3.08	2.16	0.18
vember	.42	3.40	3.44	1.43	1.00	.08	1.44	1.01	.08
cember	.26	2.92	2.95	.76	.53	.04	.77	.54	.04
uary	.49	2.98	2.93	1.46	1.02	.08	1.44	1.01	.08
bruary	.40	3.14	3.02	1.26	.88	.07	1.20	.84	.07
rch	.60	4.15	3.94	2.49	1.74	.14	2.36	1.65	.14
Subtotal		21.17	20.81	10.51	7.35	.59	10.29	7.21	.59
ril	.188	4.85	4.89	4.27	2.99	.25	4.30	3.01	.25
y	.86	5.92	5.91	5.09	3.56	.30	5.08	3.56	.30
ie	1.06	6.64	6.69	7.04	4.93	.41	7.09	4.96	.41
y	1.24	7.44	7.65	9.22	6.45	.54	9.49	6.64	.55
gust	1.20	6.85	7.12	8.22	5.75	.48	8.54	5.98	.50
tember	1.02	5.56	5.72	5.67	3.97	.33	5.83	4.08	.34
Subtotal		37.26	37.98	39.51	27.65	2.31	40.33	28.23	2.35
Total		58.43	58.79	50.02	35.00	2.90	50.62	35.44	2.94

[1] = developed from 1948-1949 Lakeshore, California Evaporation Station records.
[2] mputed evaporation = k × f.
[3] ke evaporation = pan evaporation × Weather Bureau coefficient 0.70.

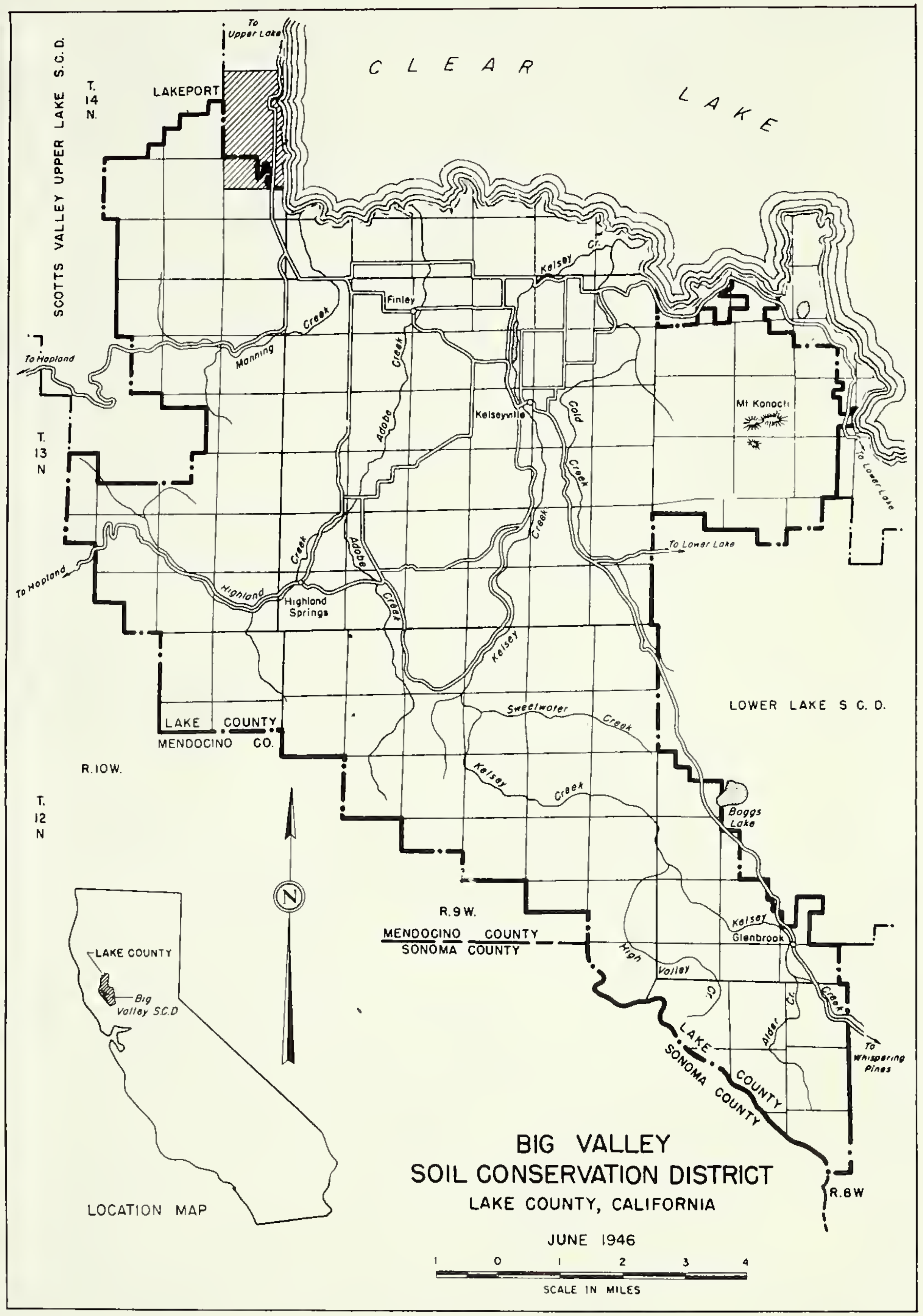


FIGURE 1

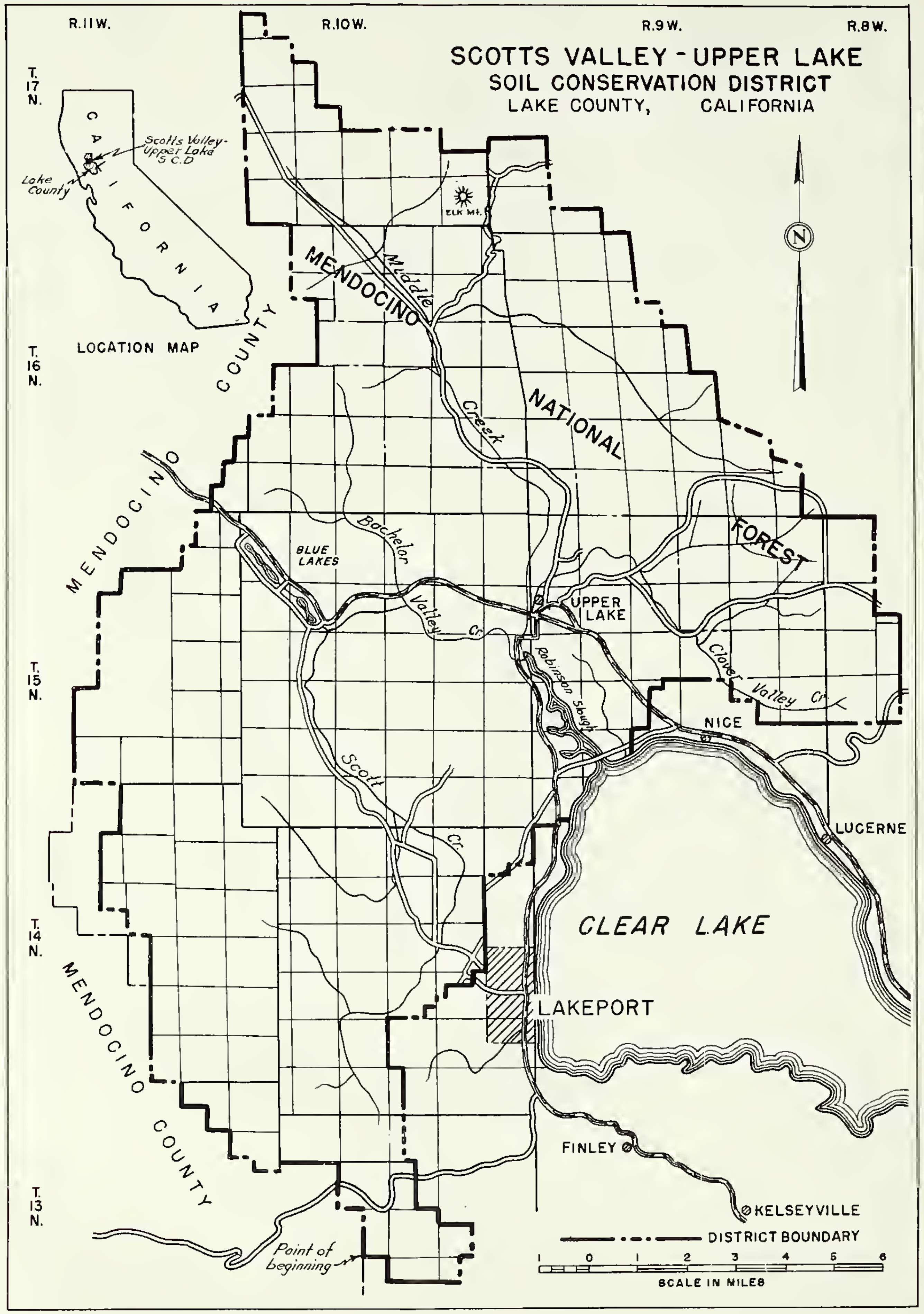


FIGURE 2

APPENDIX L

RECORDS OF APPLICATION OF IRRIGATION WATER TO SELECTED PLOTS OF REPRESENTATIVE CROPS IN CLEAR LAKE AREA IN 1949 AND 1950

RECORDS OF
APPLICATION OF IRRIGATION WATER TO SELECTED PLOTS OF REPRESENTATIVE CROPS
IN CLEAR LAKE AREA IN 1949 AND 1950

Crop	Season	Plot number on Plate 13	Well number	Unit	Method of irrigation	Acres	Depth of application, in inches											Total, in inches	Depth, in feet
							1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th		
Alfalfa	1949	1	13N/9W-12M2	Big Valley	Border check	7	5.6	6.3	7.4	6.6	15.5	7.1						48.5	4.0
	1949	2	13N/9W-16F2	Big Valley	Border check	4	5.4	3.3	9.1	7.3	8.5	8.0						41.6	3.5
	1949	3	13N/9W-22J1	Big Valley	Border check	4.5	2.3	1.5	2.7	3.1	3.0	1.1	2.5	5.2	3.1	3.4	3.0	30.9	2.6
	1949	4	14N/10W-14E2	Scott Valley	Sprinkler	10	4.4	20.4	2.5	1.3	1.3							29.9	2.5
	1949	5	15N/9W-6K1	Upper Lake	Sprinkler	18	8.1	5.4	1.8	4.2								19.5	1.6
	1949	6	16N/9W-31Q1	Upper Lake	Border check	6	8.0	6.4	4.9	10.2	7.5	5.0						42.0	3.5
	1950	7	13N/9W-16M1	Big Valley	Border check	5	4.0	4.0	3.0	4.3	4.1	3.6	4.3	4.4	3.6	1.9		37.2	3.1
	1950	5	15N/9W-6K1	Upper Lake	Sprinkler	18	5.3	8.2	6.9	7.0								27.4	2.3
	1950	8	15N/9W-7M1	Upper Lake	Sprinkler	7			Not separated									17.8	1.5
Alfalfa and young walnuts	1949	7	13N/9W-16M1	Big Valley	Border check	5	2.9	3.1	3.2	2.9	3.0	3.2	3.5					21.8	1.8
	1949	9	13N/9W-17A1	Big Valley	Border check	4	16.8	6.4										23.2	1.9
Clover	1949	2	13N/9W-16F2	Big Valley	Border check	5	4.1	6.7	6.0	5.7	4.9	2.8	6.1	3.2				39.5	3.3
	1949	5	15N/9W-6K1	Upper Lake	Sprinkler	15	6.2	5.9	1.9	6.7	8.6	8.1	0.9	1.7				40.0	3.3
	1950	5	15N/9W-6K1	Upper Lake	Sprinkler	15	2.0	5.9	6.5	9.4	5.6							29.4	2.5
Hops	1949	10	14N/10W-14D2	Scott Valley	Basin	24	4.0	2.7	6.3	4.7								17.7	1.5
	1949	11	14N/10W-14N2	Scott Valley	Basin	83	0.7	3.6	0.9	2.1								7.3	0.6
Mixed orchard	1950	12	13N/9W-5P1	Big Valley	Sprinkler	35			Continuous irrigation									7.5	0.6
Pasture	1949	13	13N/9W-11E1	Big Valley	Border check	30	2.4	3.3	5.3	7.7	25.8	3.9	8.7					57.1	4.8
	1949	7	13N/9W-16M1	Big Valley	Border check	10	2.2	2.9	3.3									8.4	0.7
	1949	3	13N/9W-22J1	Big Valley	Border check	4.5			Nineteen applications									46.4	3.9
	1949	14	13N/9W-23C1	Big Valley	Sprinkler	20			Continuous irrigation									6.3	0.5
	1949	14	13N/9W-23C1	Big Valley	Sprinkler	6			Continuous irrigation									50.4	4.2
	1950	8	15N/9W-7M1	Upper Lake	Sprinkler	30			Not separated									22.9	1.9
Pears	1949	15	13N/9W-2C2	Big Valley	Border check	35	10.5	12.1										22.6	1.9
	1949	16	13N/9W-8A2	Big Valley	Border check	5.7	25.9	10.0	7.6	10.3	12.0							65.8	5.5
	1949	17	13N/9W-9D2	Big Valley	Border check	11	5.8	5.1	6.9	2.3	13.1							33.2	2.8
	1949	13	13N/9W-11E1	Big Valley	Border check	14	3.6	4.8	11.0	14.8								34.2	2.9
	1949	1	13N/9W-12M2	Big Valley	Border check	10	4.1	8.6	12.7	4.3								29.7	2.5
	1949	18	13N/9W-16E2	Big Valley	Border check	14	7.6	6.9	8.1	4.1								26.7	2.2
	1949	9	13N/9W-17A1	Big Valley	Border check	16	6.8	12.5	2.3	4.0								25.6	2.1
	1949	3	13N/9W-22J1	Big Valley	Border check	6	4.7	5.4	4.8	6.0	5.7	5.1	2.7	2.7	3.6	1.8	5.3	47.8	4.0
	1949	19	14N/9W-34N3	Big Valley	Border check	10	11.8	10.7	12.4	8.7								43.6	3.6
	1949	4	14N/10W-14E2	Scott Valley	Sprinkler	52	7.7	1.0	7.4									16.1	1.3
	1949	11	14N/10W-14N2	Scott Valley	Basin	17	9.1											9.1	0.8
	1950	15	13N/9W-2C2	Big Valley	Border check	35	15.4	11.6										27.0	2.3
	1950	20	13N/9W-10A1	Big Valley	Border check	30	6.1	11.4	2.5	5.8								25.8	2.2
	1950	21	13N/9W-14L1	Big Valley	Border check	20	3.6	18.2	2.7									24.5	2.0
Pears, young	1949	10	14N/10W-14D2	Scott Valley	Basin	4	4.3											4.3	0.4
Pears with permanent cover crop	1949	16	13N/9W-8A2	Big Valley	Border check	5.7	6.7	4.0	4.2	5.1								20.0	1.7
	1949	22	14N/9W-32N1	Big Valley	Border check	36	4.5	9.6	2.6	21.0	10.2	1.9	14.8	16.3				80.9	6.7
	1949	23	14N/9W-33P1	Big Valley	Border check	12	11.3	14.3	19.3	19.3	20.9	10.5	14.9	19.5				130.0	10.8
	1950	24	13N/9W-10G1	Big Valley	Border check	25	3.9	4.5	4.1	8.2	11.3	2.1	15.0					49.1	4.1
	1950	25	13N/9W-16B1	Big Valley	Border check	21			Continuous irrigation									53.0	4.4
	1950	23	14N/9W-33P1	Big Valley	Border check	12	16.7	32.4	15.9	15.7								80.7	6.7
Pears with semipermanent cover crop	1949	26	13N/9W-10R1	Big Valley	Border check	30	5.7	5.2	6.4	5.4	7.8							30.5	2.5
	1950	26	13N/9W-10R1	Big Valley	Border check	30	6.0	6.3	6.3	10.5								29.1	2.4
Sudan grass	1949	2	13N/9W-16F2	Big Valley	Border check	10.3	2.1	4.5	3.0	1.5	1.8	1.5	1.4	2.8	2.3			20.9	1.7
Walnuts	1949	28	13N/9W-8K3	Big Valley	Border check	9.5	3.1	2.7	7.6									13.4	1.1
	1949	7	13N/9W-16M1	Big Valley	Border check	12	4.1	1.4										5.5	0.5
	1949	9	13N/9W-17A1	Big Valley	Border check	25	9.0											9.0	0.8
	1950	7	13N/9W-16M1	Big Valley	Border check	12	7.0											7.0	0.6
Walnuts with alfalfa	1949	28	16N/9W-31K1	Upper Lake	Sprinkler	3	9.2	9.1										18.3	1.5
Walnuts with corn	1949	28	16N/9W-31K1	Upper Lake	Sprinkler	32	9.2											9.2	0.8

