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DEPARTMENT OF WATER RESOURCES
DIVISION OF RESOURCES PLANNING

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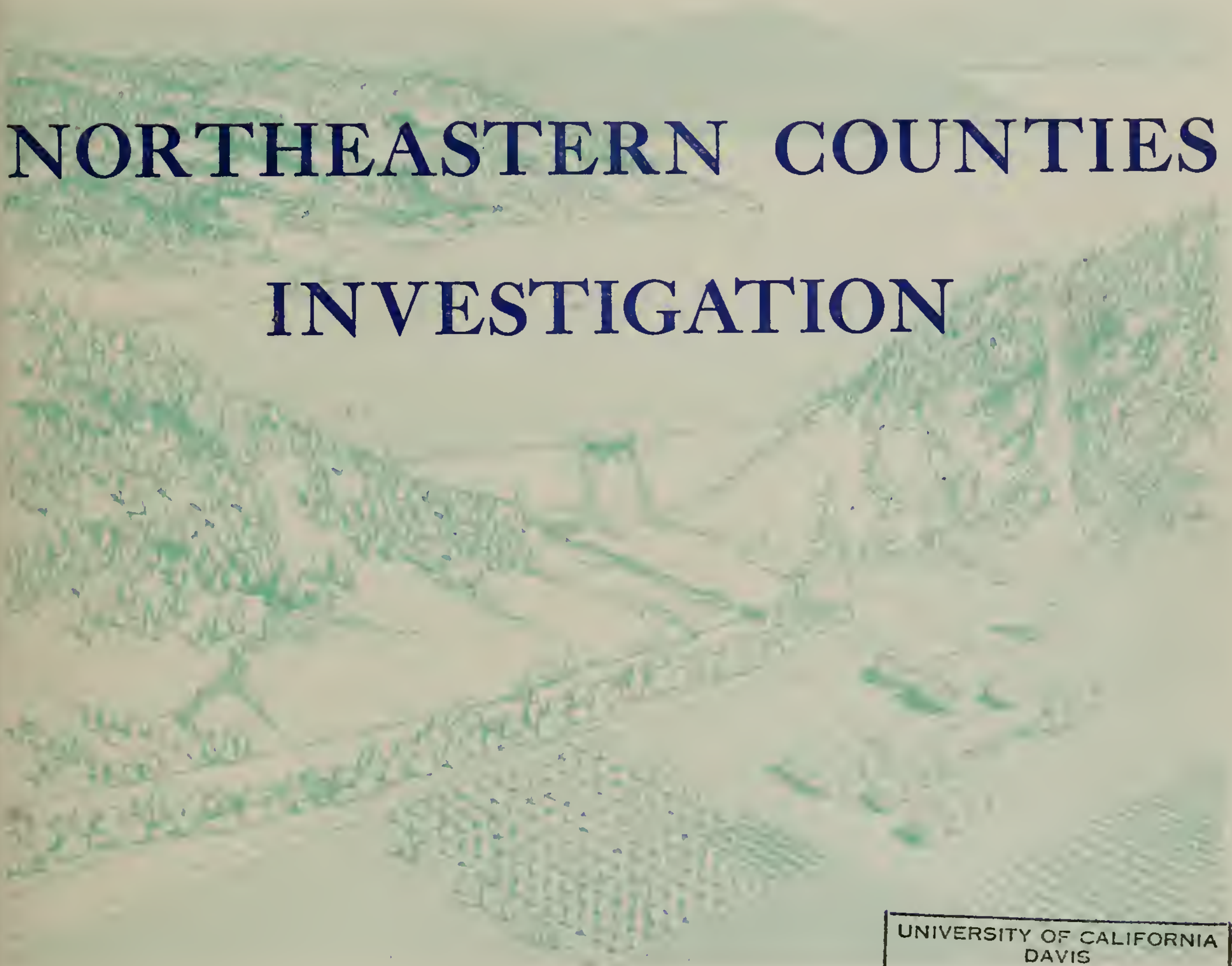

NORTHEASTERN COUNTIES INVESTIGATION

EDMUND G. BROWN
Governor

HARVEY O. BANKS
Director of Water Resources

JUNE, 1960

CALIFORNIA'S NORTHEASTERN COUNTIES

STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
DIVISION OF RESOURCES PLANNING

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LETTER OF TRANSMITTAL

EDMUND G. BROWN
GOVERNOR

HARVEY O. BANKS
DIRECTOR

ADDRESS REPLY TO
P. O. BOX 388 SACRAMENTO 2
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STATE OF CALIFORNIA
Department of Water Resources
SACRAMENTO

June 6, 1960

HONORABLE EDMUND G. BROWN, *Governor, and*
Members of the Legislature of the State of California, and
California Water Commission

GENTLEMEN: I have the honor to transmit herewith the revised and final edition of Bulletin No. 58, "Northeastern Counties Investigation," preparation of which was initiated from funds provided by Item 249 of the Budget Act of 1954.

The preliminary edition of this bulletin, dated December 1957, was published and distributed early in 1958. In September and November of 1958, the Department of Water Resources and the California Water Commission jointly held four hearings to receive comments from interested individuals and agencies. After consideration of these comments, a number of revisions were made in this bulletin. In addition, pertinent comments received at the hearings have been included as an appendix to the bulletin.

This bulletin presents results of a comprehensive analysis of present and probable ultimate water needs of the fifteen Northeastern Counties of California: Butte, Colusa, Glenn, Lake, Lassen, Modoc, Plumas, Shasta, Sierra, Siskiyou, Sutter, Tehama, Trinity, Yolo, and Yuba.

The estimates of future water requirements are predicated upon the full development of all natural resources, and include the requirements for irrigation and domestic and industrial uses of water, as well as for the maintenance of fish and game and for development of the recreational potential of these northern areas. The bulletin also contains estimates of limited ultimate mean seasonal water requirements for areas within the northeastern counties where the available water supply is inadequate to completely meet the ultimate water requirements.

Very truly yours,

Harvey O. Banks

HARVEY O. BANKS
Director

EDMUND G. BROWN
GOVERNOR

HARVEY O. BANKS
DIRECTOR OF
WATER RESOURCES

ADDRESS ALL COMMUNICATIONS TO
THE CHAIRMAN OF THE COMMISSION
P. O. BOX 388
SACRAMENTO 2

STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES

CALIFORNIA WATER COMMISSION

RESOLUTION NO. 80

REPORT ON "NORTHEASTERN COUNTIES INVESTIGATION", BULLETIN NO. 58

WHEREAS, The State Department of Water Resources has published a preliminary edition of Bulletin No. 58, entitled "Northeastern Counties Investigation", in December, 1957, and

WHEREAS, Bulletin No. 58 presents the results of a comprehensive anaylsis of present and probable ultimate water requirements of the fifteen northeastern counties of California: Butte, Colusa, Glenn, Lake, Lassen, Modoc, Plumas, Shasta, Sierra, Siskiyou, Sutter, Tehama, Trinity, Yolo, and Yuba, and

WHEREAS, These future water requirements are predicated upon full development of all the natural resources, and include the requirements for irrigation, domestic, and industrial uses of water, as well as for the maintenance of fish and game and for the development of the recreational potential of these northern counties, and

WHEREAS, The California Water Commission and the State Department of Water Resources held joint hearings on September 3, 1958, in Yreka; September 4, 1958, in Redding; September 5, 1958, in Susanville; and November 6, 1958, in Sacramento, to secure comments on the preliminary edition of Bulletin No. 58, and

WHEREAS, The State Department of Water Resources, after consideration of comments received, has revised the preliminary edition of the bulletin; now, therefore, be it

Resolved, That the California Water Commission recommend that the report be approved for printing in final form as Bulletin No. 58, and that it is further recommended that the estimates of probable future water requirements of the fifteen northern California counties contained in the report be periodically reviewed in the light of changing conditions and technology.

The foregoing resolution was adopted by the California Water Commission, State of California, at Sacramento, on June 3, 1960.

William H. Jennings

WILLIAM H. JENNINGS
Vice Chairman

William M Carah

WILLIAM M. CARAH
Executive Secretary

ACKNOWLEDGMENT

Valuable assistance and data used in this investigation were contributed by agencies of the Federal Government and of the State of California, by cities, counties, public districts, and by private companies and individuals. The Boards of Supervisors of each of the Northeastern Counties, and the offices under their direction, were most helpful at all times. This cooperation is gratefully acknowledged.

Special mention is made of the cooperation of the following:

Forest Service, United States Department of Agriculture
Soil Conservation Service, United States Department of Agriculture
Bureau of Reclamation, United States Department of Interior
Geological Survey, United States Department of Interior
California Department of Finance
California Department of Fish and Game
California Division of Forestry
California Division of Beaches and Parks
California Public Utilities Commission
University of California at Davis

ORGANIZATION

CALIFORNIA WATER COMMISSION

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WILLIAM H. JENNINGS, Vice Chairman, La Mesa

JOHN W. BRYANT, Riverside

JOHN P. BUNKER, Gustine

IRA J. CHRISMAN, Visalia

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JOHN J. KING, Petaluma

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BOARD OF ADVISORS

The Department of Water Resources engaged a board of advisors to review the work accomplished during the Northeastern Counties Investigation and to appraise the conclusions that were reached prior to publication of this bulletin. Many of the suggestions proposed by the Board of Advisors have been incorporated in the bulletin. The review board consisted of the following members:

DR. DANIEL G. ALDRICH, JR.
Chairman, Department of Soils and Plant Nutrition, University of California, Davis

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Sacramento, California

CHAPTER I

INTRODUCTION

The growth of California in the years since World War II has created problems of many types and varying degrees of magnitude and complexity. The tremendous population increase and expansion in agriculture and industry have depleted local water supplies in extensive areas of the central and southern portions of the State. The State's economy is firmly linked to those problems of existing deficiencies, and to the problem of satisfying a rapidly growing demand for additional water.

An increasing statewide interest in the waters of northern California has resulted from the necessity to develop plans for importing supplemental supplies from regions of general surplus to the areas of deficiency. The plan receiving the major attention at the present time is the Feather River Project. This project, adopted by the Legislature in 1951, as a feature of The California Water Plan, will involve the construction of a large dam on the Feather River, about 6 miles above the City of Oroville in Butte County, for conservation, flood control, and hydroelectric power generation. Extensive systems of pumping plants and conduits will convey surplus waters in the Sacramento-San Joaquin Delta made firm by operation of Oroville Reservoir, to areas of need in the San Joaquin Valley, the Santa Clara Valley, and southern California.

The Legislature has recognized the importance of developing the State's water resources to satisfy this growing demand for water in order that a healthy economy may be maintained. Realizing the need for development, yet recognizing that the present and future interests of areas of water origin must be safeguarded, the Legislature has from time to time provided funds for planning of coordinated, statewide developments of water resources in the best interests of all sections and for all people. To insure that some areas of the State do not expand to the detriment of other areas, in connection with the Central Valley Project, the Legislature has stated the policy that the watersheds wherein water originates and areas contiguous thereto which may be reasonably served therefrom, shall not be deprived of any water needed for their future development. Under the County of Origin Act, now codified as Section 10505 of the State Water Code, no assignment can be made which would deprive the counties wherein the water originates of any water which may be required for future development therein. The effect of this policy has been incorporated in all subsequent state planning for water resource development. The policy applies to the Feather River Project, to which the authorizing legislation specifically made applicable all relevant provisions of the Water Code relating to the Central Valley Project.

In light of the foregoing policy, and in connection with current planning for major water resource development in California, the need for thorough evaluation of the probable ultimate water requirements of northern areas of water surplus, based upon the full development of all their natural resources, is apparent.