APPENDIX M

SEASONAL SUMMARIES OF MONTHLY YIELD STUDIES OF PROPOSED PROJECTS

TABLE OF CONTENTS

SEASONAL SUMMARY OF MONTHLY YIELD STUDY, KELSEYVILLE RESERVOIR ON KELSEY CREEK

(In acre-feet)

Storage capacity: 36,000 acre-feet

Seasonal yield: 26,800 acre-feet

Season	Water supply		Distribution of water supply				
	Storage, October 1st	Inflow	Evaporation	Yield	Spill	Storage, September 30th	Deficiency in per cent
1920-21	0	53,900	2,000	26,800	0	25,100	-------
21-22	25,100	28,700	2,000	26,800	0	25,000	-------
22-23	25,000	29,800	2,000	26,800	100	25,900	-------
23-24	25 900	9,600	1,000	26,800	0	7,700	-------
24-25	7,700	44,600	1,500	26,800	0	24,000	-------
1925-26	24,000	32,300	2,000	26,800	800	26,700	-------
26-27	26,700	67,700	2,000	26,800	38,100	27,500	-------
27-28	27,500	37,600	2,000	26,800	9,000	27,300	-------
28-29	27,300	16,300	1,500	26,800	0	15,300	-------
29-30	15,300	30,700	1,500	26,800	0	17,700	-------
1930-31	17,700	8,500	500	25,700	0	0	4.1
31-32	0	29,800	500	26,800	0	2,500	-------
32-33	2,500	21,800	500	23,800	0	0	11.2
33-34	0	24,700	500	24,200	0	0	9.7
34-35	0	36,400	1,000	26,000	0	9,400	3.0

SEASONAL SUMMARY OF MONTHLY YIELD STUDY, LAKEPORT RESERVOIR ON SCOTT CREEK

(In acre-feet)

Storage capacity: 12,800 acre-feet

Seasonal yield: 9,300 acre-feet

Season	Water supply		Distribution of water supply				
	Storage, October 1st	Inflow	Evaporation	Yield	Spill	Storage, September 30th	Deficiency in per cent
1920-21	0	46,400	1,200	9,100	29,200	6,900	-------
21-22	6,900	16,300	1,100	9,300	6,400	6,400	-------
22-23	6,400	17,900	1,200	9,300	7,400	6,400	-------
23-24	6,400	3,000	500	8,900	0	0	4.3
24-25	0	34,800	1,100	9,300	17,300	7,100	-------
1925-26	7,100	20,200	1,200	9,300	11,900	4,900	-------
26-27	4,900	63,100	1,300	9,300	51,100	6,300	-------
27-28	6,300	26,600	1,300	9,300	16,400	5,900	-------
28-29	5,900	5,800	700	9,300	0	1,700	-------
29-30	1,700	20,400	1,000	9,300	6,500	5,300	-------
1930-31	5,300	3,500	500	8,300	0	0	10.8
31-32	0	17,300	1,100	8,000	3,400	4,800	14.0
32-33	4,800	8,900	1,000	9,300	0	3,400	-------
33-34	3,400	11,200	800	9,300	0	4,500	-------
34-35	4,500	25,000	1,000	9,300	13,700	5,500	-------

SEASONAL SUMMARY OF MONTHLY YIELD STUDY, PITNEY RIDGE RESERVOIR ON MIDDLE CREEK

(In acre-feet)

Storage capacity: 5,400 acre-feet

Seasonal yield: 5,400 acre-feet

Season	Water supply		Distribution of water supply				
	Storage, October 1st	Inflow	Evaporation	Yield	Spill	Storage, September 30th	Deficiency in per cent
1920-21	0	43,700	270	5,400	35,310	2,720	-------
21-22	2,720	15,400	450	5,400	10,050	2,220	-------
22-23	2,220	16,800	440	5,400	10,980	2,200	-------
23-24	2,200	3,000	360	4,840	0	0	10.3
24-25	0	32,600	460	5,400	24,340	2,400	-------
1925-26	2,400	22,600	450	5,400	18,030	1,120	-------
26-27	1,120	60,000	450	5,400	53,560	1,710	-------
27-28	1,710	25,100	450	5,400	18,840	2,120	-------
28-29	2,120	5,600	460	5,400	680	1,180	-------
29-30	1,180	19,100	470	5,400	13,330	1,080	-------
1930-31	1,080	3,800	240	4,640	0	0	14.1
31-32	0	16,100	430	5,130	9,860	680	5.0
32-33	680	8,300	450	5,400	2,230	900	-------
33-34	900	10,500	470	5,400	5,150	380	-------
34-35	380	23,400	450	5,400	17,030	900	-------

APPENDIX N

ESTIMATES OF COST OF PROPOSED PROJECTS

TABLE OF CONTENTS

ESTIMATED COST OF KELSEYVILLE DAM AND RESERVOIR

(Based on prices prevailing in November, 1954)

Elevation of crest of dam: 1,615 feet, U.S.G.S. datum
Elevation of crest of spillway: 1,595 feet
Height of dam to spillway crest, above stream bed: 139 feet

Capacity of reservoir to crest of spillway: 36,000 acre-feet
Capacity of spillway with 7-foot freeboard: 20,000 second-feet

Item	Quantity	Unit price	Cost	
CAPITAL COSTS				
Dam				
Diversion and care of stream		lump sum	$15,000	
Stripping and preparation of foundation				
Common	8,000 cu.yd.	$1.00	8,000	
Rock	18,000 cu.yd.	1.00	18,000	
Excavation for embankment				
From borrow pits	214,000 cu.yd.	0.35	74,900	
From quarry	137,000 cu.yd.	1.00	137,000	
Embankment				
Impervious fill	171,000 cu.yd.	0.30	51,300	
Pervious fill	337,000 cu.yd.	0.35	118,000	
Overhaul	220,000 cu.yd.	0.20	44,000	
Pressure grouting	4,440 cu.yd.	8.00	35,500	$501,700
Spillway				
Excavation				
Common	331,000 cu.yd.	1.10	364,100	
Rock	220,000 cu.yd.	1.50	330,000	
Shaping	10,000 cu.yd.	3.25	32,500	
Concrete				
Lining	235 cu.yd.	35.00	8,200	
Reinforcing steel	23,500 lb.	0.20	4,700	739,500
Outlet Works				
Excavation				
Rock	975 cu.yd.	8.00	7,800	
Concrete				
Backfill	535 cu.yd.	30.00	16,100	
Structural	50 cu.yd.	100.00	5,000	
Steel pipe	90,000 lb.	0.30	27,000	
Reinforcing steel	45,000 lb.	0.15	6,800	

Item	Quantity	Unit price	Cost	
Trashrack	2 ea.	lump sum	$1,000	
Butterfly valve, 42"	1 ea.	6,000	12,000	
Hollow jet valve 42"		10,500	10,500	
Hydraulic control lines and operating mechanism		lump sum	2,500	$88,700
Reservoir	780 acres			
Land		$50.00	$39,000	
Public utilities	1.5 miles			
Power line	3.5 miles	3,500	5,300	
Telephone line	320 acres	2,100	7,400	
Clearing reservoir lands		75.00	24,000	$75,700
Subtotal				$1,405,600
Administration and engineering, 10%				140,600
Contingencies, 15%				210,800
Interest during construction, one-half of construction period at 3.5%				30,700
Total				$1,787,700
ANNUAL COSTS				
Interest, 3.5%				$62,600
Repayment, 0.763%				13,600
Replacement, 0.07%				1,300
Operation and maintenance				6,100
General expense, 0.32%				5,700
Total				$89,300

ESTIMATED COST OF BIG VALLEY BY-PASS CHANNEL

(Based on prices prevailing in November, 1954)

Length of by-pass: 5.0 miles

Capacity of by-pass: 18,000 second-feet

Item	Quantity	Unit price	Cost	
CAPITAL COSTS				
Diversion Channel				
Excavation	686,000 cu.yd.	$0.40	$274,400	
Land and improvements	270 acres	200.00	54,000	$328,400
Structures				
Adobe Creek outlet		lump sum	5,000	
Bridge, Highway 29	9,940 sq.ft.	11.00	109,300	
Bridges, secondary roads, 2	14,200 sq.ft.	4.00	56,800	171,100
Subtotal				$499,500

Item	Quantity	Unit price	Cost
Administration and engineering, 10%			$50,000
Contingencies, 15%			74,900
Interest during construction, 3.5%			8,700
Total			$633,100
ANNUAL COSTS			
Interest, 3.5%			$22,200
Amortization, 0.763%			4,800
Replacement, 0.1%			600
Operation and maintenance			6,300
General expense, 0.32%			2,000
Total			$35,900

ESTIMATED COST OF LAKEPORT DAM AND RESERVOIR

(Based on prices prevailing in November, 1954)

Elevation of crest of dam: 1,537 feet, U.S.G.S. datum
Elevation of crest of spillway: 1,525 feet
Height of dam to spillway crest, above stream bed: 70 feet
Capacity of reservoir to crest of spillway: 13,000 acre-feet
Capacity of spillway with 5.75-foot freeboard: 21,000 second-feet

Item	Quantity	Unit price	Cost	
CAPITAL COSTS				
Dam				
Diversion and care of stream		lump sum	$5,000	
Stripping and preparation of foundation				
Rock	25,000 cu.yd.	$2.50	62,500	
Earth	10,600 cu.yd.	0.40	44,200	
Excavation for embankment				
From borrow pits	145,000 cu.yd.	0.40	58,000	
Embankment				
Impervious, borrow	287,200 cu.yd.	0.70	201,000	
Pervious, quarry	190,000 cu.yd.	0.70	133,000	
Pervious, salvage	94,700 cu.yd.	0.70	66,500	
Drilling grout holes	13,500 lin. ft.	4.00	54,000	
Pressure grouting	13,500 cu.ft.	4.00	54,000	$678,200
Spillway				
Excavation				
Common	15,000 cu.yd.	1.10	16,500	
Rock	7,000 cu.yd.	2.25	157,500	
Shaping	7,000 cu.yd.	3.25	22,800	
Concrete				
Weir and cutoff	535 cu.yd.	35.00	18,600	
Lining	3,000 cu.yd.	30.00	90,000	
Cutoff wall	40 cu.yd.	35.00	1,400	
Reinforcing steel	270,000 lb.	0.15	40,500	347,300
Outlet Works				
Excavation				
Rock	455 cu.yd	3.00	1,400	
Concrete				
Backfill	300 cu.yd.	35.00	10,500	
Structural	20 cu.yd.	100.00	2,000	
Steel pipe	43,000 lb.	$0.25	$10,800	
Reinforcing steel	24,000 lb.	0.15	3,600	
Trashrack	2,400 lb.	0.25	600	
Butterfly valve, 36"	2 ea.	5,000	10,000	
Hollow jet valve, 36"	1 ea.	9,000	9,000	
Hydraulic control lines		lump sum	1,000	$48,900
Reservoir				
Land and improvements	500 acres and buildings	lump sum	50,000	
Clearing reservoir lands	500 acres	75.00	37,500	87,500
Subtotal				$1,161,900
Administration and engineering, 10%				116,200
Contingencies, 15%				174,300
Interest during construction, 3.5%				20,300
Total				$1,472,700
ANNUAL COSTS				
Interest, 3.5%				$51,500
Repayment, 0.763%				12,400
Replacement, 0.07%				1,000
Operation and maintenance				2,600
General expense, 0.32%				4,700
Total				$72,200