AUTHORIZATION FOR INVESTIGATION

The Legislature, by the Budget Act of 1954, provided:

> "Item 249. For necessary investigations, surveys, studies, and preparation of plans and specifications for the purpose enumerated in the following schedule, the Division of Water Resources, Department of Public Works, to be paid from the funds specified in said schedule. * * *
>
> * * * * *
>
> "(b) The determination of the ultimate water needs of the County of Plumas and those portions of the Counties of Butte, Lassen, and Sierra in the Feather River Drainage Area, predicated upon the full development of all natural resources in those counties, payable from funds appropriated by Item 428.5 of the Budget Act of 1952. * * *
>
> "(c) The determination of the ultimate water needs of the Counties of Siskiyou, Shasta, Modoc, Trinity, Yuba, Tehama, Glenn, Colusa, Lake, Yolo and Sutter, and those portions of the Counties of Butte, Lassen, and Sierra not in the Feather River Drainage Area, predicated upon the full development of all natural resources in those counties, payable from the funds appropriated by Item 428.5 of the Budget Act of 1952. * * *
>
> " * * * and provided, that the money appropriated by subdivision (c) of the above schedule shall remain available for expenditure until December 31, 1956."

The Budget Act of 1954 provided funds to meet the costs of the investigation in the amount of $376,895. Of this amount, the expenditure of $90,000 was authorized for Item 249(b) and $286,895 for Item 249(c).

Additional funds in the amount of $10,000 were made available by the Budget Act of 1957 to complete editorial work and to print the preliminary edition of the bulletin. Further funds were appropriated in Item 262, Chapter 1300 of the Statutes of 1959, for printing the final edition.

RELATED INVESTIGATIONS AND REPORTS

The following reports of prior investigations, containing information pertinent to evaluation of the water requirements and water resources of the Northeastern Counties, were reviewed in connection with the current investigation:

Reports of California State Department of Public Works, Division of Water Resources.

"Sacramento River Basin." Bulletin No. 26, 1931.

"Pit River Investigation." Bulletin No. 41, 1933.

"Survey of Mountainous Areas." Bulletin No. 56, December, 1955.

"Northeastern Counties Investigation, Report on Upper Feather River Service Area." April, 1955.

Reports of California State Water Resources Board.

"Water Resources of California." Bulletin No. 1, 1951.

"Water Utilization and Requirements of California." Bulletin No. 2, October, 1954.

"The California Water Plan." Bulletin No. 3, May, 1957.

"Sutter-Yuba Counties Investigation." Bulletin No. 6, September, 1952.

"Lake County Investigation." Bulletin No. 14, (preliminary report) October, 1955.

"Interim Report on Klamath River Basin Investigation, Water Utilization and Requirements." March, 1954.

The Department of Water Resources is presently conducting a cooperative investigation in Shasta County. This investigation has as its objective the formulation of plans for conservation and utilization of the county's water resources to meet present and future needs.

The Department also is investigating the geologic and hydrologic characteristics of the principal valley fill areas of the Northeastern Counties of Modoc, Lassen, Plumas, and Sierra, as a possible source of an economic and dependable water supply for these mountain valleys.

Pursuant to Chapter 61, Statutes of 1956, now contained in Section 232 of the California Water Code, the Department of Water Resources is conducting an investigation to determine in detail: the amount of water resources available in the separate watersheds in the State; the amounts of present and ultimate water required for beneficial uses in those watersheds; and, from the foregoing, the quantities of water, if any, available for export from the watersheds of origin. This investigation, which will continue over a period of years, will be accomplished in greater detail than has heretofore been undertaken and will serve as a basis for assuring reservation of adequate water resources for the areas of origin.

Numerous studies which relate to the problem of evaluating water resources and water requirements have been conducted by such federal agencies as the Bureau of Reclamation, Geological Survey, and Soil Conservation Service, in the area of investigation. This information, as well as data supplied by many of the individual counties and other entities, has been utilized to the maximum possible extent.

OBJECTIVE AND SCOPE OF INVESTIGATION

The general objective of this investigation was to estimate the ultimate water needs of the designated counties in northeastern California, predicated upon full development of all natural resources. In attaining this objective, it was necessary that the scope of the investigation include evaluation of the potential development of the basic natural resources of the counties under consideration. Included were the water, land, and recreational resources, and population and employment. Of major importance in forecasting ultimate water requirements was consideration of the present uses of water, and a detailed evaluation of unit values of consumptive water use under present, as well as ultimate, conditions for various types of development.

A brief and generalized description of the methods employed in estimating the present use of water and forecasting the ultimate water requirement will serve to illustrate the scope of this investigation. In general, the estimates and forecasts were made on an areal basis; that is, determinations were made of the various types of development requiring the beneficial consumptive use of water. Appropriate factors of unit water use for different types of development were then applied to these areas in order to estimate their total water consumption and requirement. Exceptions to this general method were made in estimating the ultimate water requirements for urban communities, and in estimating the quantity of water needed for the manufacture of forest products. In the case of the water needed for urban communities, requirements were based on population estimates; for the forest products industry, they were based on the sustained timber yield of the forest lands.

In the case of present water requirements, areas of irrigated agricultural types of development were determined from a land use survey conducted in 1954 through 1956. Unit values of consumptive use of irrigation water were estimated on the basis of an assumed full available water supply, but reduced where applicable to express the present deficiency in actual water supply development. Estimates of urban and rural domestic populations were extended from census data. Estimates of unit values of per capita requirement for urban and rural uses were based on data obtained from records furnished by water service agencies and on records maintained by the Public Utilities Commission. Included in these estimates was water use by commercial areas and industries.

In the case of ultimate water requirements, methods similar to those used in estimating present water requirements were applied. The inherent capacity of the land to support the various types of forecast development was determined by the following procedures.

The extent of irrigable lands that might ultimately be irrigated was determined on the basis of the physical capability of the lands to utilize water, with consideration given to the reasonableness of the physical and economic possibilities of developing and conveying water to the places of possible demand. As a result, estimates of total ultimate water requirement for certain areas of inherent water deficiency are somewhat less than had they been estimated on the basis of land capability only.

Irrigated crop patterns were projected in part on the basis of the land classification survey data. Emphasis was placed upon the determination of future irrigation water use, since irrigated agriculture is, and probably will continue as, the major consumer of water supplies.

Future urban, suburban, and rural domestic population and the probable future pattern of economic development was projected on the basis of indicated trends of population growth, communications, natural resources, and other factors pertinent to a balanced economy.

The forecasts of future recreational areas were established on the basis of broad classification, utilizing recognized standards of suitability for this type of development. The recreational areas were further subdivided into lands suitable for homes, commercial recreational uses, camp grounds and picnic areas, and organizational camps.

Estimates of the extent of forest lands under ultimate development were based on recent surveys and appraisals of the forest area and timber volume made by the United States Forest Service. Utilizing these data, estimates were made of the ultimate sustained yield capacity of the commercial forest lands and the ultimate annual production of major forest products for each of the fifteen counties concerned.

The ultimate extent of other water-using areas, such as swamp and marsh lands, was determined on the assumption that lands presently classified as swamp and marsh would be maintained in that state rather than be drained and reclaimed, and that certain lands of the lower Klamath Lake area would be converted to controlled marsh for waterfowl habitat. The estimates of use of water resulting from evaporation from water surfaces of reservoirs were based on studies of existing works and those proposed under The California Water Plan.

Considerable emphasis was placed upon the determination of unit values of consumptive use of water by irrigated crops. This phase included a review of all available data on the subject. In addition, it was found necessary to initiate a program of additional field work to gather new data. Field work started in 1954, and included measurement and study of soil moisture depletion from field plots, and installation and maintenance of atmometer stations, evaporation pans, and other instruments. The field program which was commenced and continued for the three years of the investigation is still in progress, and is presently being financed by appropriations made for the California Water Development Program.

While the unit values of consumptive use of water presented herein are based on the best data presently available, it should be noted that the program of additional data collection is in an early stage. Only after a number of years of basic experimental work to collect new information, and of compilation and analysis of the data, can fully reliable estimates be made available for use.

Since the basic premise for the estimates of ultimate water needs of the Northeastern Counties was the full development of all natural resources, special consideration was given to urban and industrial growth potentials and to recreational development under ultimate development. Lacking qualified experts in these fields, the Department of Water Resources employed the firm of Pacific Planning and Research, consultants in urban economic planning. The consultants assisted in the analysis of the expanding water needs that would inevitably result from future population increase, and from anticipated growth of industry, commerce, and recreation. This firm conducted field surveys, held discussions with representatives of concerned county, state, and federal agencies, and prepared estimates of ultimate population, urban areas, and recreational areas and uses. The data compiled by the consultants, and their conclusions relating to ultimate population and economic development, are contained in Appendix A, "Future Population, Economic and Recreation Development of California's Northeastern Counties."

A substantial portion of the water served to irrigated agriculture, urban areas, industries, and other water-using areas is consumed or lost to further beneficial use. However, there are uses of water that are not necessarily consumptive in nature, such as those for the generation of hydroelectric energy, for the propagation and preservation of fish life, and for the general aesthetic aspects of recreational development.

Certain factors of demand may be imposed upon the water by the nature of its beneficial use, such as those pertaining to specific rates, places, and times of delivery; losses of water; and quality of the water. In general, non-consumptive use demand factors can only be evaluated on the basis of the specific plan of water resources development.

Because of its close relationship to water utilization, estimates of the available water supply were included within the scope of the investigation. For each hydrographic unit, estimates were made of the average seasonal natural runoff. The physical characteristics of ground water basins were also investigated, and the results summarized. Water quality problems were located and discussed, and a tabulation pertaining to the quality of all waters available for development and use was prepared.

Since a principal purpose of this investigation was to provide all available information on water use and requirements within the Northeastern Counties, the data were analyzed and studied on the basis of both hydrographic units and counties. All data were therefore tabulated by hydrographic units, and by the portions of each hydrographic unit within counties. Since the sum of seasonal water requirements for a number of smaller subdivisions does not represent the over-all area water requirement, it was necessary to determine the amounts of return flow that could be utilized within a given hydrographic unit, or would flow to and be made available in a lower unit. As a final step in the investigation an estimate was made of the ultimate depletion to the total water supply that would result from full development of all natural resources within the fifteen counties.

AREA UNDER INVESTIGATION

The area under investigation, which lies in northeastern California generally north of the City of Sacramento and east of the Coast Range, includes the 15 counties which comprise State Assembly Districts 2, 3, and 4. These counties referred to in this report as the "Northeastern Counties," are Butte, Colusa, Glenn, Lake, Lassen, Modoc, Plumas, Shasta, Sierra, Siskiyou, Sutter, Tehama, Trinity, Yolo, and Yuba. This group of counties comprises 23 per cent of the total area of the State, contains 3 per cent of the present population of the State, and is the source for almost 40 per cent of California's water resources. The area is one of bountiful land and water resources. Significant among these are the extensive agricultural lands of the Sacramento Valley and upland valleys which are ringed by the Coast Range, Klamath Mountains, Cascade Range, and the Sierra Nevada. These mountains give rise to the stream systems of the Klamath, Trinity, Pit, Feather, and Sacramento Rivers, which supply the agricultural lands with their necessary irrigation waters.

Drainage Basins

The Northeastern Counties area extends into three of the major hydrographic divisions of the State. Portions of Modoc, Siskiyou, Trinity, and Lake Counties lie within the North Coastal Drainage Basin, which includes the Klamath, Trinity, Mad, and Eel Rivers draining westward directly into the Pacific Ocean. Portions of Modoc, Lassen, and Sierra Counties lie within the Lahontan Drainage Basin, which includes minor streams draining eastward into closed basins. The Susan River is the largest stream of the Lahontan Drainage Basin included in this investigation. The greatest portion of the area covered by the Northeastern Counties lies within the Central Valley Drainage Basin, contiguous to the Sacramento River. Included in this area are parts of the counties named above, except Trinity County, and all of the remaining counties.

The area under investigation within the North Coastal Drainage Basin is primarily mountainous, but has several valleys at elevations of 3,000 to 4,000 feet. Urban, industrial, and agricultural developments are located primarily in these valleys. Tulelake area, Butte Valley, Shasta Valley, Scott Valley, and Hayfork Valley are such areas located within subbasins of the Klamath and Trinity Rivers.

The Lahontan Drainage Basin, located east of the ridge of the Sierra Nevada, contains several valley areas suitable for development, but is handicapped by light precipitation. Honey Lake Basin and Surprise Valley, at elevations of 4,000 feet and 5,000 feet respectively, contain most of the agricultural development in this area. Madeline Plains contains a large area of land classified as irrigable but has no natural source of water suitable for development.

The Central Valley Drainage Basin contains large upstream valley areas ranging in elevation from 2,500 feet to 5,000 feet, as well as the extensive Sacramento Valley area which varies in elevation from near sea level to about 500 feet. Principal upstream areas include Fall River Valley, Big Valley, and South Fork of Pit River Valley along the Pit River; Sierra Valley, Mohawk Valley, and Indian Valley on the Feather River; and Upper Lake Valley, Scotts Valley and Kelseyville Valley adjacent to Clear Lake. The Sacramento River, after being joined by the Pit and McCloud Rivers above Shasta Reservoir, enters the Sacramento Valley below Redding and follows a meandering course through the valley to the Sacramento-San Joaquin Delta. It is joined by numerous intermittent and perennial streams from the Coast Range

Indian Valley, a Mountain Valley in the Northeastern Counties

Department of Water Resources Photograph

Rice Under Irrigation on the Broad Floor of the Sacramento Valley

United States Bureau of Reclamation Photograph on the west and the Sierra Nevada on the east. Chief among the tributaries is the Feather River, which contributes about 20 per cent of the flow of the Sacramento River at the Delta.

Climate

In the area under investigation, which has a range in latitude of 3.5 degrees, or about 260 miles, the climatic conditions are influenced to a great extent by the Pacific Ocean and the orientation and location of topographic features. The situation of the Pacific high-pressure area known as the "Hawaiian High" determines the general effect of Pacific storms on the weather. This pressure ridge exercises considerable control over the landward movement of water-bearing air masses that originate in the central and northern Pacific Ocean. Abrupt changes in topography, however, cause wide variations in the climate.

The topography has a marked effect on the geographical distribution of precipitation. This is evidenced by the variation of the mean seasonal precipitation from in excess of 100 inches in western Siskiyou County to less than 10 inches in eastern Modoc and Lassen Counties. Precipitation on most of the agricultural lands is in the range of from 15 to 25 inches per season, occurring mostly during the months from October through March. Much of the precipitation falls in the form of snow on the higher mountain ranges, although rain above 8,000 feet sometimes occurs. Heavy snowfall is the usual winter feature of the Sierra Nevada at elevations above 5,000 feet. Snow falls in moderate amounts on the mountains and the plateaus in Lassen, Modoc, and Siskiyou Counties. Precipitation in the form of rain is characteristic in the lower Coast Range and the Sacramento Valley, while snow in small amounts falls in the higher elevations of the Coast Range. The northerly and westward movement of the prevailing Pacific high-pressure ridge during the summer results in a practically rainless period during those months, except for local showers and thunderstorms which occur in the mountainous areas.

Temperature, wind movement, and humidity are similarly influenced by the movement of the Pacific Coast air masses and the topography of northern California. Warm, dry summers characterize the Northeastern Counties, but there may be as much as 25 degrees difference between average daily temperatures in the Sacramento Valley and the higher elevations of the Sierra Nevada. Maximum daily summer temperatures in the Sacramento Valley and in the northern plateaus often exceed 100 degrees as a result of the solar heating of the air trapped in the basins under cloudless skies. In the winter, temperatures range from moderate in the Sacramento Valley to low in mountains and plateaus. The Sacramento Valley generally experiences frost-free temperatures from March to about the middle of November. The mountain valley and plateau areas are usually frost-free from June until the latter part of September, but in many locations frosts may occur in any month of the year.

Geology

The State of California has been divided into eleven geomorphic provinces. Geomorphic provinces are major land areas that have similar geologic and geographic features. Within the Northeastern Counties are found at least parts of seven provinces. These are: the Great Valley of California, the Northern Coast Ranges, the Klamath Mountains, the Cascade Range, the Modoc Plateau, the Basin-Ranges, and the Sierra Nevada. The major geologic characteristics of these provinces have considerable effect on the precipitation pattern, runoff, and ground water storage, as well as on soil types, main avenues of travel, recreational features, and the supply, location and accessibility of mineral deposits in the area. A generalized geologic map of the Northeastern Counties is shown on Plate I.

The Sacramento Valley, northern part of the Great Valley Province, is a broad alluvial plain about 40 miles wide and 150 miles long. The elevation of most of the valley is near sea level, but the valley rises gently toward the north and towards the foothills on either side. Rising conspicuously above the otherwise almost featureless valley plain are the Marysville Buttes, the remnants of a large volcano. The alluvial sediments in the Sacramento Valley form a huge ground water reservoir. Structural traps in the underlying, older sedimentary rocks form reservoirs for natural gas. The near-surface clay deposits could supply the ceramics industry for centuries, while alluvial sands and gravels provide an almost limitless supply of aggregate.

The western border of the Northeastern Counties area from Yolo to Tehama Counties lies in the northern Coast Ranges. These ranges are characterized by longitudinal ridges and intervening valleys which were formed by folding, faulting, and subsequent erosion of Mesozoic sedimentary rocks. Most of these mountains and valleys trend N. 30°-40° W. Many of the small valleys are alluviated and form small ground water basins flanked and underlain by the older sedimentary rocks. Irregular, knobby, landslide topography is characteristically developed on the Franciscan formation in the area. Volcanic flows and cones are prominent in the southern part of the area around Clear Lake in Lake County, which is the largest landslide-formed lake in California.

The Jurassic, Cretaceous, and Tertiary sedimentary rocks which are found in the Coast Range dip to the east beneath the Sacramento Valley.

The Klamath Mountains are complex formations with rugged topography. Included in the Klamath

Mountains are portions of Shasta and Siskiyou Counties, and almost all of Trinity County. Much of the area is inaccessible. The high mountains cool the moisture-laden air of storms blowing in from the ocean, resulting in high precipitation. The area had once been eroded to a landscape of gentle relief, but the Klamath River and its tributaries have cut deep, rugged canyons across the entire mountain mass. Only the gentler slopes and flat crests of the highest ridges reveal the existence of the once gentle plain. Successive terraces veneered with gold-bearing gravels have been left perched along steep canyon walls by the rapidly down-cutting streams. Hard, metamorphosed Paleozoic and older rocks have been exposed by the deep stream dissection. Highly deformed Mesozoic sedimentary and volcanic rocks and intrusives are also exposed in the area. These older rocks contain valuable deposits of both metallic and nonmetallic minerals. A few small structural basins have preserved remnants of the early Tertiary sedimentary and volcanic rocks which once may have blanketed the entire area. These structural depressions now form small ground water basins.

The Cascade Range, which was formed by a chain of volcanic cones, extends from Washington and Oregon into the northern central part of California. The Cascade Range extends through the middle portions of Siskiyou and Shasta Counties, and into smaller areas of Lassen, Plumas, Butte, and Tehama Counties. Lassen Peak, the only active volcano in the United States, forms the southern terminus of the Cascade Range. The Pit River transects the range between Lassen Peak and Mount Shasta. Lavas and fragmental volcanic rocks predominate, but lake sediments are found in several of the structural depressions in the area. On the southwest, the volcanic rocks dip beneath the sediments of the Sacramento Valley. On the east, the rocks merge with the lava beds of the Modoc Plateau. On the south, the volcanic rocks blanket the northern end of the Sierra Nevada, and on the west the flows extend along the eastern edge of the Klamath Mountains. Some of the lava flows, interbedded gravels, and volcanic debris are extremely permeable. Precipitation, which is high near the peaks, is completely absorbed by the rocks in some areas. The moisture reappears as ground water flowing from large springs. Glaciers descending from Mount Shasta deposited moraines to the north. Outwash from the glaciers extends into Shasta Valley. Several valleys now occupy depressions in the volcanics of the area and form small ground water basins filled with lacustrine and alluvial sediments. The area drains to the Klamath River on the north and to the Sacramento River on the south.

An immense volcanic plateau covers the eastern portion of the State of Oregon and extends to the Cascade Range in northern California. In California it is known as the Modoc Plateau. The plateau area includes portions of Modoc, Lassen, Siskiyou, and Shasta Counties. The rocks consist of a thick accumulation of lava flows and tuff beds with an interlayering of lake sediments, soils, and stream deposits. Some of the rocks are extremely permeable, and the scant precipitation usually disappears into the ground and moves as ground water to the big springs in the area. The largest valleys were formed as structural depressions in the volcanic rocks. Many of the valleys have been, and some are now, occupied by lakes such as Eagle Lake. The alluvial deposits in some of the valleys are shallow, providing poor ground water storage. However, this deficiency is compensated in a few valleys by water-bearing volcanic rocks beneath and adjacent to the alluviated areas.

The geomorphic province known as the Basin-Range extends from Nevada into California along the eastern margins of the Sierra Nevada and Modoc Plateau in Lassen and Modoc Counties. This region of fault block mountains is characterized by interior drainage with development of lakes and playas. Goose Lake, Honey Lake, and the lakes in Surprise Valley are examples of these. The Basin-Range structure extends into the Sierra Nevada as far as Meadow Valley in Plumas County and into the Modoc Plateau. The bedrock reflects the granitics and volcanics found in the adjacent provinces. The valleys form ground water basins filled with alluvial and lake sediments.

The Sierra Nevada is a huge fault block of granitic and metamorphic rocks overlain by remnants of Tertiary volcanic and sedimentary rocks. A multiple fault scarp forms the eastern boundary of the Sierra Nevada Province. In the north, the older rocks of the Sierra Nevada disappear beneath the volcanics of the Cascade Range and Modoc Plateau. The block is tilted gently to the west and disappears beneath the sediments of the Sacramento Valley. Plumas and Sierra Counties, and the eastern half of Butte County, are included in the Sierra Nevada. Several belts of mineralization extend through the area. A number of valleys have been formed as structural depressions in the main Sierra block. These valleys have been filled with alluvial and lacustrine sediments and form important ground water basins.

Soils

Soils within the Northeastern Counties vary widely in composition and depth, and in physical and chemical properties. The geology, previously discussed accounts for differences in parent material, while other variations are influenced by topography, climate, age, and vegetation.

In general, the soils may be divided into three broad groups: (1) Residual soils, which have developed in place by the disintegration and weathering, and the action of soil-forming processes on the underlying bedrock, which may be of both sedimentary and igneous origin; (2) Alluvial soils, which have developed from transported sediments of pre-existing soils and other materials; and (3) Organic soils, which have been derived mainly from the decomposition of organic materials under marshy conditions.

Residual soils occur mainly on hilly and mountainous lands. Soil differences largely are dependent upon variations of parent material and climatic factors. Soil depth varies from very shallow on scab lands or lands having considerable rock present on the surface and throughout the profile, to good depth on lands having little or no rock present. Drainage is usually good. Suitability of much of these soils for irrigation development is limited because of the complex topographic conditions, shallow soil depth, and excessive amounts of rock. Under favorable conditions, however, certain of these soils are suited for many climatically adapted crops.

Alluvial soils vary in their physical and chemical characteristics according to the nature of the deposition, their age, and the degree of development that has taken place since their deposition. This group of soils can be further divided into three broad subdivisions (1) old valley fillings, (2) basin and lacustrine soils, and (3) recent alluvium.

(1) Soils derived from old valley fillings and remnants of former alluvial fans are extensive along both sides of the Sacramento Valley floor and many other mountain valleys throughout the Northeastern Counties. These soils have undergone marked changes in profile characteristics since their deposition. Leaching and other soil forming processes have brought about soils varying from those with dense claypan or cemented hardpan subsoils, to those with moderately compact subsoils. Agriculturally, these soils are generally suitable for shallow to medium deep rooted crops.

(2) Basin and lacustrine soils have developed from fine sediments deposited in overflow basins or fresh water lakes. These soils are normally fine textured and, due to limited or restricted drainage, an accumulation of saline and alkaline salts is often present. Much of the saline soil could be reclaimed by improvement of local drainage. Certain of the alkaline lacustrine soils, because of the greater difficulty in reclamation, were not considered as potentially irrigable, particularly in Surprise Valley and Honey Lake Valley and certain areas in the upper Klamath River drainage basin. Otherwise the basin and lacustrine soils are suitable for many climatically adapted medium and shallow rooted crops.