ESTIMATED COST OF SPILLWAY CHANNEL TO CLEAR LAKE

(Based on prices prevailing in November, 1954)

Length of spillway channel: 2.5 miles
Capacity of spillway with 5.75-foot freeboard: 21,000 second-feet

Item	Quantity	Unit price	Cost	
CAPITAL COSTS				
Spillway Channel				
Excavation of natural channel	80,000 cu.yd.	$0.40	$32,000	
Excavation for lined channel	135,000 cu.yd.	0.30	40,500	
Concrete lining	7,150 cu.yd.	35.00	250,000	
Steel fabric	213,000 lb.	0.15	32,000	$354,500
Structures				
Bridges and approaches	2 ea.	lump sum	56,000	
Rights of way	45 acres	200.00	9,000	65,000
Subtotal				$419,500
Administration and engineering, 10%				42,000
Contingencies, 15%				$62,900
Interest during consturction, 3.5%				7,300
Total				$531,700
ANNUAL COSTS				
Interest, 3.5%				$18,600
Amortization, 0.763%				4,100
Replacement, 0.05%				300
Operation and maintenance				2,700
General expense, 0.32%				1,700
Total				$27,400

ESTIMATED COST OF BACHELOR VALLEY CONVEYANCE AND PUMPING SYSTEM

(Based on prices prevailing in November, 1954)

Item	Quantity	Unit price	Cost	
CAPITAL COSTS				
Conveyance Ditches				
Main ditch	4,200 lin.ft.	$0.45	$1,900	
Lower ditch	5,300 lin.ft.	0.75	4,000	
Upper ditch	15,800 lin.ft.	0.38	6,000	
Pipe under Highway 20	100 lin.ft.	50.00	5,000	$16,900
Pumping Plants and Pipe Lines				
Pumping Plant No. 1, pumps, motors, and electrical equipment	2 ea.	6,600	13,200	
Pumping Plant No. 2, pump, motor, and electrical equipment	2 ea.	8,000	16,000	
Pump houses	2 ea.	500	1,000	
Steel pipe				
18-inch	7,400 lb.	0.25	1,800	
30-inch	59,000 lb.	0.25	14,800	
Check dam for sump of Pumping Plant No. 1		lump sum	500	47,300
Diversion Dam on Scott Creek				
Excavation	1,000 cu.yd.	0.25	300	
Clay blanket	500 cu.yd.	1.00	500	
Concrete	61 cu.yd.	100.00	6,100	
Reinforcing steel	4,500 lb.	0.15	700	
Timber	2.5 MBM	325.00	800	
Hardware		lump sum	300	8,700
Dayle Creek Regulating Dam and Reservoir				
Stripping	1,500 cu.yd.	0.40	$600	
Embankment	6,400 cu.yd.	0.50	3,200	
Spillway				
Excavation	200 cu.yd.	1.00	200	
Concrete lining	30 cu.yd.	35.00	1,100	
Reinforcing steel	2,300 lb.	0.15	300	
Outlet works		lump sum	1,400	$6,800
Subtotal				$79,700
Administration and engineering, 10%				8,000
Contingencies, 15%				12,000
Interest during construction, 3.5%				1,400
Total				$101,100
ANNUAL COSTS				
Interest, 3.5%				$3,400
Amortization, 0.763%				800
Replacement, 0.5%				500
Operation and maintenance				3,400
General expense, 0.32%				300
Electric energy				6,700
Total				$15,100

ESTIMATED COST OF BACHELOR VALLEY DISTRIBUTION SYSTEM

(Based on prices prevailing in November, 1954)

Distribution system: Unlined canals and ditches Acreage served: 1,000 acres

Item	Quantity	Unit price	Cost	
CAPITAL COSTS				
Distribution system	1,000 acres	$20.00	$20,000	$20,000
Subtotal				$20,000
Administration and engineering, 10%				2,000
Contingencies, 15%				3,000
Interest during construction 3.5%				400
Total				$25,400
ANNUAL COSTS				
Interest, 3.5%				$900
Amortization, 0.763%				200
Operation and maintenance				3,600
Total				$4,700

ESTIMATED COST OF DISTRIBUTION SYSTEM FOR TULE LAKE, HELMS, AND EDMANDS RECLAMATION DISTRICTS

(Based on prices prevailing in November, 1954)

Distribution system: Unlined canals and ditches

Acreage served: 700 acres

Item	Quantity	Unit price	Cost	
CAPITAL COSTS				
Distribution system	600 acres	$20.00	$12,000	$12,000
Subtotal				$12,000
Administration and engineering, 10%				1,200
Contingencies, 15%				1,800
Interest during construction, none				
Total				$15,000

Item	Quantity	Unit price	Cost
ANNUAL COSTS			
Interest, 3.5%			$600
Amortization, 0.763%			100
Operation and maintenance			1,600
Total			$2,300

ESTIMATED COST OF PITNEY RIDGE DAM AND RESERVOIR

(Based on prices prevailing in November, 1954)

Elevation of crest of dam: 1,555 feet, U.S.G.S. datum
Elevation of crest of spillway: 1,542 feet
Height of dam to spillway crest, above stream bed: 64 feet

Capacity of reservoir to crest of spillway: 5,400 acre-feet
Capacity of spillway with 5-foot freeboard: 20,800 second-feet

Item	Quantity	Unit price	Cost	
CAPITAL COSTS				
Dam				
Diversion and care of stream		lump sum	$2,000	
Stripping and preparation of foundation	105,000 cu.yd.	$0.60	63,000	
Embankment				
Impervious, borrow	199,000 cu.yd.	.70	139,300	
Pervious, salvage	200,000 cu.yd.	.70	140,000	
Riprap, salvage	4,800 cu.yd.	1.00	4,800	
Drilling grout holes	3,200 lin.ft.	4.00	12,800	
Pressure grouting	2,400 cu.ft.	4.00	9,600	$371,500
Spillway				
Excavation				
Rock	27,500 cu.yd.	2.00	55,000	
Concrete				
Weir and cutoff wall	450 cu.yd.	35.00	15,800	
Lining	1,500 cu.yd.	35.00	52,500	
Reinforcing steel	150,000 lb.	0.15	22,500	145,800
Outlet Works				
Excavation				
Rock	370 cu.yd.	6.00	2,200	
Concrete				
Backfill	237 cu.yd.	0.30	7,100	
Structural	5 cu.yd.	1.00	500	
Steel pipe	9,800 lb.	0.30	2,900	
Reinforcing steel	17,700 lb.	0.15	2,700	
High-pressure slide gate, 24"	2 ea.	$8,500	$17,000	
Hollow jet valve, 24"	1 ea.	5,000	5,000	
Control house and lines		lump sum	1,000	
Trashrack		lump sum	600	$39,000
Reservoir				
Relocate county road	3 miles	15,000	45,000	45,000
Subtotal				$601,300
Administration and engineering, 10%				$60,100
Contingencies, 15%				90,200
Interest during construction, 3.5%				13,200
Total				$764,800
ANNUAL COSTS				
Interest, 3.5%				$26,800
Repayment, 0.763%				5,800
Replacement 0.07%				500
Operation and maintenance				1,100
General expense, 0.32%				2,400
Total				$36,600

ESTIMATED COST OF MIDDLE CREEK DIVERSION AND SUPPLY DITCH

(Based on prices prevailing in November, 1954)

levation of crest of weir: 1,410 feet, U.S.G.S. datum
eight of weir above stream bed: 5 feet
ength of weir crest: 100 feet

Capacity of supply ditch: 30 second-feet
Length of supply ditch: 4 miles

Item	Quantity	Unit price	Cost	
PITAL COSTS				
Diversion Works				
ripping and preparation of foundation	30 cu.yd.	$6.00	$200	
oncrete	50 cu.yd.	60.00	3,000	
einforcing steel	3,600 lb.	0.20	700	
ardware		lump sum	300	
umber	1,250 MBM	400.00	500	
Subtotal				$4,700
Supply Ditch				
xcavation	9,700 cu.yd.	0.35	3,400	
olled fill	9,700 cu.yd.	0.30	3,000	
Subtotal				$6,400
County Road Crossing				
xcavation	30 cu.yd.	2.00	60	
oncrete	13 cu.yd.	100.00	1,300	
eel	1,000 lb.	0.15	50	
epairing roadway		lump sum	200	1,710
Farm Road Crossing				
orrugated metal pipe, 36″	20 lin.ft.	10.00	200	
xcavation	20 cu.yd.	1.00	20	
iprap		lump sum	30	250

Item	Quantity	Unit price	Cost	
Alley Creek Crossing				
Flume	30 lin.ft.	$10.00	$300	$300
Right of way	10 acres	500.00	5,000	5,000
Subtotal				$18,350
Administration and engineering, 10%				1,835
Contingencies, 15%				2,755
Interest during construction, none				
Total				$22,940
ANNUAL COSTS				
Interest, 3.5%				$805
Amortization, 0.763%				175
Replacement, 0.5%				115
Operation and maintenance				230
General expense, 0.32%				75
Total				$1,400

ESTIMATED COST OF UPPER LAKE DISTRIBUTION SYSTEM

(Based on prices prevailing in November, 1954)

stribution system: Unlined canals and ditches

Acreage served: 2,000 acres

Item	Quantity	Unit price	Cost	
PITAL COSTS				
tribution system	2,000 acres	$20.00	$40,000	$40,000
Subtotal				$40,000
ministration and engineering, 10%				4,000
ntingencies, 15%				6,000
terest during construction, 3.5%				1,400
Total				$51,400

Item	Quantity	Unit price	Cost
ANNUAL COSTS			
Interest, 3.5%			$1,800
Amortization, 0.763%			390
Operation and maintenance			
Ditch tender service, $0.50 per acre-foot			2,700
Maintenance charge, $0.40 per acre			800
District overhead, $0.50 per acre			1,000
Total			$6,690

APPENDIX O

COMMENTS OF CONCERNED AGENCIES ON PRELIMINARY DRAFT OF BULLETIN NO. 14, "LAKE COUNTY INVESTIGATION"

TABLE OF CONTENTS

CO-OPERATIVE EXTENSION WORK
IN
AGRICULTURE AND HOME ECONOMICS
STATE OF CALIFORNIA

University of California
United States Department
of Agriculture and County
of Lake, Co-operating

University of California
College of Agriculture Extension Service
KELSEYVILLE, CALIF.

January 4, 1956

MR. SAM R. LEEDOM
Administrative Assistant
State Water Resources Board
Public Works Building
Sacramento 5, California

DEAR MR. LEEDOM:

This is in answer to your letter of December 14, asking that we review the draft of Bulletin 14, "Lake County Investigation," and furnish you with any comments we may have on it.

I believe this bulletin is very well written and quite complete. I found it very interesting as far as I was concerned, as I have been in the county only four years and much of the information applies to things that have happened here in the past as well as in the present. I really have no suggestions for any changes in this bulletin.

Thank you for giving us a copy of this investigation report.

Sincerely yours,

WILLARD C. LUSK
Farm Advisor

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
REGIONAL OFFICE, REGION 2
SACRAMENTO, CALIFORNIA

February 28, 1956

MR. HARVEY O. BANKS
State Engineer
Division of Water Resources
P. O. Box 1079
Sacramento 5, California

DEAR MR. BANKS:

We have reviewed the draft of Bulletin No. 14, "Lake County Investigation" dated October 1955, which accompanied Mr. Leedom's letter of December 14 (your file 625.1 Item 4.0). This report is very well prepared and presents a considerable volume of valuable basic data much of which was not previously available. Since we have not made any detailed investigations in this area, we have no specific comments on your studies or conclusions.

We appreciate your courtesy in allowing us to review this excellent report.

Sincerely yours,

R. S. CALLAND
Acting Regional Director

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
CALIFORNIA REGION

630 Sansome Street
San Francisco 11, California

March 1, 1956

MR. HARVEY O. BANKS, *Secretary*
State Water Resources Board
Public Works Building
Sacramento 5, California

DEAR MR. BANKS:

Reference is made to your letter of December 13, 1955 transmitting a draft of Bulletin No. 14, "Lake County Investigations" for review by the Forest Service.

We have read the draft with interest, since some of the water control projects are near, and involve water from, lands of the Mendocino National Forest. The report has also been reviewed by that Forest. We have no particular comments on the report with respect to Forest Service interests. When the final draft is printed we would appreciate receiving one copy for this office and a copy for the Mendocino Forest.

Very truly yours,

K. W. KENNEDY, Chief
Div. of Watershed Management & Engineering
By C. A. DAVIDSON

Board of Supervisors
Lake County, California
Lakeport, California

April 25, 1956

Mr. Harvey O. Banks, *Secretary*
State Water Resources Board
Public Works Building
Sacramento 5, California

Dear Mr. Banks:

Receipt is acknowledged of copies of State Water Resources Board Bulletin No. 14, "Lake County Investigation."

This Board, operating through our Lake County Water Commission has reviewed the report and has made certain suggestions for change, clarification, or further study to representatives of the State Division of Water Resources.

The Commission, after reviewing the Bulletin concurs, in general, with the findings therein, and considers the Bulletin will be a valuable guide and source of information for future plans of water development for Lake County. However, upon advice of the Commission, and after due consideration the Board of Supervisors wishes to set down certain reservations regarding their acceptance of the estimates of the irrigable land in the area covered by the report, and estimates of present and ultimate water requirements presented in Chapter III. This Board is of the opinion that, although such estimates may be based upon full consideration of all present factors, they may, because of unforeseen changes in the economy of this area, and possible technological advances, prove to be in error to the detriment of the county, if such estimates are used as a basis for allocation of water.