(3) Recent alluvial soils occupy flood plains adjacent to the major and minor stream channels. In general, these soils are deep, friable, and medium textured and have undergone little or no change in their profile characteristics since deposition. Where adequately drained, these soils have wide crop adaptability and are highly valued as agricultural lands.

Organic soils are not found in any great extent within the Northeastern Counties. Small areas do exist in the Tule Lake and Klamath Lake areas, and in West Valley near Likely. In general, these soils are highly productive where reclamation has been brought about by drainage. They are normally medium to fine textured and suitable for a wide variety of climatically adapted crops.

Hydrographic Units

In order to facilitate analysis of present and probable future water requirements, and for subsequent investigations of water supply problems, the area of the Northeastern Counties lying within the three major drainage basins was divided into 75 hydrographic units. The hydrographic unit boundaries were determined from consideration of water supply and related water service. Those units in the mountainous and upland areas were separated on the natural drainage lines of the larger tributary streams, and at convenient stream gaging stations. Boundaries of hydrographic units on the valley floor included those water-using units that had similar physical and operational characteristics. Principal factors considered were present and potential sources of water supply, and existing water service agencies.

The boundaries of the hydrographic units are shown on Plate 2, "Hydrographic Units Within the Northeastern Counties". Areas of the hydrographic units, which were determined by the cutting and weighing method from most recently available maps, are shown in Table 1. Areas of each of the Northeastern Counties, similarly determined, are presented in Table 2.

TABLE 1

AREAS OF HYDROGRAPHIC UNITS WITHIN THE NORTHEASTERN COUNTIES

Hydrographic Unit		Area, in acres
Reference number	Name	
	North Coastal Drainage Basin	
1	Tulelake	1,089,700
2	Butte Valley	387,800
3	Klamath River	1,190,200
4	Shasta Valley	507,400
5	Scott Valley	423,500
6	Salmon River	475,200
7	Upper Trinity River	467,400
8	Lower Trinity River	652,000
9	South Fork Trinity River	509,300
10	Southern Trinity County	419,900
11	Lake Pillsbury	243,700
	SUBTOTAL	6,366,100

TABLE 1—Continued

AREAS OF HYDROGRAPHIC UNITS WITHIN THE NORTHEASTERN COUNTIES

Hydrographic Unit: Reference number	Hydrographic Unit: Name	Area, in acres
	Central Valley Drainage Basin	
12	Goose Lake	234,700
13	Jess Valley	160,300
14	Alturas	753,400
15	Big Valley	795,800
16	McArthur	779,200
17	Hat Creek	609,400
18	Montgomery Creek	234,000
19	McCloud River	383,500
20	Dunsmuir	274,700
21	Shasta Lake	244,500
22	Clear Creek	147,000
23	Keswick	29,900
24	Cottonwood Creek	601,600
25	Olinda	51,200
26	Redbank Creek	154,000
27	Elder Creek	83,200
28	Thomes Creek	222,500
29	Stony Creek	476,700
30	Clear Lake	609,600
31	Middletown	132,000
32	Stillwater Plains	80,500
33	Cow Creek	272,700
34	Bear Creek	103,700
35	Battle Creek	231,600
36	Paynes Creek	86,000
37	Antelope Creek	130,800
38	Mill Creek	118,300
39	Deer Creek	160,400
40	Chico Creek	222,700
41	Paradise	116,300
42	North Fork Feather River	771,200
43	East Branch Feather River	653,800
44	Sierra Valley	336,800
45	Middle Fork Feather River	430,900
46	South Fork Feather River	101,000
47	North Yuba River	365,500
48	Challenge	115,800
49	Wyandotte	86,900
50	Anderson	60,600
51	Corning	197,500
52	Los Molinos	182,100
53	Fruto	171,700
54	Orland	138,000
55	Durham	110,100
56	Colusa	589,000
57	Gridley	330,900
58	Browns Valley	42,400
59	Cortina	289,300
60	Arbuckle	128,300
61	Sutter	82,400
62	Marysville	231,600
63	Pleasant Grove	18,700
64	West Yolo	63,000
65	Capay	58,200
66	Woodland	207,100
67	East Yolo	182,500
	SUBTOTAL	14,445,500
	Lahontan Drainage Basin	
68	Surprise Valley	496,400
69	Madeline Plains	513,300
70	Eagle Lake	278,100
71	Willow Creek	93,000
72	Secret Valley	416,500
73	Susan River	371,200
74	Herlong	363,100
75	Little Truckee River	101,000
	SUBTOTAL	2,632,600
	TOTAL, NORTHEASTERN COUNTIES	23,444,200

TABLE 2

AREAS OF THE NORTHEASTERN COUNTIES

County	Area, in acres	County	Area, in acres
Butte	1,075,600	Sutter	390,500
Colusa	741,300	Tehama	1,913,600
Glenn	828,000	Trinity	2,048,600
Lake	855,100	Yolo	652,700
Lassen	3,026,500	Yuba	411,000
Modoc	2,694,300		
Plumas	1,681,000	TOTAL, NORTHEASTERN COUNTIES	23,444,200
Shasta	2,462,300		
Sierra	609,300		
Siskiyou	4,054,400		

PRESENT ECONOMY AND DEVELOPMENT

The present economy of the Northeastern Counties is based upon the utilization of the natural resources for agriculture, timber, and mining industries and, in recent years, for recreation. The counties are endowed with broad areas of good quality farm lands capable of growing numerous crops, and have extensive foothill and mountain meadow areas suitable for irrigated pasture and dry range for livestock. The mountains sustain vast stands of fir and pine forests, much of which is still in its virgin state after a century of logging. Mineral assets are present in varied forms. Gold was responsible for the original settlement of the area, but now plays a minor role in the economic pattern. More important at present is the natural gas industry being developed in the Sacramento Valley. The land resources, enhanced by the climate, lakes, rivers, and wildlife, make much of the area desirable for recreational and sporting purposes. Services for tourists and sportsmen throughout the area constitute one of the more important factors in the economy.

There follows a brief description of the present economy and development within each of the 15 counties under consideration.

Butte County

Butte County was one of the original counties organized in the State by the Act of 1850. At the time of its founding it included portions of several surrounding counties, but was later reduced in size to its present 1,680 square miles. The 1956 population was estimated to be about 70,000. The 1950 Census showed the distribution to be about 40 per cent urban and 60 per cent rural.

The terrain rises from the Sacramento Valley floor at an elevation of about 60 feet to over 6,000 feet at the summit of the Sierra Nevada. The change in topography is accompanied by seasonal diversity of temperatures and rainfall. Hot dry summers and mild winters are the usual pattern for the valley and foothill areas, while the higher lands experience cooler summers and more rigorous winters. Mean seasonal precipitation varies from a low value of 20 inches near Chico to over 80 inches at Magalia, only 15 miles eastward. Heavy snowfall at higher elevations may occur from late in November to early in March.

Credit for much of the early development of Butte County goes to General John Bidwell, who made his home near Chico. Numerous land grants were made by the Mexican Government in the 1840's following surveys conducted by General Bidwell. The rush of emigrants into Butte County, however, followed the discovery of gold at what is now Bidwell's Bar on the Middle Fork of the Feather River, a few months after James Marshall's discovery at Coloma.

The easy diggings began to wane within a few years making necessary large capital investments to continue extracting gold by underground and hydraulic mining. Accompanying the change in mining methods was the development of water necessary in the operations. Diversion works and many miles of ditches and flumes were constructed for this purpose. The timber industry began to develop as the demand for timber arose from the mining and water development enterprises. An interesting use of water during this period was the fluming of logs and lumber from the mountainous areas down to the valley floor for shipment elsewhere or use locally.

Agriculture. As the cost of mining increased, small operators were excluded, and many were forced to turn to agricultural pursuits. General Bidwell's horticultural and agricultural experiments had shown that a large variety of crops could be grown, including vegetables, fruits, vineyards, and olives, as well as the grains grown by Spanish settlers. An orange seedling planted at Bidwell's Bar in 1856 grew and subsequent propagation formed the beginning of a profitable citrus industry around Oroville. As Butte County's economy began to change from one of mining to agriculture, the water once used for the mines and placer diggings was diverted to the valley farm land. The necessity for irrigation water had long been apparent, and the Miocene, Palermo, and Forbestown mining ditches became the nucleus of the Thermalito, Table Mountain, and Oroville-Wyandotte Irrigation Districts' distribution systems.

Many enterprises were promoted before the turn of the century to develop large irrigation works, with most ending in failure. Among later notable private developments which proved successful were the Sutter-Butte Canal built in 1905, and the Western Canal completed in 1915 to bring water from the Feather River to lands in the Biggs-Gridley and Nelson areas, respectively. In the years that followed, organized efforts through the formation of public districts brought much of the foothill and valley lands of Butte County under irrigation. The principal agencies now serving water to irrigate lands are shown in Table 3.

Water rights for several areas in Butte County have been adjudicated by court proceedings. For adjudicated areas, State Watermasters administer distribution of available water supplies.

Butte County is adapted to a wide variety of crops, and contains an extensive agricultural area. The present irrigated area in the county, determined during the period from 1954 through 1956, is about 176,000 acres. Rice is the most widely grown crop, with 84,800 acres devoted to this purpose. The combined area of pasture and alfalfa amounted to 33,700 acres, while 29,000 acres were in deciduous orchard, including peaches, prunes, cherries, apples, almonds, and walnuts. A great variety of vegetables, field crops, and garden products are grown on 20,100 acres of irrigated land. The unique thermal belts near Oroville enable 6,200 acres of citrus fruits to be grown in that area.

TABLE 3

PRINCIPAL IRRIGATION WATER SERVICE AGENCIES IN BUTTE COUNTY

Name	Location	Irrigated area, in acres*
Privately Owned Water Companies		
Sutter Butte Canal Company	Gridley, Biggs	16,997
Pacific Gas and Electric Company, (Western Canal)	Nelson	17,586
Mutual Water Companies		
Biggs Ditch	Biggs	450
Dayton Mutual	Chico	1,868
Durham Mutual	Durham	5,800
Water Users Association, Gridley Colony, Ditch No. 1	Gridley	1,200
Irrigation Districts		
Oroville-Wyandotte	Oroville	4,450
Paradise	Paradise	450
Richvale	Richvale	13,475
Table Mountain	Oroville	450
Thermalito	Oroville	1,670
Reclamation Districts		
Number 833	Gridley	10,000
Water Districts		
Biggs West Gridley	Biggs	11,837
Butte	Gridley	17,000

* (Information for period from 1950 through 1954.)

Timber. Since the construction of the first sawmill in 1852, lumber has been a substantial contributor to the economy of the County. Heavy precipitation on the higher watersheds has been conducive to the growth of substantial stands of timber. Approximately one-third of the county's area is commercial forest land, as reported by the California Forest and Range Experiment Station of the United States Forest Service. The total area of commercial forest land is 356,000 acres, of which 117,000 acres are in public ownership, and 239,000 acres are privately owned. In addition to the above area, there are approximately 252,000 acres of noncommercial forest land, including land withdrawn from timber utilization by statute or administrative order, or which, because of adverse locations, are physically inaccessible.

In 1951 there were 24 active sawmills in the county, producing 3.5 per cent of the State's timber crop, placing Butte County as ninth in such production. The volume produced by species was as follows:

Species	*Volume, in thousands of board feet*
Douglas fir	36,531
Ponderosa pine	65,624
True firs	35,822
Sugar pine	28,158
Incense cedar	3,147
Total	169,282

Mining. Mining in Butte County began with the gold rush in 1848, and rose to a peak after the development of the world's first successful floating bucket-line dredge near Oroville in 1898. Over $71,000,000 in gold was produced in Butte County between 1880 and 1952, several times that amount having been produced before that time. Since 1952, gold production has dwindled to a mere trickle.