The water resources of Lake County are vital to our development and this Board views with concern the setting at the present time of any limit on the use of waters originating in Lake County.

Differences in standards of various agencies for classifying irrigable lands, the potential increase in population and possible changes in our economy and eventual development make it clear and imperative that the Board at this time is unwilling to accept or concur in the setting of a limit on the use of our native water resources. We feel that this statement should be made a part of the final draft of Bulletin No. 14.

Very truly yours,

Lake County Board of Supervisors
Thos. L. Garner
County Clerk and Clerk of the
Board of Supervisors

o

printed in CALIFORNIA STATE PRINTING OFFICE
311 7-57 500

DEPARTMENT OF WATER RESOURCES 1957

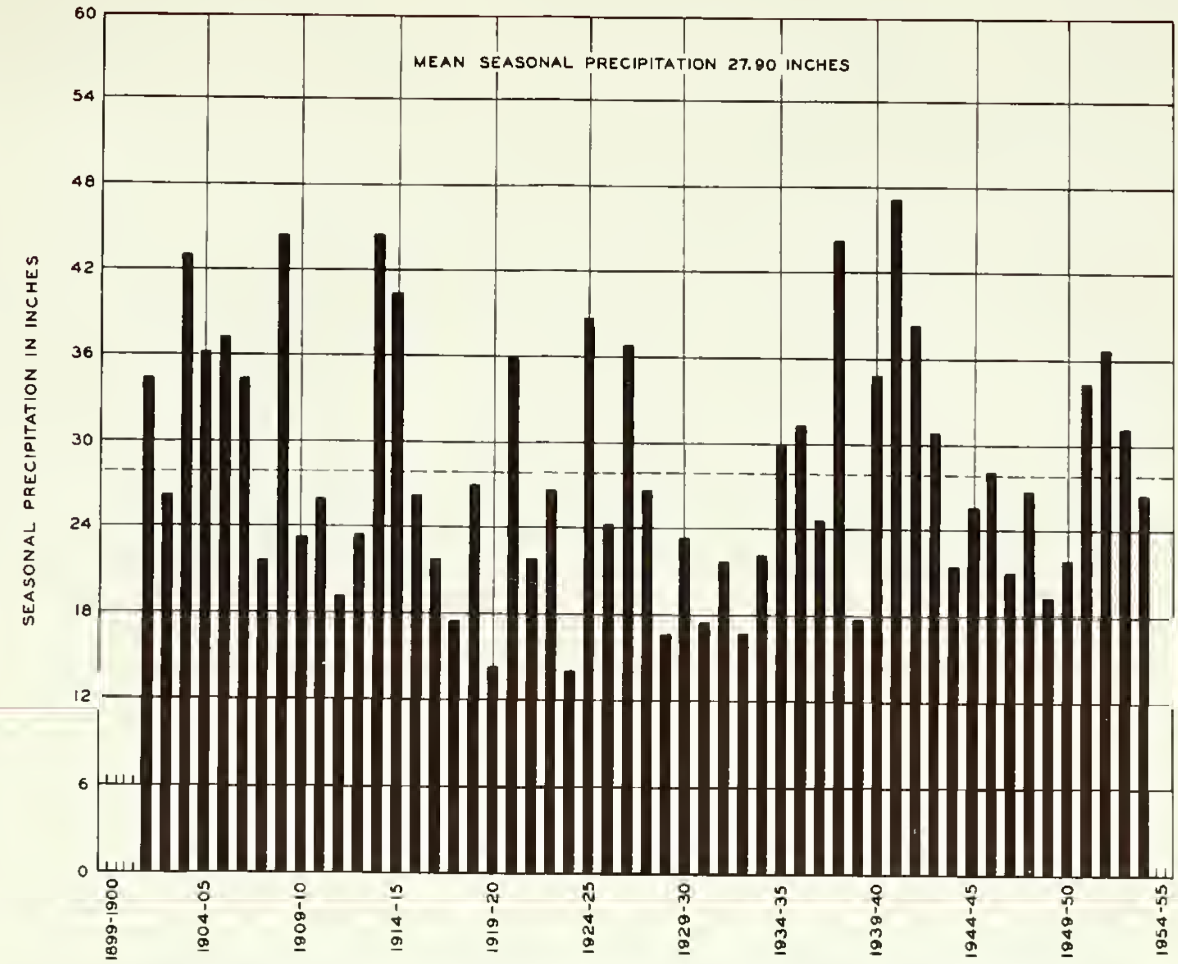
STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
DIVISION OF RESOURCES PLANNING
LAKE COUNTY INVESTIGATION

HYDROGRAPHIC UNITS
AND
PRINCIPAL ORGANIZED WATER AGENCIES

DEPARTMENT OF WATER RESOURCES 1957

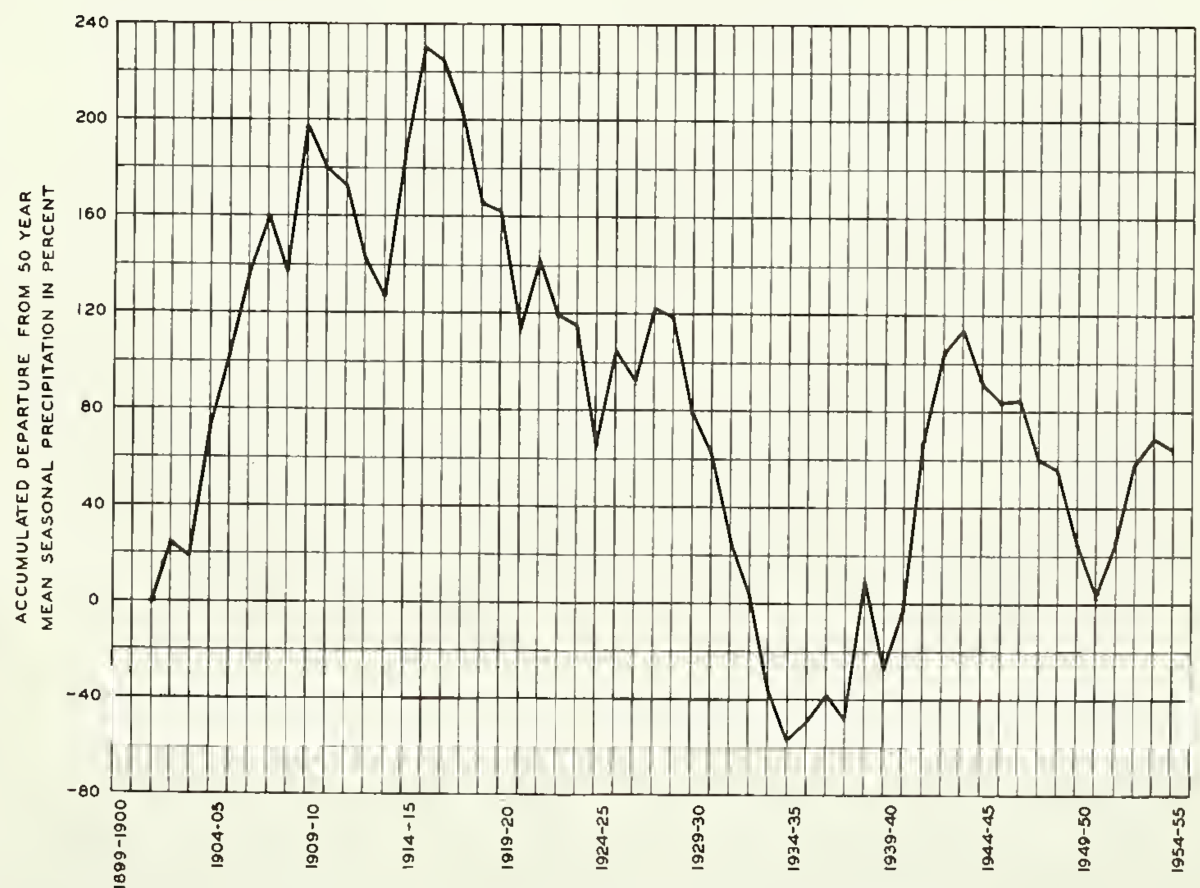

CLEAR LAKE
UPPER LAKE UNIT
BIG VALLEY UNIT
SCOTT VALLEY UNIT
Bachelor Valley
RUMSEY GAGE
LEGEND
—15— PRECIPITATION IN INCHES
L-2 STREAM GAGING STATION
5 94 PRECIPITATION STATION
STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
DIVISION OF RESOURCES PLANNING
LAKE COUNTY INVESTIGATION
LINES OF EQUAL MEAN SEASONAL PRECIPITATION
1898-1947

PLATE 4



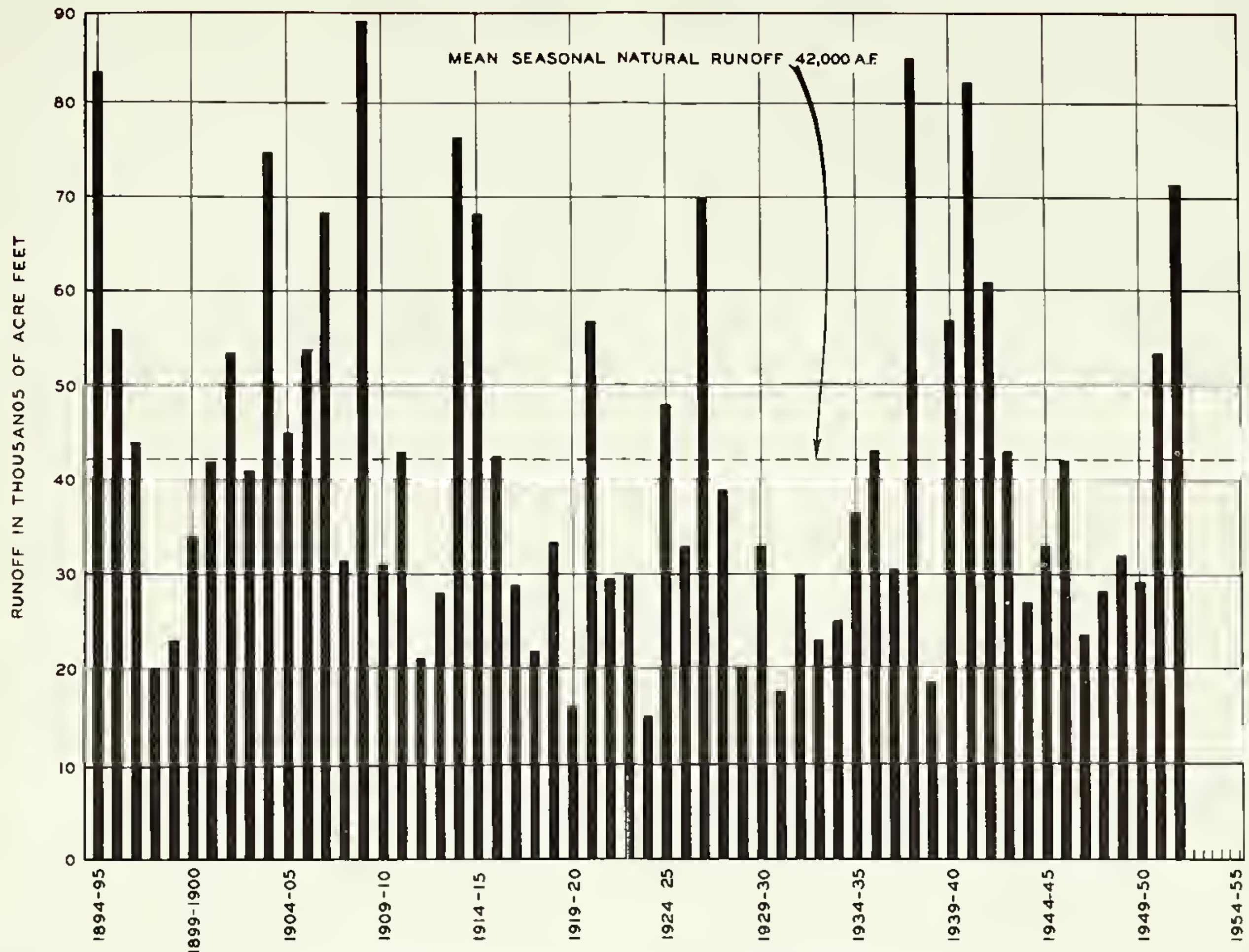
RECORDED SEASONAL PRECIPITATION AT LAKEPORT

PLATE 5



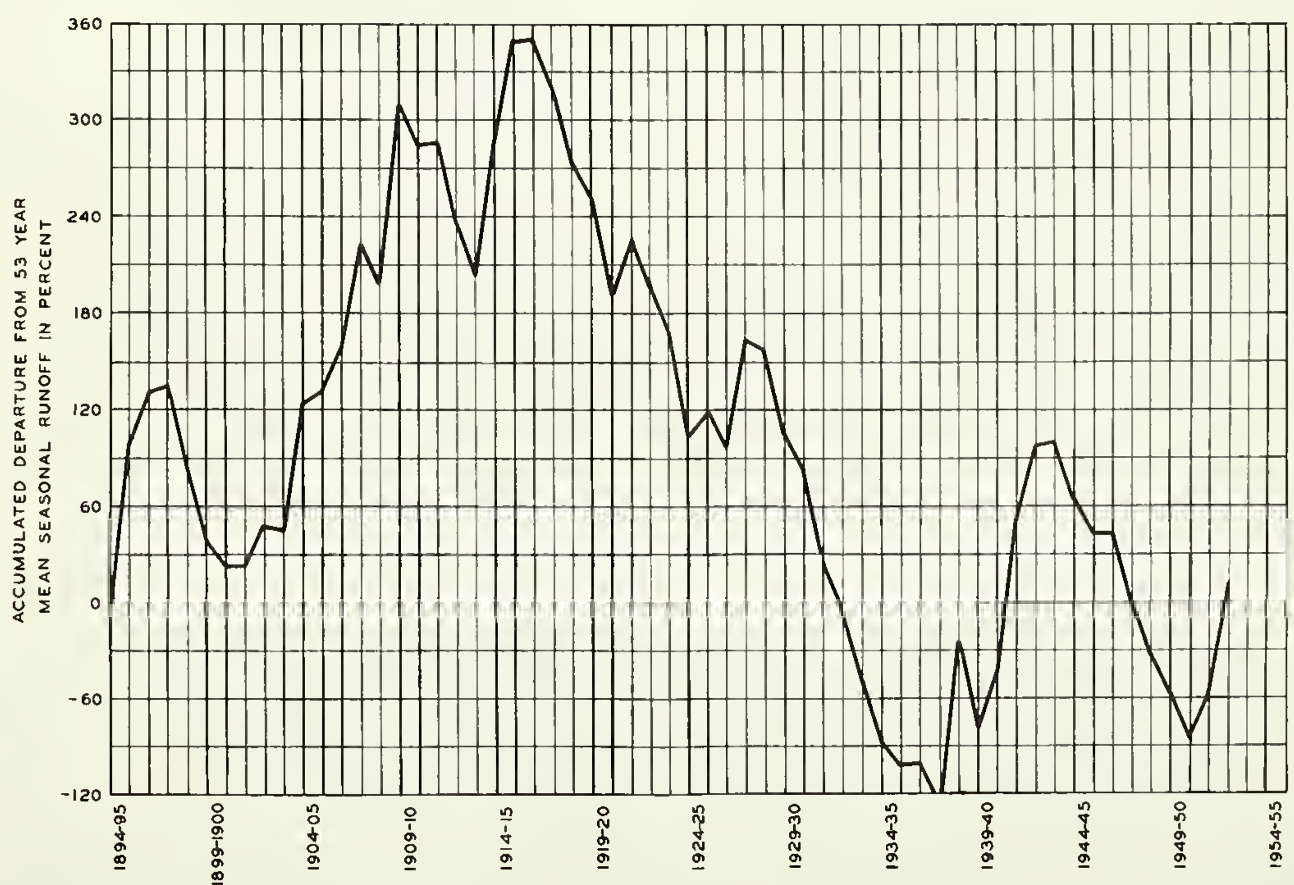
ACCUMULATED DEPARTURE FROM MEAN SEASONAL PRECIPITATION AT LAKEPORT

PLATE 6



RECORDED AND ESTIMATED SEASONAL RUNOFF
OF KELSEY CREEK NEAR KELSEYVILLE

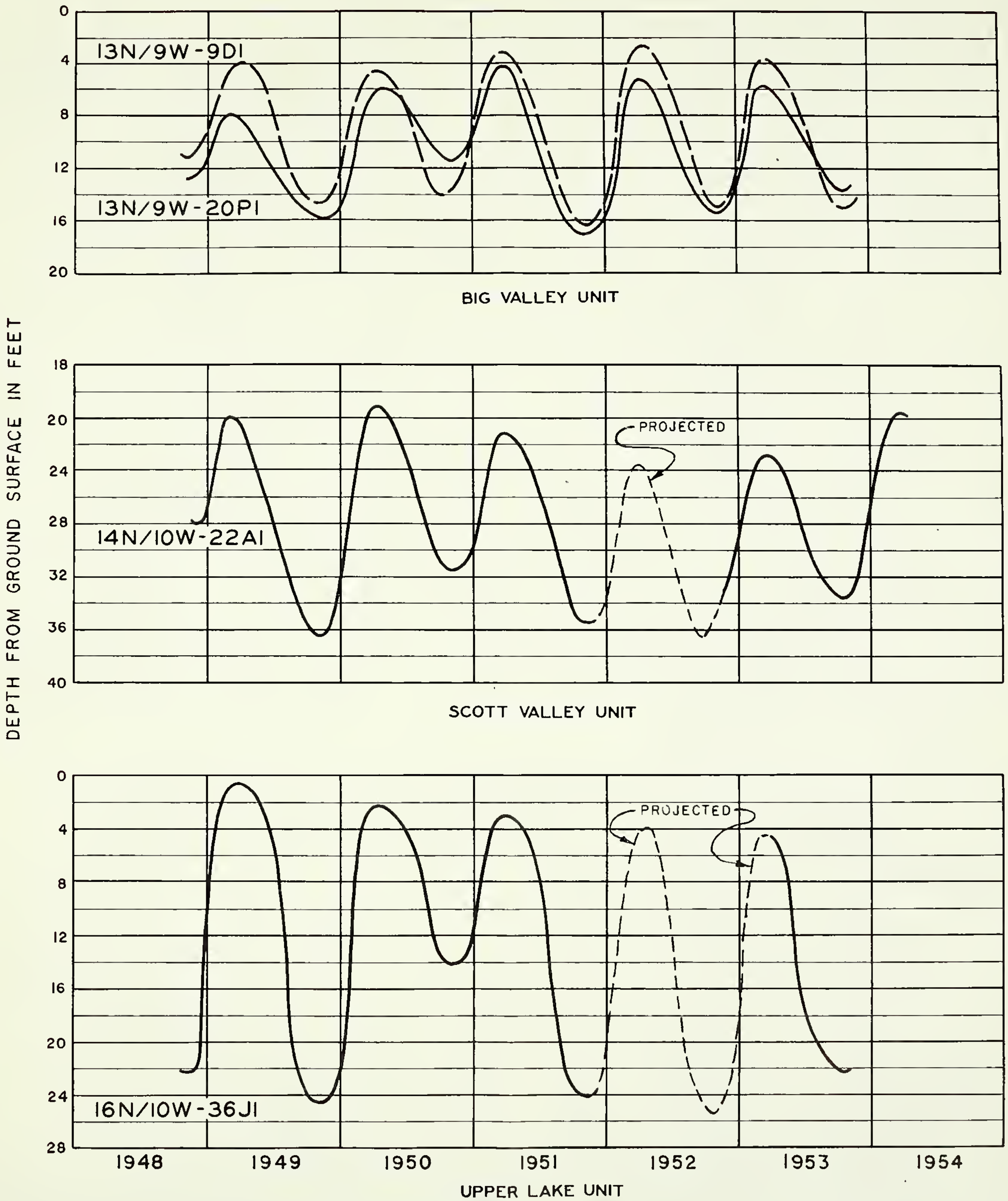
PLATE 7



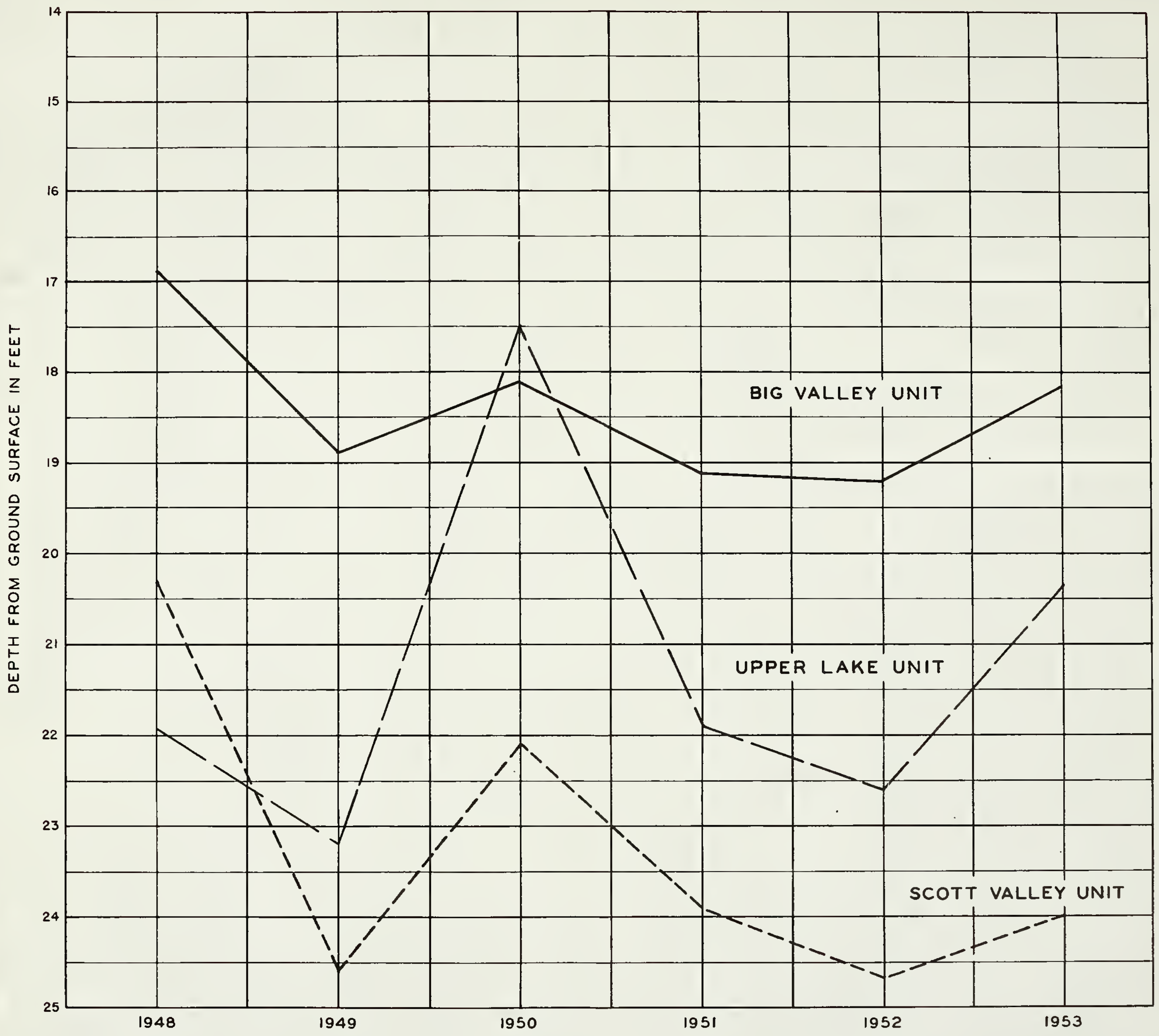
ACCUMULATED DEPARTURE FROM MEAN SEASONAL RUNOFF
OF KELSEY CREEK NEAR KELSEYVILLE

DEPARTMENT OF WATER RESOURCES 1957


CLEAR LAKE
UPPER LAKE UNIT
BIG VALLEY UNIT
SCOTT VALLEY UNIT
FREE AREA
CONFINED AREA
LEGEND
—1320— LINES OF EQUAL ELEVATION IN FEET
STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
DIVISION OF RESOURCES PLANNING
LAKE COUNTY INVESTIGATION
LINES OF EQUAL ELEVATION
OF
GROUND WATER
FALL OF 1953



MEASURED DEPTHS TO GROUND WATER AT SELECTED WELLS



AVERAGE FALL DEPTH TO GROUND WATER

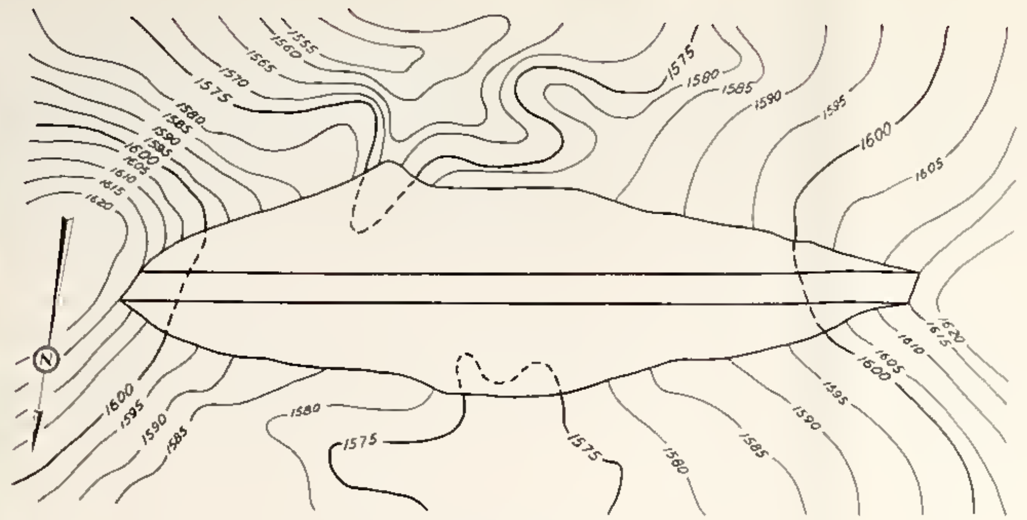
PLATE 12

CLEAR LAKE
UPPER LAKE UNIT
SCOTTS VALLEY UNIT
FREE AREA
CONFINED AREA
LAKEPORT
LEGEND
+2 LINES OF EQUAL CHANGE IN FEET
STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
DIVISION OF RESOURCES PLANNING
LAKE COUNTY INVESTIGATION
LINES OF EQUAL CHANGE
IN
GROUND WATER ELEVATION
FALL OF 1948 TO FALL OF 1953


CLEAR LAKE
UPPER LAKE UNIT
CONFINED AREA
FREE AREA
FREE AREA
FREE
SCOTT VALLEY UNIT
CONFINED AREA
FREE AREA
BIG VALLEY UNIT
CONFINED AREA
FREE AREA
LAKEPORT
LEGEND
IRRIGATED LANDS
IRRIGABLE LANDS
STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
DIVISION OF RESOURCES PLANNING
LAKE COUNTY INVESTIGATION
IRRIGATED AND IRRIGABLE LANDS
1953