Construction materials, including miscellaneous stone, sand and gravel, have been produced in significant amounts since 1910. Annual production rose to a pre-depression peak of $556,301 in 1928, and to a post-war peak of over $1,000,000 in value during 1954.

Natural gas has been produced in Butte County since 1917, but production did not become important until after the discovery of the Chico Gas Field. There are now three gas fields and one area under exploration in the county. Current annual production of natural gas exceeds $1,000,000 in value.

World War II stimulated the production of zinc and copper and their associated minerals, but production stopped after the war. Chromite production reached a peak during World War I, and production was revived during World War II. Recent production of chromite has been high under stimulus from the Federal strategic minerals buying program.

As reported by the California State Division of Mines, the total value of mineral production in Butte County during 1954 was $2,068,460, principally for natural gas and aggregates.

Recreation. Diversity of recreational activities and ease of access make this an important resource of Butte County. There are several mountain streams along the northeast county line that are nationally famous for their trout fisheries. The Feather River below the site of Oroville Dam and afterbays is important for salmon, steelhead, and shad fishing. The Sacramento River, which forms the western county boundary, abounds with salmon, steelhead, sturgeon, striped bass, smallmouth bass, and catfish.

Deer hunting is important and very productive in the mountainous eastern section. The foothill area is utilized as winter range.

Upland game such as pheasant, quail, and dove are exploited to a considerable extent. There are 13 clubs in Butte County with over 11,000 acres open to private pheasant hunting. Waterfowl shooting is an intensive short season sport. There are a number of hunting clubs in the county, one of which is a 9,000-acre private club. The California Department of Fish and Game maintains the Gray Lodge Waterfowl Management Area in the southern part of the county, partly to provide a public hunting area and partly to reduce depredation of crops by waterfowl.

The timbered areas at the higher elevations provide many camping and picnic inducements. The 640-foot high Feather Falls on Fall River is a major scenic attraction. The canyon of the Middle Fork Feather River is one of spectacular beauty which lures the more hardy venturer.

The main highways, U. S. 99-East and 40-Alternate, carry large volumes of tourist traffic through the county. Many accommodations are available to travelers in the Cities of Chico and Oroville and along the highways. Richardson Springs, near Chico, is a private mineral spring resort. There are two state parks in Butte County: Feather Falls State Park and Curry-Bidwell Bar State Park on the Middle Fork Feather River. The latter park will be inundated by Oroville Reservoir.

Colusa County

Colusa County was one of the original 27 counties organized by the Legislature in 1850. It originally included the present County of Glenn and parts of Tehama County. In 1891, the county boundaries were finally established giving the county an area of 1,160 square miles. The 1956 population was estimated to be about 12,000. On the basis of the 1950 Census, the distribution would be about 26 per cent urban and 74 per cent rural.

The terrain of Colusa County slopes eastward from the ridge of mountains which separates it from Lake County, to the Sacramento River. The maximum elevation at Snow Mountain in the northwest corner of the county is 7,056 feet, with the lowest elevation on the Sacramento Valley floor approximating 30 feet. The climate is typical of the Sacramento Valley, with hot dry summers and mild winters. Average seasonal rainfall varies from less than 16 inches at the town of Colusa to over 50 inches in the mountains. The growing season on the valley floor extends from early in March to late November, making the county well adapted to growing many agricultural products.

Although the first white men in Colusa County were probably immigrants coming from Oregon to California, settlement did not take place until after surveys were made in the 1840's by General John Bidwell. Early settlers took up land grants from the Mexican Government. Navigation advantages of the Sacramento River were responsible for the first settlements taking place along the river. The production of grain became of major importance in the years that followed. Grain raising received its impetus from the demand created by the large number of freight teams hauling supplies to the mines in the Sierra Nevada. Over half the county was planted to wheat and barley, but near the turn of the century production of those grains declined as the emphasis turned to irrigated crops.

Agriculture. The availability of abundant water from the Sacramento River proved an attraction for the promotion of large scale water development projects for irrigation. One of the earliest schemes was promoted by Will S. Green of Colusa in 1864, and was to consist of a large irrigation and navigation canal to serve Colusa and Yolo Counties. It was not until after passage of the Wright Act in 1887, however, that progress was made toward bringing water to the lands from the Sacramento River. The Central Irrigation District was the fourth irrigation district to form in the state, and embraced an area of 156,550 acres in what was then Colusa County (now Colusa and Glenn Counties). A portion of the Central Canal was constructed, but financial difficulties postponed progress for several years. Private capital took over the project in 1903. The canal was completed and a pumping plant installed at the river intake. The years that followed were frought with litigation and financial difficulty, until it appeared advisable for the formation of irrigation districts to take over the system. Six districts were then formed in the two counties from 1916 to 1920, the largest being the Glenn-Colusa Irrigation District, with a gross area of about 121,600 acres.

Irrigation development by public agencies was not confined to irrigation districts. One of the earliest forms of public improvement was the reclamation of swamp and overflow lands by means of levees and drains. Of the several reclamation districts that have entered the field of irrigation service, Reclamation District No. 108 is notable. This district in Colusa and Yolo Counties was formed in 1870 under the reclamation law of 1868, and comprises 74,246 acres in the two counties. Like many other districts, it was plagued with financial setbacks in its early years. The principal agencies now serving water to irrigated lands are listed in Table 4.

The vast acreage of wheat and barley, prominent in the early development of Colusa County, gave way to other crops. Rice became the dominant cereal following its introduction into the county in 1911. As indicated by the crop survey, made under this investigation in 1955 and 1956, 63,400 acres were cropped to rice out of the total of 108,000 acres of irrigated land in the county. Other leading irrigated crops included 15,200 acres of orchard, 11,400 acres of pasture, 8,000 acres of field crops, consisting mainly of beans and silage, 4,600 acres of alfalfa, and 1,800 acres of truck crops.

TABLE 4

PRINCIPAL IRRIGATION WATER SERVICE AGENCIES IN COLUSA COUNTY

Name	Location	Irrigated area, in acres*
Mutual Water Companies		
Colusa Irrigation Company	Colusa	1,200
Roberts Ditch Irrigation Company	Colusa	1,400
Swinford Tract Irrigation Company	Colusa	136
Irrigation Districts		
Compton-Delevan	Maxwell	3,022
Glenn-Colusa	Delevan	73,687
Maxwell	Maxwell	1,730
Princeton-Codora-Glenn	Willows	See Glenn County
Provident	Willows	See Glenn County
Reclamation Districts		
Number 108	Grimes	12,661
Number 1004	Colusa	11,460
Water Districts		
Compton Water District	Maxwell	3,500

* (Information for period from 1950 through 1954.)

Timber. While the United States Forest Service has classified 276,000 acres of Colusa County as forest land, only 27,000 acres are of commercial importance. All but 1,000 acres of these are in public domain. In 1951 there was only one active mill in the county, and the production figures are not available. The Forest Service estimates that practically all of the commercial saw timber is old growth with an approximate volume of 564,000,000 board feet.

Mining. Colusa County can boast of mineral occurrences as unusual as any in the State. The early history of mining in the county is obscure, only fragmentary reports being available prior to 1875. Copper excited some interest about 1861, but only a little ore was shipped to a smelter. In 1865, gold was first produced from the Manzanita Mine. This mine is the one notable quicksilver mine of the world where there has been a sufficient percentage of gold to work the ore at times for that metal alone. Bitumens are also present in the ore. The production of "Colusa Sandstone" was once a major industry. The massive sandstone was used in construction of several large buildings, including the Ferry Building, Monadnock Building, and St. Francis Hotel in San Francisco, and the Clunie Building in Sacramento. The sandstone quarries have been relatively idle since 1915. Important production of mineral water and mercury was registered during the first decade of this century, but, after 1916, production dwindled. Seeps of oil and natural gas have long been known in the county, but production has been negligible.

As reported by the California State Division of Mines, the 1954 mineral production of Colusa County amounted to $88,400, primarily for sand and gravel, but including natural gas and chromite. The State Division of Oil and Gas recorded the production of 4,094,000 cubic feet of natural gas during 1954. Production of sand and gravel was down from the 1953 high of 201,627 tons valued at $111,341.

Recreation. Little Stony Creek and the South Fork of Stony Creek in the mountainous area in western Colusa County provide suitable conditions for support of trout populations and are stocked with catchable trout by the Department of Fish and Game. East Park Reservoir of the Orland Reclamation Project furnishes good warm water fishing, especially for white crappie. The Sacramento River, which flows through a portion of the county and forms several miles of the eastern boundary, supports an important fishery for salmon, steelhead, sturgeon, striped bass, catfish, and small mouth bass.

Deer hunting is restricted to a limited area in western Colusa County. There is one commercial hunting club west of Williams of about 20,000 acres which affords good deer hunting.

There are nine commercial clubs with a total area of over 8,500 acres devoted to pheasant hunting. Waterfowl hunting is a major part of the recreational economy of the county. There are several commercial gun clubs with approximately 45,000 acres devoted to waterfowl shooting.

At the higher elevations in the Mendocino National Forest, there are desirable camping and picnic areas. However, these are too far from centers of population to be heavily used on a one-day basis. At Wilbur Springs, south of Bear Valley, there is a commercial health resort using the natural mineral springs.

Glenn County

Glenn County, originally part of Colusa County, was created by the Legislature of 1891, and was named for Dr. H. J. Glenn, a prominent landowner and early settler. The 1956 population was estimated to be 17,000. Based on the 1950 Census, the distribution of the population is about 20 per cent urban and 80 per cent rural.

Glenn County's 1,290 square miles extend westward from the Sacramento River at an elevation of about 70 feet to a maximum of about 7,400 feet at the crest of the Coast Range. The climate is typical of the Sacramento Valley with hot dry summers and mild winters. Seasonal rainfall varies from approximately 17 inches near Willows to over 50 inches in the mountains. The growing season extends from March until November.

The early history of Glenn County is coupled to that of Colusa County, of which it was a part for some 40 years. The promotion of the Central Irrigation District by Will S. Green probably had the greatest impact on the agricultural economy of the area. Until the turn of the century, the emphasis was on dry grain farming. Although, the feverish activity of the Sierra Nevada gold mines by-passed Glenn County, it was here that the grain was produced for freight teams hauling supplies to the mines.

Agriculture. The early grain farming was productive but showed the need for irrigation. Attempts at irrigation were local in nature until the formation of the Central Irrigation District in 1877, comprising some 156,500 acres in what is now Glenn and Colusa Counties.

In the meantime irrigation development in the northern portion of the county did not remain static. Shortly after the turn of the century, the United States Reclamation Service was solicited to study the possibilities of development of Stony Creek for irrigation in the Orland area. This resulted in the construction of East Park Reservoir on Stony Creek in 1910, with Stony Gorge Reservoir added in 1928. The Orland Reclamation Project was among the earliest to be constructed under the Reclamation Act of 1902.

The principal agencies serving water to irrigated lands are listed in Table 5.

TABLE 5

PRINCIPAL IRRIGATION WATER SERVICE AGENCIES IN GLENN COUNTY

Name	Location	Irrigated area, in acres*
Mutual Water Companies		
Loam Ridge Mutual Users Company	Orland	1,000
Orland Unit Water Users Association	Orland	22,450
Willow Creek Mutual Water Company	Willows	750
Irrigation Districts		
Glenn-Colusa	Delevan	(See Colusa County)
Jacinto	Willows	9,095
Princeton-Codora-Glenn	Willows	6,848
Provident	Glenn	10,579
Reclamation Districts		
Number 1004	(See Colusa County)	

* (Information for period from 1950 through 1954.)

Agriculture is the leading economic activity in Glenn County. The 1955 County Agricultural Commissioner's report shows the total values of agricultural products to be about $32,000,000. This includes about $19,000,000 for crop production and about $13,000,000 for livestock, poultry, and minor agricultural products. The leading crop in Glenn County is rice. The present land use survey, made during this investi-

Unique Thermal Belts Permit Orange Culture in Butte and Glenn Counties

United States Bureau of Reclamation Photographs

gation in 1955 and 1956, showed 62,300 acres in rice out of a total irrigated area of 150,500 acres. The second major crop, irrigated pasture, occupied 58,100 acres. Other important crops included alfalfa with 8,500 acres, deciduous orchards with 8,100 acres, grain 1,500 acres, and subtropical orchards 1,400 acres.

Timber. Timber production in Glenn County is a minor contributor to the county's economy. The total area of commercial forest lands amounts to about 113,000 acres, of which 87,000 acres are in public ownership and 26,000 acres are privately owned. In addition to the above, there are 250,000 acres of noncommercial forest lands, including chaparral areas. In 1951 there were two active sawmills in the county, but their exact production figures are unknown. However, these two mills, together with the one in Colusa County, produced approximately 14 million board feet of lumber in 1951. Lumber is produced from ponderosa pine, Douglas and true firs, sugar pine and incense cedar.

Mining. The economy of Glenn County is not materially affected by its mineral production. However, of historical interest is the salt-seepage in Salt Spring Valley which was a far-famed source of salt for the Indians of California, and was the resort of most of the tribes within a radius of 75 miles. The top crust of the seep was scraped off in summer, stored crude, or refined on the spot by dissolving in water and gathering the salt after evaporation. The salt springs are at present utilized only as salt licks for cattle.

With the exception of some manganese and chromium ores produced during war years, and the production of natural gas since 1944, mineral production in Glenn County has consisted almost entirely of sand and gravel. As of December, 1954, the proved acreage, in the four gas fields and one exploratory area in Glenn County was 690 acres. As reported by the California State Division of Mines, the total value of mineral production, mostly sand and gravel, in Glenn County during 1954 was $478,547. The State Division of Oil and Gas reports that 681,734,000 cubic feet of natural gas were produced in Glenn County during 1954. This would account for nearly $190,000 of the total value of mineral production.

Recreation. Fishing and hunting provide the major recreation outlet in Glenn County. The Coast Range in the western extremity of the county provides streams which support sizable populations of trout. These streams, not easily accessible, are the upper tributaries of the Eel River. The East Fork of Stony Creek is a good trout stream in its upper reaches and is stocked regularly.

The Sacramento River forms a portion of the eastern county boundary and flows through a portion of the southeastern corner. There is good fishing in the river for salmon, steelhead, striped bass, black bass, catfish, shad, and sturgeon.

Stony Gorge Reservoir of the Orland Reclamation Project, located on Stony Creek, is a steep-sided reservoir that is more suitable for surface water sports than it is for fishing for the warm-water fish which sparsely inhabit the lake.

Deer hunting is an important big game sport in Glenn County with the mountainous area providing natural habitat. Upland game bagged in important quantities in the county include pheasants, quail, and doves. Two licensed clubs maintain shooting areas for members. Waterfowl shooting receives considerable attention with approximately 3,000 acres in four gun clubs devoted to hunting of ducks and geese.

The timbered areas in the National Forest lands in the western portion of the county provide attractive camping and picnicking sites.

Lake County

Lake County was created by the Legislature of 1861 out of territory that was originally part of Napa County. Its outstanding feature is Clear Lake, which is the largest fresh water lake wholly within the State. The 1955 population was estimated to be about 11,000, and the 1950 Census listed the entire population as rural. This included 25 per cent rural farm population and 75 per cent rural non-farm population. There are about 1,340 square miles of land area in the county. The terrain is characterized by smooth valleys and rolling hills, as well as steep mountainous areas. Elevations vary from about 650 feet to in excess of 5,000 feet on the higher peaks. The elevation of Clear Lake is about 1,320 feet. The summers are warm and dry, and winters are moderate in Lake County. Seasonal precipitation varies from 22 inches at Kelseyville to in excess of 80 inches on Mt. St. Helena. Precipitation in the form of snow frequently falls in winter months at the higher elevations, but does not form a snow pack. The growing season extends from late in March into October.

Before 1840, the only inhabitants of what is now Lake County were numerous tribes of Indians. Settlement by white men followed receipt of one of the first land grants in the area by Salvador Vallejo, brother of General Mariano G. Vallejo. The early settlers were principally engaged in stock raising, farming, and fur trapping.

Much of the early history revolves around controversy over the waters of Clear Lake. For those attracted to its shores, conflicts arose with those who would regulate the level of the lake by changing the regimen of its outflow. One of the earliest water supply developments was that of the predecessor to the Clear Lake Water Company which purchased an existing flour mill and dam on Cache Creek two miles below the outlet of Clear Lake in 1867. Heavy rains the following winter caused the lake level to rise to unprecedented heights, causing some flooding of surrounding owners. After receiving no redress from the courts, a vigilance committee was formed and the mill was burned and the dam destroyed.

In the years that followed many fanciful plans were proposed for developing the waters of Clear Lake, including numerous ones for hydroelectric development on Cache Creek. None of these, however, were to come into realization. In the meantime the Yolo Water and Power Company was formed, and after purchasing the interests of other companies, constructed a dam on Cache Creek about five miles downstream from the rim of the lake in 1914. The erection of this dam only added to the controversy over earlier obstructions to the outlet, with a final settlement in 1920 in the case of "Gopcevic vs. Yolo Water and Power Company", in the Superior Court of Mendocino County. This decree, and the Bemmerly decree, established the criteria under which the company and its successor, the Clear Lake Water Company, must operate the outlet works.

Agriculture. The earlier agricultural pursuits in Lake County were centered around the raising of grain, livestock, and truck crops. The area is ideally suited to orchard crops. For years it has been noted for its premium quality pears, but at present, walnuts are the leading commodity. The 1955 County Agricultural Commissioner report showed about 10,700 acres in walnuts and 4,400 acres in pears. Out of a total income from agricultural products of slightly over $6,000,000, orchard production accounted for about $4,000,000, and livestock and poultry accounted for about $1,800,000.

The total irrigated area during 1955 and 1956, as surveyed during this investigation, was 16,200 acres. This included 6,200 acres of deciduous orchard, 6,000 acres of pasture, and 2,500 acres of alfalfa. There is a present trend toward increasing acreages of irrigated pasture wherever water supplies permit. There are no large organized agencies in Lake County to serve irrigation water.

Timber. Although lumber production in Lake County is not of major significance on a State-wide basis, its nine active sawmills contribute substantially to the economy of the county. Approximately 88 per cent of the 804,000 acres of land area is in forest land. However, only 175,000 acres are of commercial value. Of these commercial lands, 105,000 acres are in public ownership and 70,000 acres are private lands.

The volume of timber produced in 1951 by the nine mills in Lake County, and by one active mill in Napa County, amounted to approximately 14 million board feet. The cut was predominantly ponderosa pine and Douglas fir, but included nearly two million board feet of redwood.

Mining. "Quicksilver" attracted prospectors to Lake County as early as 1850, and development and production from the deposits was recorded in 1862. From the standpoint of total value, mercury production has been the most important mining industry in Lake County. A total of 18,100 flasks was produced in 1877. The peak value of $1,045,726 was reached in 1941. Borax and sulphur attracted the California Borax Company to Borax Lake at the south end of Clear Lake in 1864. Between 1864 and 1868, the company produced 1,881,697 pounds of sulphur valued at $53,500 from the Sulphur Bank Mine. The mine was idle for a period and was later reopened to produce mercury.

As reported by the California State Division of Mines, the total value of mineral production in Lake County during 1954 was $770,993. In addition to mercury, chromite, manganese ore, pumice, sand and gravel were produced.

Recreation. The recreational resources have been highly developed in Lake County. As early as 1852, a resort was established at Harbin Spring near Middletown, and in the years that followed a dozen or more mineral spring resorts were developed. Although in former years the reputed therapeutic value of the mineral waters was the major attraction to the Lake County area, now the ready accessibility of the area and changing customs have made water sports, fishing, and hunting the major attractions. Today numerous resorts and summer homes surround the lake, and there is every indication that the growth of this type of development will continue.

Trout streams are limited to the headwaters of the Eel River, tributary to Lake Pillsbury, and the North Fork of Cache Creek. Cache Creek below Clear Lake is a good warm-water stream supporting a fairly large population of catfish and smallmouth bass. The Eel River above Van Arsdale Dam, made accessible by a fish ladder, is an important steelhead spawning area.

Clear Lake has become a major water sports location, particularly for swimming, boating, water skiing, and fishing. However, it is not fished heavily enough to control the bass and rough fish populations. The lake supports a large population of catfish and has the potential to support a greater fishery than exists at present. Lake Pillsbury, a Pacific Gas and Electric Company storage reservoir, has limited resort development.

Deer hunting is an important and productive activity in Lake County. There are three commercial hunting clubs in the county, and large areas of the Mendocino National Forest are open to deer hunting.

There are several camping and vacation areas in the northern mountainous region maintained by the United States Forest Service, and the California Division of Beaches and Parks operates the Clear Lake State Park.

Lassen County

Lassen County was organized by an act of the Legislature in 1864 from portions of Plumas and Shasta Counties, and was named in honor of Peter J. Lassen, an early explorer and pioneer. The county has an area of 4,550 square miles. The 1956 population was estimated to be about 16,000. On the basis of the 1950 Census, this is nearly equally distributed between urban and rural residents.

Lassen County is primarily mountainous, with valley areas located in Honey Lake Basin, Madeline Plains, and in Big Valley. Warm days and cool nights characterize the summers, while winters are often quite severe. Seasonal precipitation varies from approximately 10 inches near the Nevada State line to in excess of 50 inches in the mountains to the west. Local summer showers and thunderstorms are not infrequent, although most of the precipitation comes in the period from early fall to mid-spring with considerable amounts in the mountains occurring as snow.

Historically most of the activity in Lassen County centered in the Honey Lake Valley, as early settlers were attracted to the area as they passed through on their trek to California. Because of its remoteness from the state capitol, there was considerable agitation in 1856 to form a new state to be created out of parts of California and Nevada east of the 120th meridian. A few years later in 1863 when the boundary between California and Nevada was surveyed the people in Honey Lake Valley found themselves west of the 120th meridian and excluded from the proposed State of "Nataqua."

Agriculture. The low precipitation on the areas suitable for farming makes irrigation mandatory in most localities. The first notice of claim to water was made in 1854 by Isaac Roop, who diverted the waters of Piute Creek to irrigate his land. The years that followed saw many claims filed and ditches constructed for use of water out of the Susan River and tributaries to Honey Lake. The period was fraught with disagreements and litigation, some of which extend down to the present day. The subject of much of the controversy centers around waters of Eagle Lake. The existence of this large body of water, some 1,000 feet above the valley floor, held an attraction for many as a source of irrigation water. One of the earliest of these was C. A. Merrill, operator of a sawmill near Susanville, who saw potential wealth in the dry lands of the valley. Through Merrill's efforts in Washington D. C., Congress passed in 1875 the predecessor to the "Desert Land Act", providing for the sale of desert lands in Lassen County. Work commenced immediately on a tunnel through the hills between Eagle Lake and the valley, only to cease shortly due to financial difficulties.

Later attempts by other enterprisers met the same fate, until the early 1920's when promoters of the "Bly" irrigation project succeeded in partially completing the physical works and sold out to the Tule and Baxter Irrigation Districts, which bonded their lands to finance the purchase. Years of disappointment and failure that followed were caused by lack of water, alkali troubles, and slow development of land. Financial difficulties resulted in dissolution of the Baxter Creek Irrigation District, and bankruptcy for the Tule Irrigation District. The latter district is still in receivership.

The Lassen Irrigation Company, a mutual water company, provides water to irrigate 5,000 acres near Standish. The Big Valley Irrigation District, formed in 1925, has been inactive until recently. Most of the present irrigation water supply is developed by individual diversions. Distribution of the available water under adjudicated water rights is administered by State Watermaster Service.

From the beginning of the early settlement in Lassen County, the beef industry has been an important segment of the economy, with agriculture devoted almost entirely to the support of livestock. The availability of large tracts of public land for grazing has made livestock raising a generally profitable venture, coupled with the production of forage crops for winter feed. The County Agricultural Commissioner's report for 1955 shows that, of the total value of agricultural production of nearly $6,900,000, the value of livestock and wool was $3,600,000, and that most of the remainder was from hay and pasture. The area of irrigated land as determined during the period from 1954 through 1956 was 74,700 acres. The area of irrigated pasture, which is both grazed and cut for hay, was 60,900 acres, and the area of alfalfa was 7,800 acres. There was also about 5,800 acres of grain and grain hay.