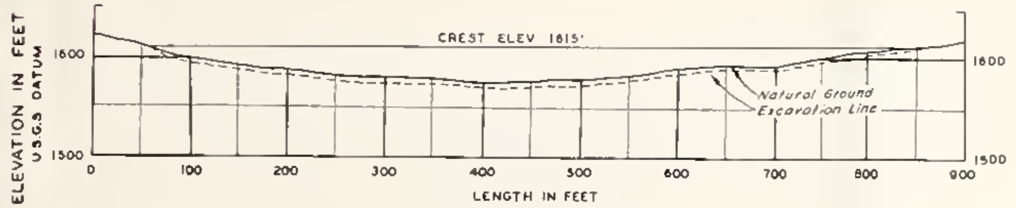
PLATE 14

DEPARTMENT OF WATER RESOURCES 1957



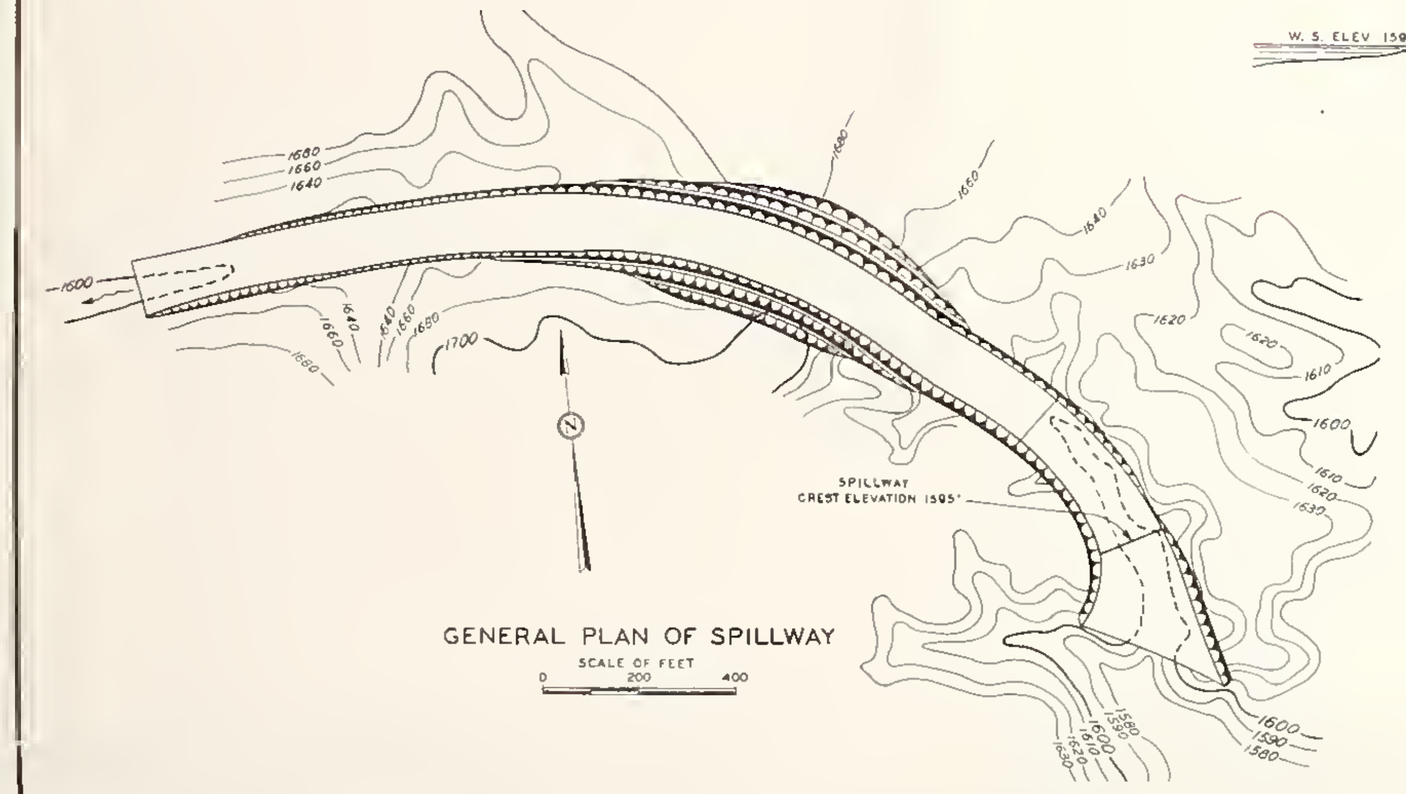
GENERAL PLAN

SCALE OF FEET 0 100 200



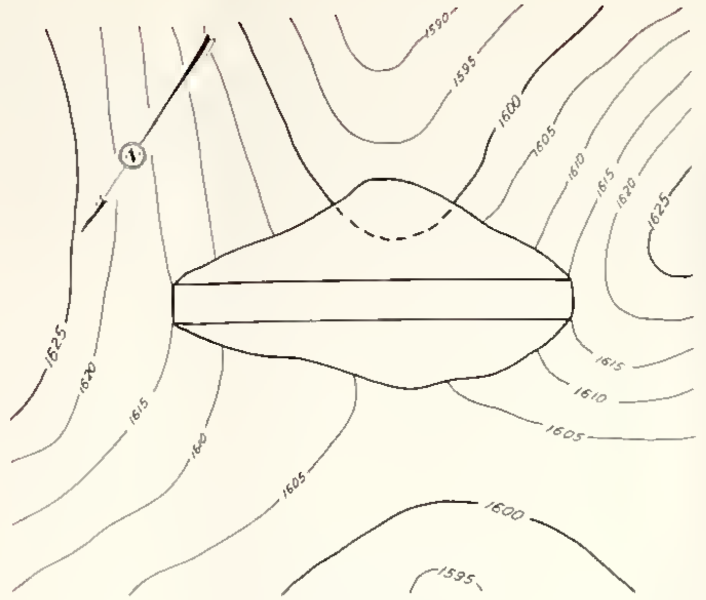
PROFILE OF DAM
LOOKING UPSTREAM

SADDLE DAM NO. 1



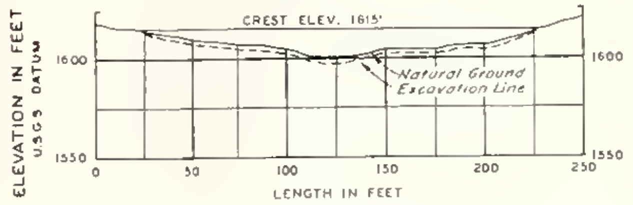
GENERAL PLAN OF SPILLWAY

SCALE OF FEET 0 200 400

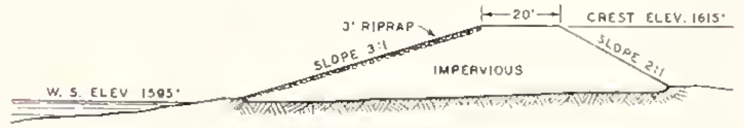


GENERAL PLAN

SCALE OF FEET 0 50 100



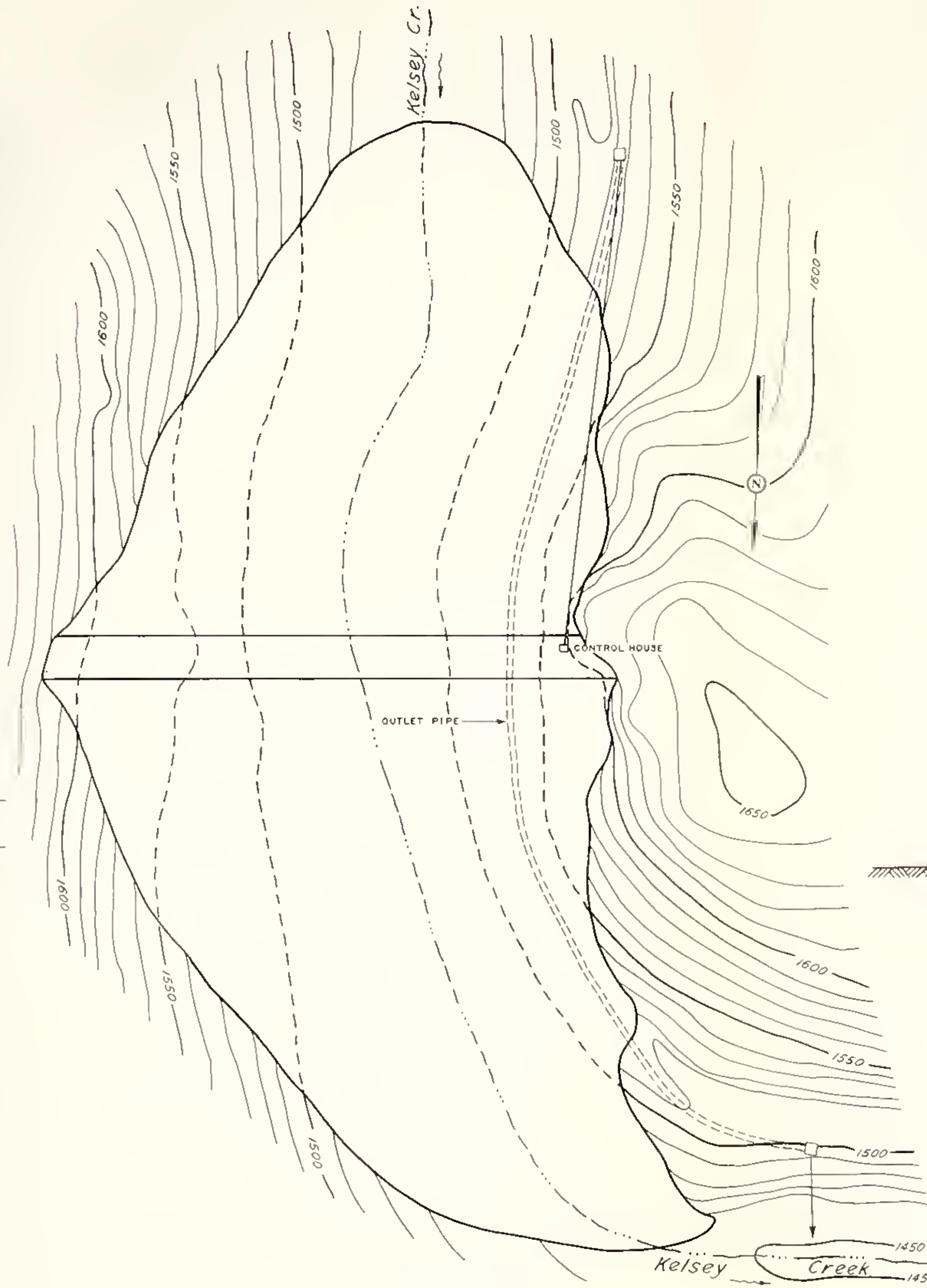
PROFILE OF DAM
LOOKING UPSTREAM



SECTION OF DAM

SCALE OF FEET 0 25 50

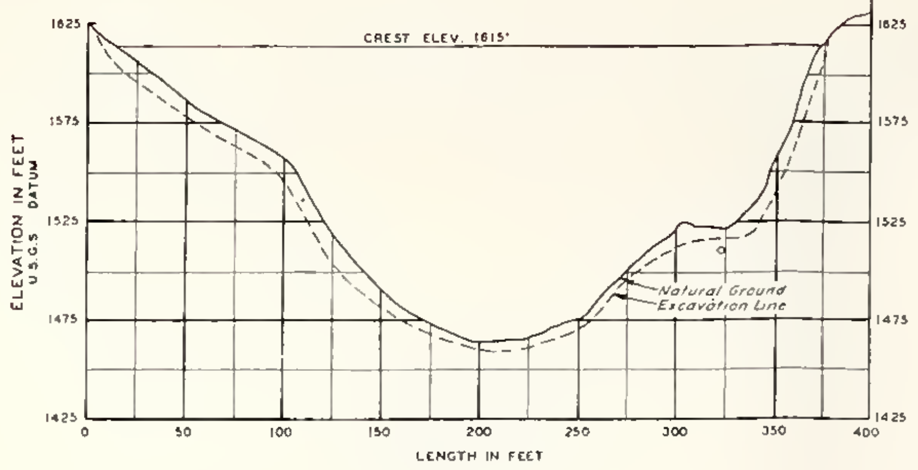
SADDLE DAM NO. 2



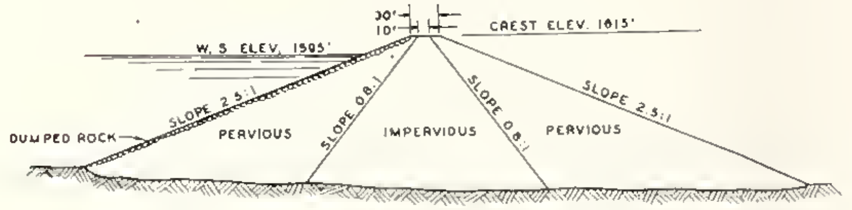
GENERAL PLAN

SCALE OF FEET 0 50 100

KELSEYVILLE DAM

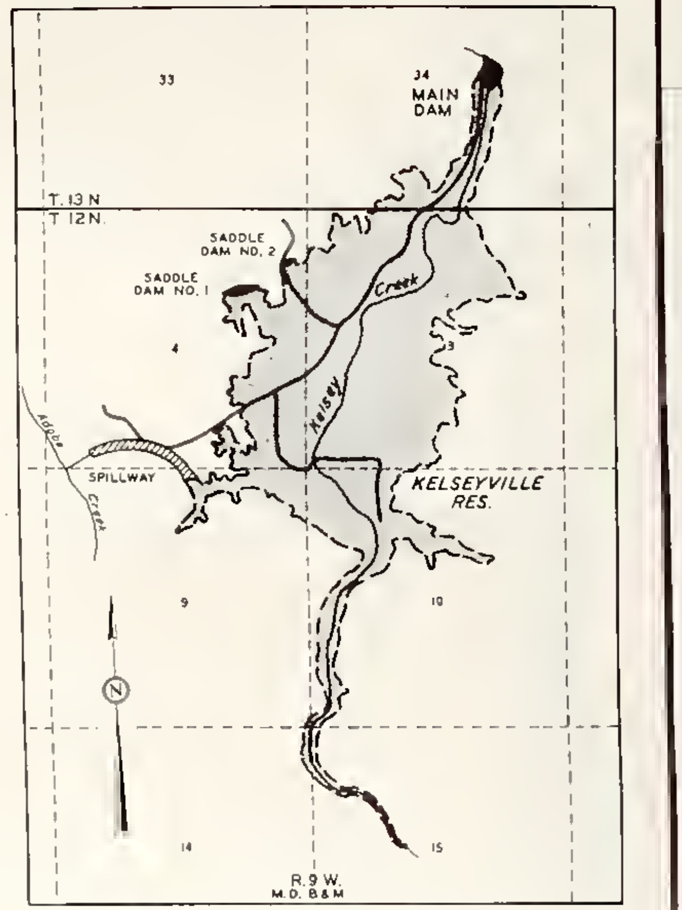


PROFILE OF DAM
LOOKING UPSTREAM



SECTION OF MAIN DAM AND SADDLE DAM NO. 1

SCALE OF FEET 0 100 200



GENERAL PLAN OF RESERVOIR

SCALE OF FEET 0 2000 4000

TYPICAL HALF-SECTION OF BY-PASS CHANNEL

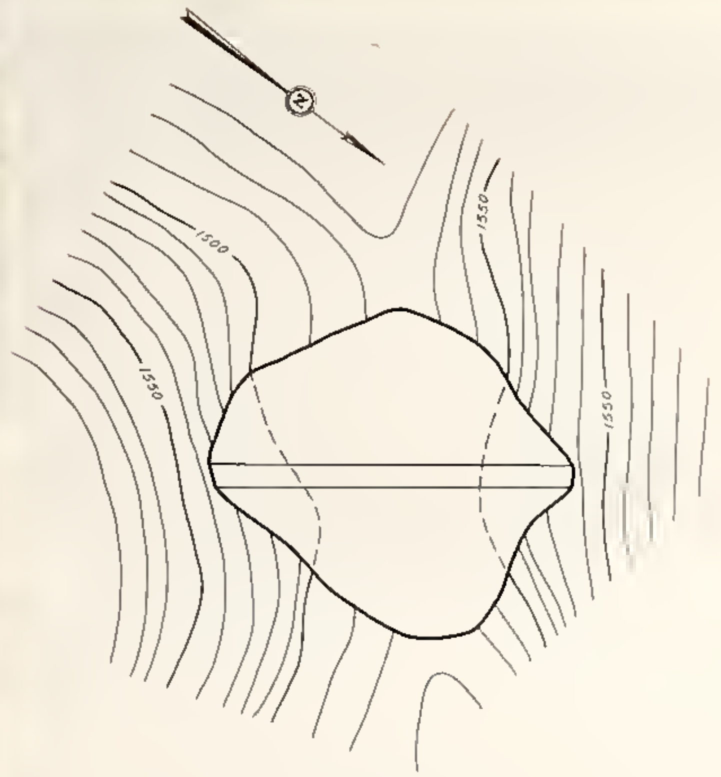
SCALE OF FEET 0 10 20

STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
DIVISION OF RESOURCES PLANNING

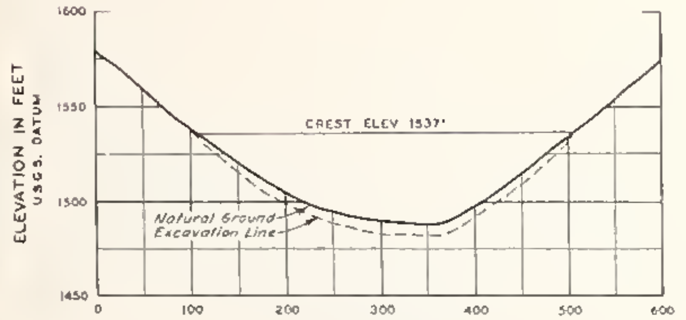
LAKE COUNTY INVESTIGATION

BIG VALLEY PROJECT

DEPARTMENT OF WATER RESOURCES 1957

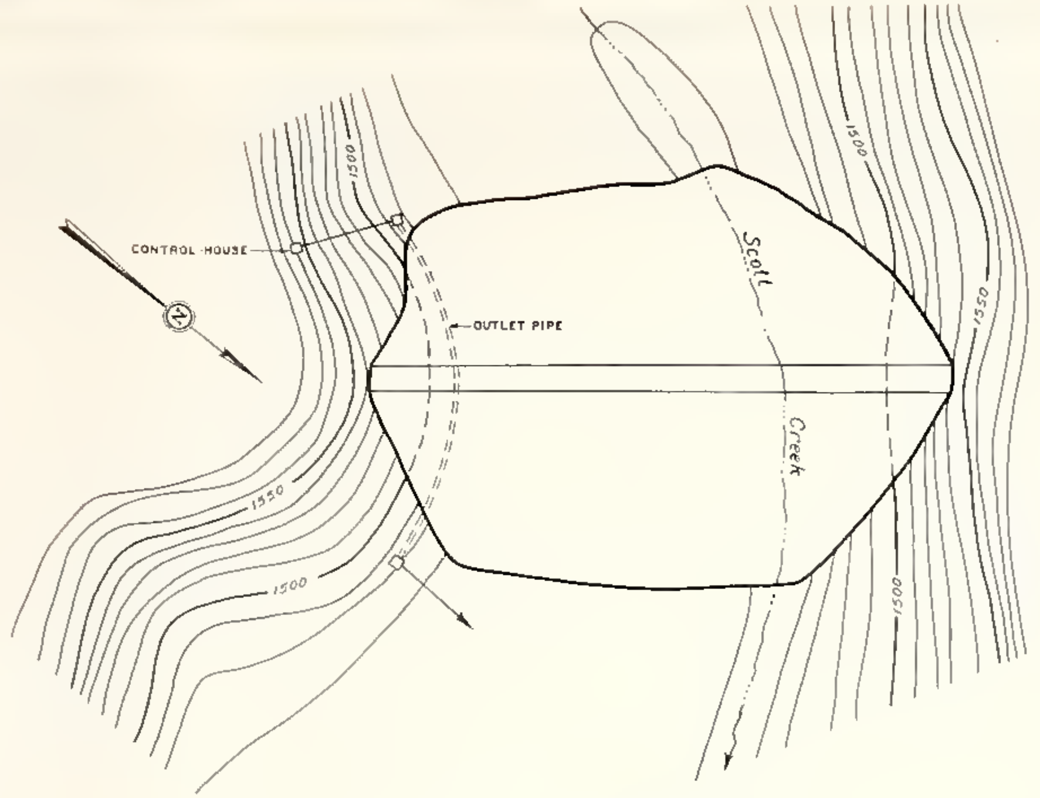


GENERAL PLAN
SCALE OF FEET
0 100 200

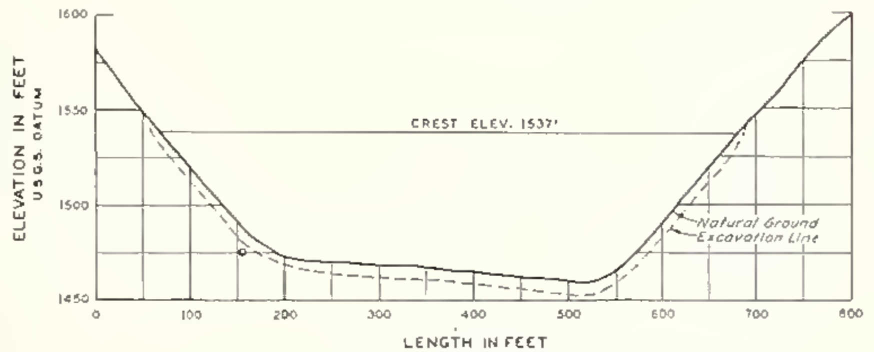


PROFILE OF DAM
LOOKING UPSTREAM

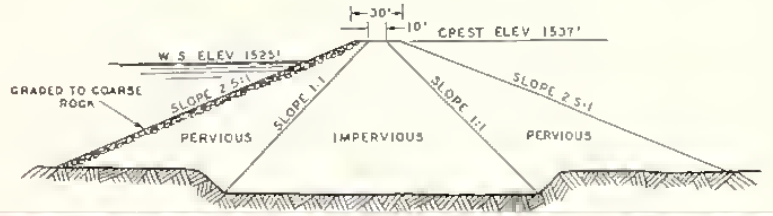
SADDLE DAM NO. 1



GENERAL PLAN
SCALE OF FEET
0 100 200

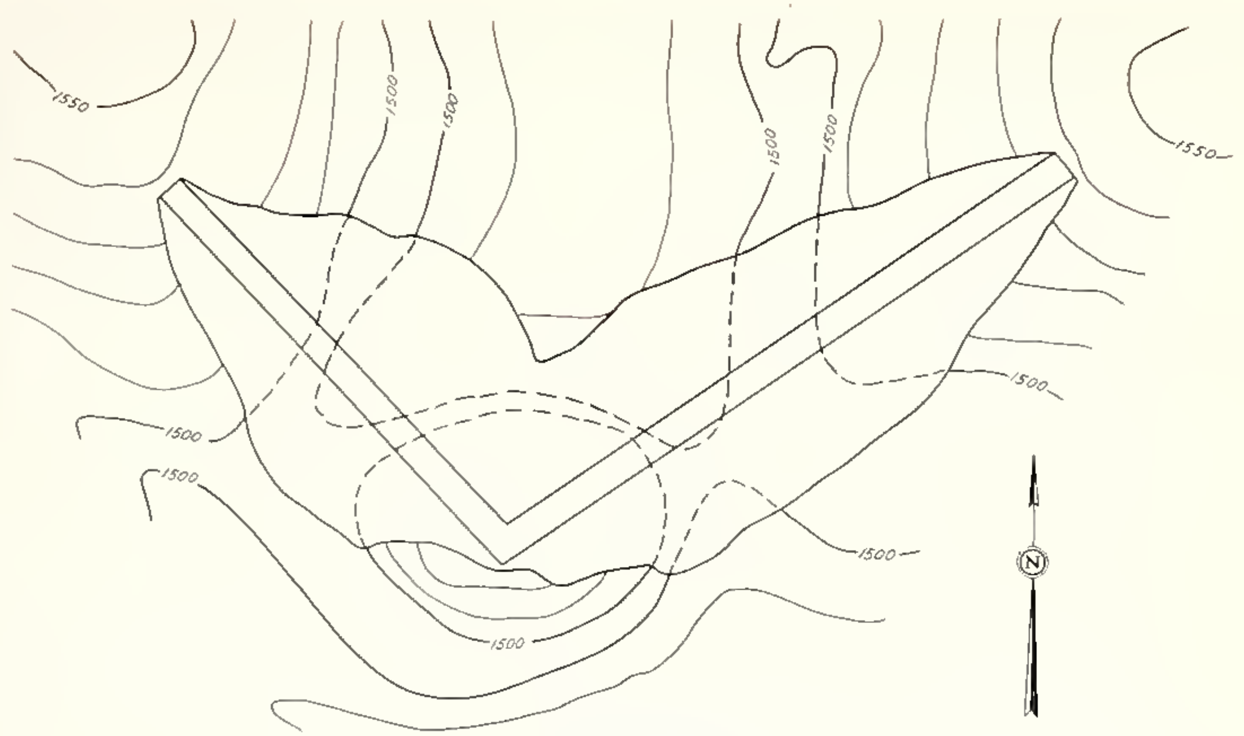


PROFILE OF DAM
LOOKING UPSTREAM

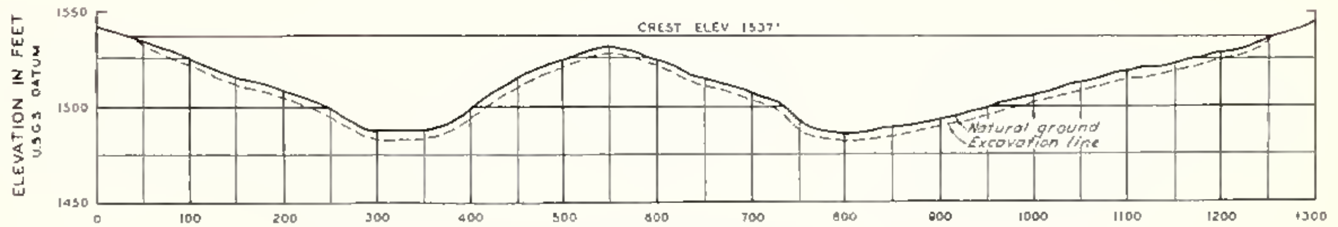


TYPICAL SECTION OF DAMS
SCALE OF FEET
0 50 100

LAKEPORT DAM

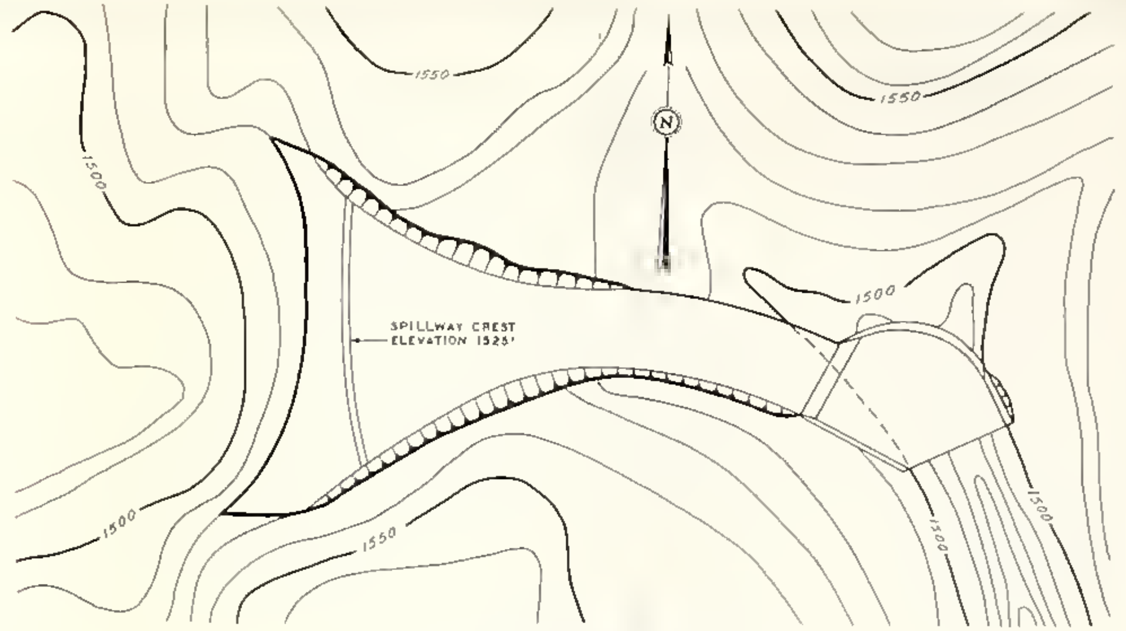


GENERAL PLAN
SCALE OF FEET
0 100 200

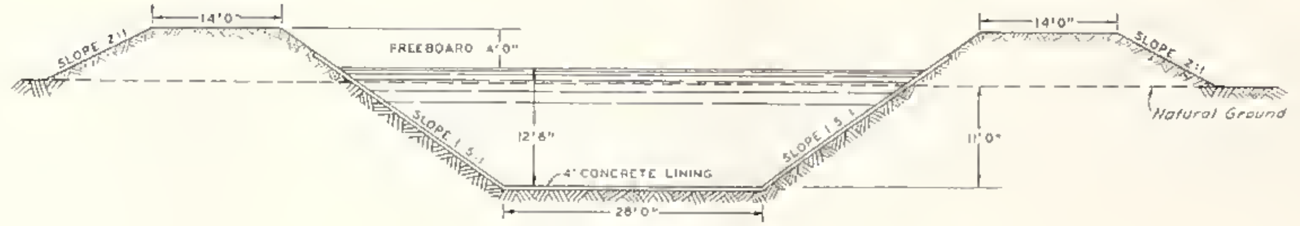


PROFILE OF DAM
LOOKING UPSTREAM

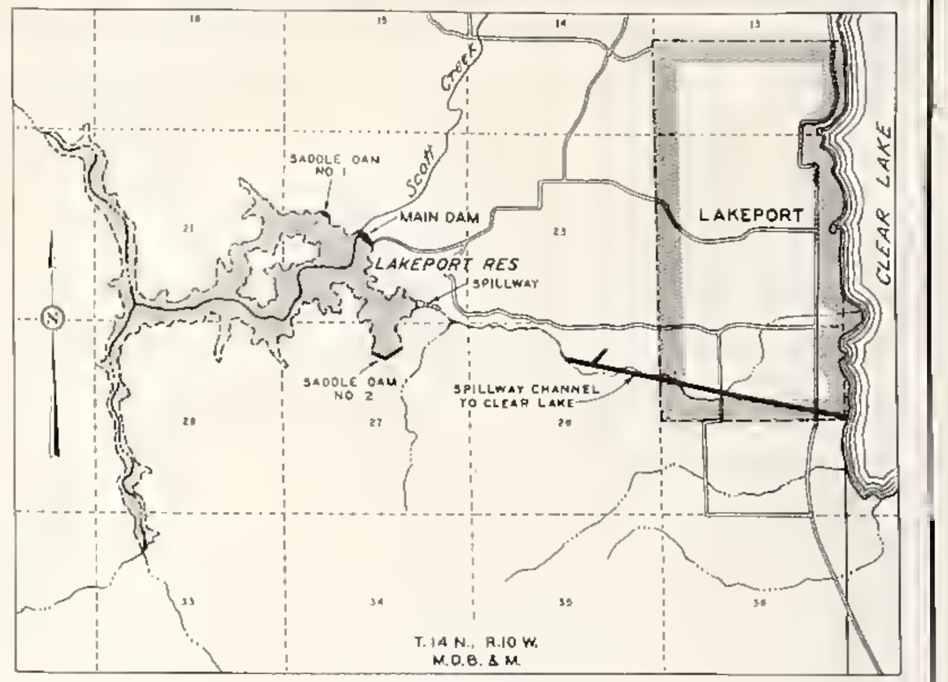
SADDLE DAM NO. 2



GENERAL PLAN OF SPILLWAY
SCALE OF FEET
0 100 200