Timber. The production of lumber is the leading industry of Lassen County. The vast stands of virgin timber were exploited in the early days but have continued to produce a substantial volume of forest products. Lassen County holds fifth place among the state's lumber producing counties. Approximately 28 per cent of the county land area, or 829,000 acres, are forest. Public ownership covers 452,000 acres of the commercial forest land, and 377,000 acres are in private ownership. Noncommercial forest land adds another 468,000 acres to the total forested area. In 1951 there were nine active sawmills in the county which produced 5.3 per cent of the state's harvest. The cut is predominantly ponderosa pine, but also includes Douglas fir and true firs, sugar pine and incense cedar. Out of a total volume of 257,156,000 board feet produced in 1951, 165,000,000 board feet were ponderosa pine. Although the present production exceeds the ultimate possible sustained yield, much of the stand is in old growth. Harvesting the mature and overripe trees will promote increased young growth and more productive forests.

Mining. Peter Lassen discovered gold in Honey Lake Valley in 1855. Indirect results of this led to the formation of the "State of Nataqua" in 1856 and the Sagebrush or Boundary Line War waged by settlers in the early 1860's. From a geological standpoint, the county is not favorably situated for the development of deep-seated mineral deposits such as those found in the Sierra Nevada. However, several small productive districts have been developed. Careful prospecting may reveal other mineralized areas of commercial value. A few uranium prospects appear promising.

As reported by the California State Division of Mines, the total value of mineral production in Lassen County during 1954 was $195,200. The value of sand and gravel was $95,000. Other minerals including granite, crushed stone, tungsten concentrates and volcanic cinders, were valued at $100,200.

Recreation. As many of the streams in Lassen County course through higher mountainous regions, they are fairly productive for trout fishing. These include Pine Creek, Susan River, Ash Creek, Red Rock Creek, and Cedar Creek.

The Pit River which flows through the northwestern corner of the county is a major stream that is now relatively undeveloped as a recreational resource. There is, however, limited fishing for bass, trout, and catfish.

Eagle Lake is an outstanding recreational resource of Lassen County although its current development is extremely limited. The biology of Eagle Lake has been the subject of much nationally published misinformation. However, it is true that many species of fish have beeen planted in the lake, but are, apparently, no longer there. Although large numbers of small native fish such as chub and dace thrive, the black bass which were introduced have disappeared. Why these predatory fish should not survive with such an abundant food supply is somewhat of an enigma. However, the answer more than likely lies in such prosaic reasons as unfavorable lake temperatures for spawning or unsuitable habitat for young bass. The California Department of Fish and Game definitely does not subscribe to the theory that a "sea monster" inhabits the depths of the lake.

The native Eagle Lake trout, *Salmo gairdneri aquilarum*, while of interest to ichthyologists, is considered a game fish and is just one more variety of rainbow trout among many. The reason for the small number of trout in the lake is that the suitable areas for trout spawning are extremely limited. Pine Creek, the only sizeable tributary to Eagle Lake, is not accessible during spawning season. In the lower reaches above the lake, Pine Creek at that time normally dwindles to a trickle which is lost in the fractured volcanic rock of the stream bed. Improvement of the stream channel, together with stabilization of the lake surface, could improve the biologic conditions for trout so that a sound management program would provide some excellent angling opportunity.

Two man-made reservoirs, valuable as recreational areas, are Mountain Meadows near Westwood, and Tule Lake near Madeline. The former is owned by the Pacific Gas and Electric Company and is a good rainbow trout lake. Tule Lake Reservoir is owned by the California Department of Fish and Game and is fairly productive of large trout. There are numerous small reservoirs throughout the county that support some trout and catfish.

Deer hunting is a very rewarding sport in much of the county. California mule deer and Rocky Mountain whitetail deer find natural habitat there. Goose and duck hunting are important in the eastern part of the county. There are several productive nesting areas, including Ash Meadows, Madeline Plains, and Honey Lake. The latter two areas are waterfowl management areas operated by the California Department of Fish and Game.

The mountains and forests abound with camping and picnicking sites. A portion of Lassen Volcanic National Park, the South Warner Wild Area, and all of Carbon Peak Wild Area are located in the county. Much of the area east of Lassen Park is suitable for recreation.

Modoc County

Modoc County was created by the Legislature in 1874 by division of Siskiyou County. The county occupies an area of about 4,300 square miles in the extreme northeastern corner of the state. The 1956 population was estimated to be about 9,300. About 70 per cent of the population is rural and 30 per cent is urban.

Modoc County is primarily mountainous, consisting of high volcanic plateaus, valleys, and mountain ranges. The terrain rises from an elevation of approximately 3,500 feet in the southwest corner of the county to the 9,906-foot summit of Eagle Peak, high in the Warner Mountains in the southeast. Summer daytime temperatures over most of the area are generally mild. Nights are generally cool. The winters are usually severe. Seasonal precipitation varies across the county from approximately 10 inches in the southeastern corner to approximately 50 inches in the west. Much of the precipitation falls in the form of snow, particularly on the mountains. The growing season varies somewhat throughout the county, depending chiefly on the elevation. The average growing season extends from about the middle of May to about the middle of October.

Much of the early history of Modoc County coincides with that of Siskiyou County of which it was a part. Originally, the area was occupied by numerous Indian tribes. The first known white men to enter this region were the fur trappers of the Hudson's Bay Company. These early explorers gave the Pit River its name from the numerous pits dug along the river by the Indians to trap wild game.

Although the discovery of gold in Siskiyou County to the west caused considerable activity there, the area to the east that was to become Modoc County escaped much of the excitement of the gold fever. Settlement of the area was slow to begin because of disputes taking place between the settlers and the Indian tribes. It was not until the close of the Modoc Indian Wars in 1873 that settlers in any number were induced to remain. Those who came in the 1870's were attracted by the abundant growth of grasses in the valleys of the Pit River in the vicinity of the present town of Likely, and in Big Valley.

Agriculture. The natural pastures and range land made the area ideal for cattle. The meadow grasses could be cut for hay and dry-farmed grains could be raised. Because of the ease with which water could be diverted from the streams, irrigation and water development commenced almost immediately. Most of the endeavors were by private individuals, although there was limited collective development. Numerous reservoirs were constructed to give regulation to the stream flow. The first public district to form in the county was Hot Spring Valley Irrigation District in 1919, followed in 1925 by Big Valley Irrigation District in Modoc and Lassen Counties. The latter district has been inactive until recently. Following the Pit River Investigation by the former State Division of Water Resources, the South Fork Irrigation District was formed in 1934. The largest use of irrigation water in Modoc County occurs along the Pit River and its tributaries where diversions by individual irrigators are made under adjudicated water rights administered by the State Watermaster Service.

The northwest corner of Modoc County extends into the Federal Klamath Reclamation Project area east of Tule Lake where reclamation and irrigation development was begun in 1904. This area, covering some 64,000 acres of irrigable land, is one of the important agricultural areas in the county. In 1952, the Tule Lake Irrigation District was organized in Modoc and Siskiyou Counties to assume the distribution of water from the Klamath Reclamation Project.

The land use survey made during 1955 and 1956 under this investigation shows that about 151,300 acres of land were irrigated. Some 80,700 acres were devoted to irrigated pasture. Irrigated grain and grain hay were produced on 34,100 acres, alfalfa on 27,800 acres and truck crops on 9,200 acres. The Modoc County Agricultural Commissioner reports that the value of agricultural crops and livestock produced during 1954 amounts to $9,300,000. The value of truck and field crops was about $4,940,000. This, however, represents cash crops from about 60,000 acres. The additional 90,000 acres were devoted to feeding and maintenance of livestock. The total cash value of livestock, wool, and dairy products was about $4,360,000.

Timber. The harvesting of the vast stands of timber has made lumber the second major industry in Modoc County. The Modoc National Forest alone encompasses 1,357,000 acres. Within the county, there are approximately 675,000 acres of commercial forest land of which 458,000 acres are publicly owned and 217,000 acres are privately owned. In addition to the above area, there are 622,000 acres of forest lands covered with juniper and other noncommercial vegetation. There were eight active sawmills in Modoc County in 1951 which produced 106,300,000 board feet of ponderosa pine, 24,200,000 board feet of true firs and about 600,000 board feet of incense cedar.

Mining. Modoc County contains a number of mineral resources including gold, silver, copper, and mercury, but commercial production of these has not been very successful. Since 1921 production of nonmetallic minerals has exceeded the value of the production of metals. Unusual nonmetallic minerals mined in Modoc County include optical grade iceland spar and high grade peat moss. Sand and gravel leads the nonmetallic minerals in value of production. Pumice for blocks and for aggregate is also important. The occurrence of variegated obsidian is of interest to rock collectors and lapidaries, but is of little commercial value. The search for uranium has recently brought prospectors to Modoc County

The California State Division of Mines reported that the total value of mineral production in Modoc County in 1954 was $445,800. This includes $310,700 for sand and gravel.

Recreation. The many perennial streams which are tributary to the Pit River below Alturas support sizable trout populations. The upper reaches of the South Fork of the Pit River likewise support a good trout fishery, as do New Pine and Bidwell Creeks in the Warner Mountains.

Goose Lake and its tributary streams provide limited trout fishing. Several of the artificial reservoirs throughout the county contain cold water and are suitable for trout.

Deer hunting is the most important big game sport, although antelope and bear are taken in considerable numbers in some years. The Devils Garden area in Modoc County provides winter range for one of the largest herds of Rocky Mountain mule deer in California.

Clear Lake Reservoir and Goose Lake are large bodies of water along the Pacific Migratory Waterfowl Flyway, and are important nesting and moulting areas for wildfowl, particularly geese. Goose hunting in these areas provides considerable sport, while duck hunting is somewhat secondary. Clear Lake Reservoir and part of Tule Lake sump are federal waterfowl refuges.

There are many timbered areas that provide excellent camping and vacation attractions. The Warner Mountains along the eastern boundary offer outstanding inducements to vacationers. Much of this area is primitive with limited access at the present time.

Plumas County

In 1854 the Legislature created Plumas County out of a portion of Butte County. The county derived its name from the Spanish designation for the Feather River, "El Rio de las Plumas", named by Captain Louis Arguello in 1820. Plumas County covers an area of about 2,630 square miles and contains a population of about 12,000, according to 1956 estimates. The 1950 Census shows the population as entirely rural but only 4 per cent is listed as rural farm.

Located at the contact between the Sierra granitics and the volcanics of the Cascades, Plumas County is an area of deep canyons, high mountains, and numerous valleys. Elevations range from approximately 1,000 feet in the depths of the Feather River Canyon to 8,377 feet at Mt. Ingalls Peak in the east-central section. Precipitation is extremely heavy in the western portion of the county, amounting to as much as 80 inches per season near Bucks Lake but is as little as 10 inches per season along the eastern boundary of the county in Sierra Valley. Much of the precipitation falls in the form of snow. The winters are quite cold, and the summers have warm days and cool nights. The growing season for frost tolerant crops in the valleys extends from early in May to late in September.

Development of Plumas County began following the gold discovery in the Gold Lake territory in 1850. Prior to this, emigrants following the Peter Lassen route passed through the northern area on their way to earlier discovered diggings. Later they entered the county by way of Sierra Valley through the pass to the east discovered by James Beckwourth. The first settlements were those of the gold seekers, but as the demand for food increased, due to the difficulty of obtaining provisions from the outside, early attempts were made at agricultural pursuits in the mountain valleys. Cereals were grown, and the production of dairy products reached some importance. Flour mills were constructed in American and Indian valleys.

Sawmills were constructed in the early 1850's to satisfy the demand for lumber used in the mines and flumes. Gold mining was the foundation of the county's economy, and, as hydraulic mining activities increased, many miles of ditches and several small dams were built to develop the necessary water. After the turn of the century mining activity began to wane.