SECTION OF SPILLWAY CHANNEL
SCALE OF FEET
0 10 20



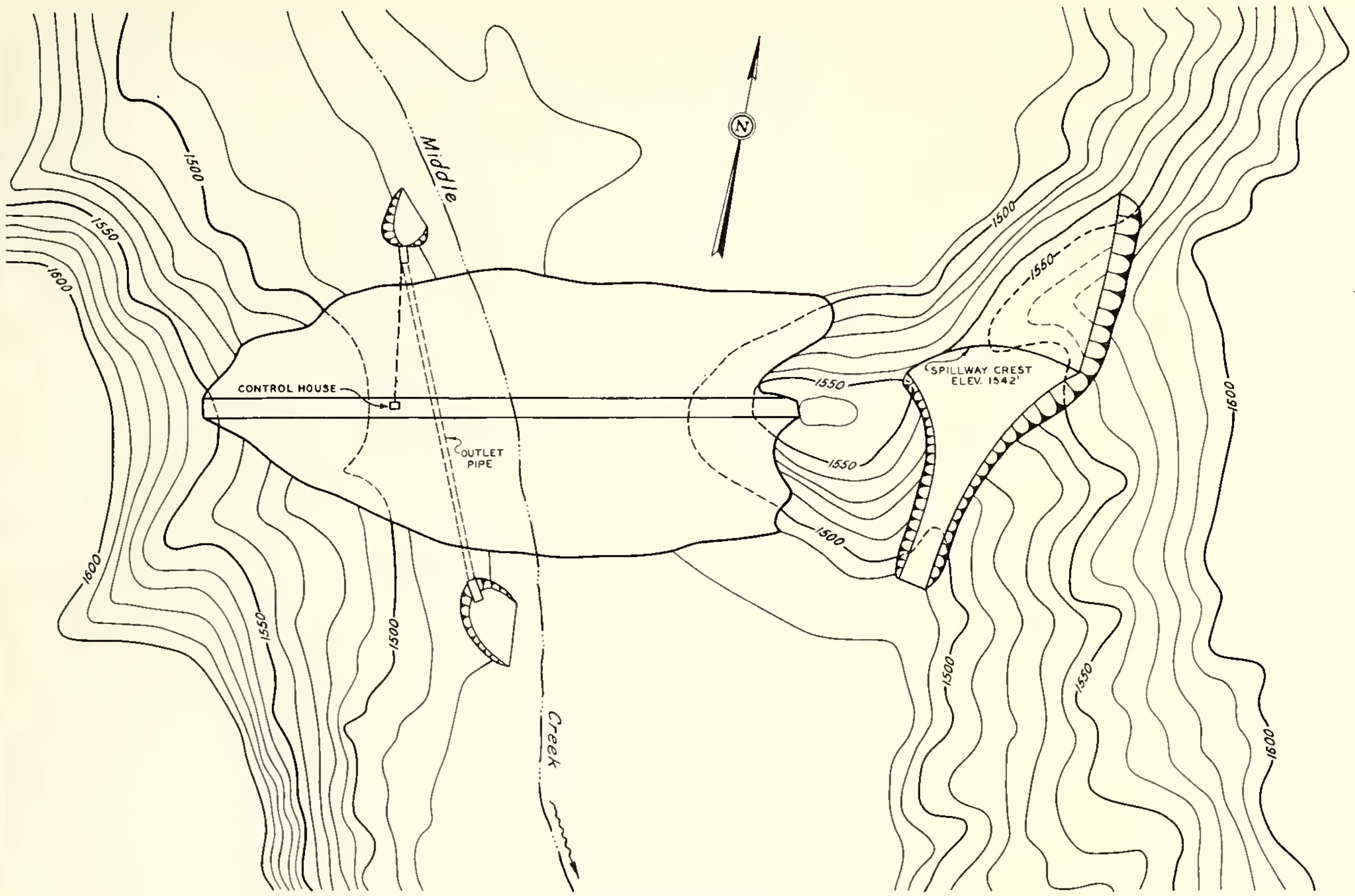
GENERAL PLAN
LAKEPORT PROJECT
SCALE OF MILES
0 0.5 1

STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES

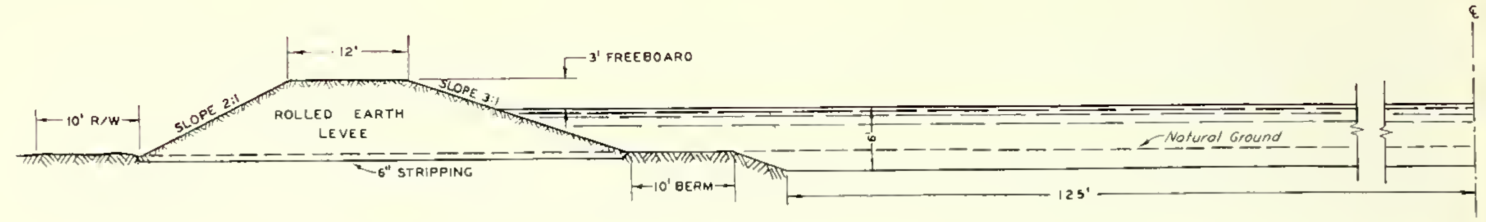
LAKE COUNTY INVESTIGATION

LAKEPORT PROJECT

DEPARTMENT OF WATER RESOURCES 1957

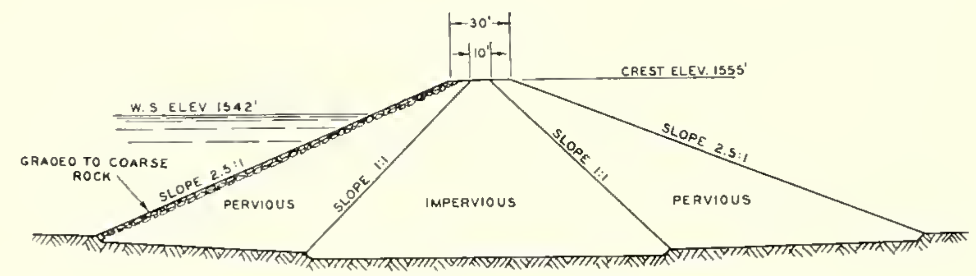


GENERAL PLAN
SCALE OF FEET
0 100 200

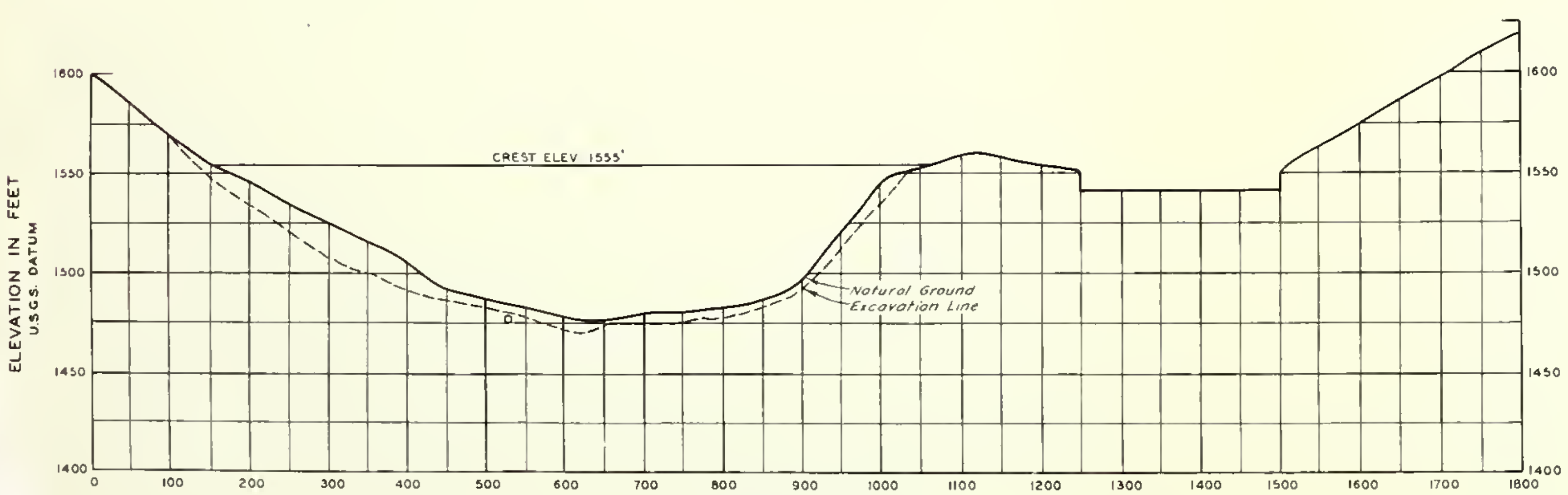


TYPICAL HALF SECTION OF CLOVER CREEK DIVERSION
SCALE OF FEET
0 10 20

NOTE: Levee shown in Half Section is typical of all levees to be constructed on Middle Creek.



SECTION OF DAM
SCALE OF FEET
0 50 100



PROFILE OF DAM
LOOKING UPSTREAM

PITNEY RIDGE DAM

STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
DIVISION OF RESOURCES PLANNING

LAKE COUNTY INVESTIGATION

UPPER LAKE PROJECT