Agriculture. Early settlers in the valleys of Plumas County were attracted to the favorable conditions for livestock raising. The abundant grass and the ease with which the streams could be diverted, provided the impetus for an agricultural activity which was to remain one of the important industries of the area. Agriculture was developed to its present level prior to World War I, and has remained fairly stable since then. There are no organized agencies serving irrigation water in significant amounts. However, water rights have been adjudicated by the courts for the mountain valleys, and distribution of the available supplies is administered by a State Department of Water Resources Watermaster. Limited water supplies prevent expansion of the irrigated area without additional development to conserve winter and early spring runoff.

The 1954 land use survey by the Department of Water Resources showed the total irrigated area in Plumas County to be almost 52,300 acres. This was predominantly pasture; 17,100 acres being improved pasture, and 31,900 acres being meadow pasture. Irrigated grain and grain hay were grown on 2,100 acres and alfalfa on 1,000 acres. The gross value of agricultural products was reported by the County Agricultural Commissioner to be about $2,300,000 for 1955. This was derived almost entirely from the sale of beef cattle and other livestock products.

Timber. The production of timber in Plumas County is the major industry of the area. From the beginning of the first sawmills of the 1850's, this great natural resource has been developed. Today, approximately three-fourths of the county area is still covered by the 1,228,000 acres of commercial forests. Of this total area, 911,000 acres are public forest land and 317,000 acres are privately owned. In timber production Plumas County ranked sixth in 1951 among the State's counties, producing five per cent of the total crop. There were 19 active sawmills in the county that year whose output in 1951 reached 243,800,000 board feet. The volume produced by species is shown in the following tabulation.

Species	*Volume, in thousand board feet*
Douglas fir	39,987
Ponderosa pine	59,539
True firs	100,899
Sugar pine	30,017
Incense cedar	13,345
Other softwoods	11
Total	343,798

Mining. The colorful history of the gold-rich Plumas County area began in 1850 when credulous prospectors spread throughout the area in search for a mythical lake with gold-pebbled shores. "Cities" sprang up almost overnight wherever prospectors

Yuba Consolidated Dredge
Mining Gold From
Gravel Deposits Near
Hammantan, Yuba County

State Division of Mines
Photograph

Haying in Plumas County

Department of Water Resources
Photograph

found rich diggings. Rich Bar, one such city, turned out to be one of the most spectacular discoveries of the gold rush. The claims there were so fantastically rich that they were limited to ten square feet. From two to three million dollars in gold were produced from Rich Bar during the first two years after its discovery. When legal action forced the cessation of hydraulic mining, drift mining was undertaken in the richer auriferous gravel deposits, and several famous quartz mines were opened. The peak value for gold production occurred prior to 1880. Although accurate records were not kept, the total value probably amounted to several million dollars. Currently, only a little placer mining and drift mining for gold are reported in Plumas County.

Copper mining flourished from 1915 to 1931 with subsequent spurts in production until 1945. With copper reserves in producing mines depleted, and with the removal of government premiums for strategic and critical metals production, the copper industry in Plumas County became defunct. Revival of the industry will probably depend upon the making of new major discoveries or future increases in the price of copper.

In the last few years production of barite, manganese, and chromite has been of some importance. During 1954, sand and gravel and crushed stone led the minerals in production value. As reported by the California State Division of Mines, the total value of mineral production in Plumas County during 1954 was $111,095. Over $100,000 of the total may be attributed to production of sand, gravel, and crushed stone.

Recreation. The many streams tributary to the Feather River provide good trout fishing. The North Fork of the Feather River is limited in productivity because of diversions for hydroelectric power development. The Middle Fork of the Feather River from Nelson Point downstream is an important trout stream, although it is not heavily fished at the present time because of limited accessibility.

Lake Almanor supports a large population of brown and rainbow trout and largemouth and smallmouth bass. Kokanee salmon have recently been planted experimentally in the lake. This artificial lake, owned by the Pacific Gas & Electric Company, is also popular for water sports and summer home sites.

Rocky Mountain mule deer and California mule deer are found in large numbers in Plumas County making big game hunting an important sport.

The heavily timbered mountains, scenic valleys, and spectacular stream-cut canyons are an attraction to vacationers. Many camping, hiking, and picnicking areas are to be found. A portion of Lassen Volcanic National Park is located in Plumas County.

The Johnsville area is receiving increased attention for winter sports use. The State Division of Beaches and Parks has plans for acquisition of approximately 6,000 acres for state park purposes, including the historic townsite of Johnsville and several picturesque lakes in the area.

Shasta County

Shasta County was one of the original 27 counties created by Act of the Legislature in 1850. At the time of its founding the County included an expanse nearly five times its present 3,850 square miles and was named for Mt. Shasta, 14,161 feet in elevation, then within its borders. The 1956 population was estimated to be about 46,000. The 1950 Census showed the population to be about 30 per cent urban and 70 per cent rural.

Located at the northern end of the Sacramento Valley, Shasta County contains the junction of several mountain ranges and three major tributaries of the Sacramento River. The Pit, McCloud, and Sacramento Rivers join in Shasta Lake to form the main stream of the Sacramento River which flows out of the county at an elevation of approximately 360 feet. The highest point is the 10,437-foot summit of Mt. Lassen in the southeast corner of the county. The topography away from the Sacramento Valley floor is formed by volcanic plateaus, rugged mountains, and deep stream-cut canyons. In the valley the climate is characterized by dry hot summers and mild winters. At the higher elevations cool summer and severe winter temperatures prevail. Seasonal precipitation varies from less than 18 inches at Hat Creek in the east-central part of the County to in excess of 80 inches near Castella in the northwest. The growing season in the Sacramento Valley near Anderson extends from late March into November, but around Fall River Mills does not begin until about the first of May and ends during October.

The first white men to visit the area now known as Shasta County, were the fur trappers of the Hudson's Bay Company. The last of these fur trappers, and the one to whom much subsequent history was due, was Pearson B. Reading, who acquired a land grant from the Mexican Government in 1844. Shortly after Marshall's discovery of gold on the American River, Reading discovered the yellow metal on Clear Creek and a rush of feverish gold seekers followed.

Mining operations to work the auriferous gravels required plentiful supplies of water, and many miles of ditches were constructed in the Clear Creek and Cottonwood Creek areas. As the easy diggings began to play out, operations changed to quartz mining. Hydraulic methods forced out the smaller operators, and the majority of the water conveyance systems fell into abandonment. One system that remained was that of the Dry Creek Tunnel and Fluming Company, whose property and water rights were acquired by the Happy Valley Irrigation Company in 1891. This system brought water from the North Fork of Cottonwood Creek and South Fork of Clear Creek to the upper terrace lands around Olinda.

Settlement in the Pit River Valley around Fall River Mills came later than other parts of Shasta County, as it was not touched by the gold rush fever. Pioneers attracted to the area by the abundance of water and fertile land found grain and potato raising to be profitable.

Agriculture. Shasta County affords good conditions for cattle raising with extensive area of foothill range land and valley areas for hay and irrigated pasture. The County Agricultural Commission's Crop Report in 1955 shows that out of a total agricultural crop value of nearly six million dollars, $4,500,000 were derived from the livestock industry. Field crops are predominantly grain and hay, and most of such crops are fed by the producer to his livestock. Orchard crops include apples, olives, and walnuts. Strawberry plants are a relatively new crop which have a high cash value. Soil and climate conditions enable the culture of a vigorous, disease-free plant which is sold to other areas where strawberries are raised.

The land use survey in 1954 through 1956 showed the present irrigated area to be about 62,000 acres. The predominant crops were pasture with 55,300 acres, alfalfa with 3,600 acres, and hay and grain with 1,200 acres. The remainder was in truck, field, and orchard crops.

In 1914, the formation of the Anderson-Cottonwood Irrigation District in Shasta and Tehama Counties marked the first such organization in the Sacramento Valley, other than those formed under the Wright Act between 1887 and 1891. This district of some 32,113 acres was organized in the head of the Sacramento Valley below Redding to divert water from the Sacramento River. Its early history of financing and construction was not without difficulty. However, improvement of conditions enabled it to achieve a sound financial status. The principal agencies now serving water to irrigated lands are shown in Table 6. There are many private diversions from streams in Shasta County made under adjudicated water rights administered by the State Watermaster Service.

TABLE 6

PRINCIPAL IRRIGATION WATER SERVICE AGENCIES IN SHASTA COUNTY

Name	Location	Irrigated area, in acres*
Commercial Water Companies		
Happy Valley	Olinda	5,000
Mutual Water Companies		
Bee Creek Ditch and Water Company	Ono	250
Excelsior Ditch	Oak Run	85
Gover and Wilcox Ditch	Anderson	150
Millville Ditch Company, Inc.	Millville	175
Townsend Flat Water Ditch Company	Redding	340
Verde Vale Water Company	Anderson	20
Cook-Butcher Ditch	Bella Vista	300
Irrigation Districts		
Anderson-Cottonwood	Anderson	19,320

* (Information for period from 1950 through 1954.)

Timber. Development of Shasta County's large timber resources began with the supplying of lumber for early day mining operations. Today the industry is the principal contributor to the economy of the county. Approximately one-half of the land area in the county, or about 1,263,000 acres, is covered with commercial forests. Public forest land accounts for 532,000 acres, and 731,000 acres are in private ownership. In addition to the commercial forest area, there are 930,000 acres of non-commercial forest land.

In 1951 there were 40 active sawmills in Shasta County producing 6.2 per cent of the State's crop, giving the County fourth place in timber output. The volume produced by species was as follows:

Species	*Volume in thousand board feet*
Douglas fir	75,210
Ponderosa pine	134,735
True firs	44,382
Sugar pine	26,929
Incense cedar	19,257
Other softwoods	631
Total	301,144

The Redding area has grown to be one of the major lumber manufacturing centers of California. It is situated at the head of the Sacramento Valley, with access to water, power, and rail transportation. The highway system reaches out from Redding into Trinity County to the west, Siskiyou County to the north, and Modoc and Lassen Counties to the east, all timber producing counties. In addition to lumber, plywood and fiber board are manufactured there. The total value of the timber production in Shasta County in 1954 was over 14 million dollars, more than twice that from agriculture.

Mining. The mining industry in Shasta County began with the discovery of gold on Clear Creek in 1848. Gold production was curtailed by the "Camanetti Act" which limited hydraulic mining to that protected by debris storage, but has been continuous on a modest scale to the present. The highest peak production was recorded in 1937, but the 1909 peak was almost as high. Current production is down because of the relatively low price of gold.

The total accumulated value of copper production exceeds that of gold. More than $110,000,000 worth of copper has been produced in Shasta County. The copper mining and smelting industry thrived from 1896 until the end of World War I. A big smelter was operated at Keswick until 1907. Other smelters were built near the Afterthought, Balaklala, Bully Hill, and Mammoth Mines. The maximum amount of copper produced in one year was 58,665,447 pounds in 1909.

The maximum annual value of copper production amounted to $9,701,500. An increase in the zinc content of the copper ores, together with increasing costs of operation, lower prices of copper and silver, and law suits resulting from smoke damage, combined to make copper smelting unprofitable in the Shasta Copper Belt. All of the smelters were idle by 1919, and some of the largest mines were shut down. Much of the post World War I production of copper came from the Iron Mountain deposit, but reserves there were reported depleted in 1947.

From 1896 until the end of World War I, Shasta County led the state in total value of mineral production exclusive of petroleum. Several industries were active during that period as a result of the prosperity produced by the high copper and gold production. Of these industries, the following failed to survive the post World War I depression: brick, chromite, lime, and mineral water. Limestone production lasted only a little longer. Chromite mining was later revived under stimulus from the economic demands of World War II. The limestone in Shasta County occurs abundantly and is of good quality. Early production provided flux for local smelters, lime for agricultural and other local uses, and dimension and miscellaneous stone. In the future, the abundant limestone and shale deposits, plus the gypsum and coal which can also be produced in Shasta County, could provide the raw materials for a future cement manufacturing industry.

Pyrite has been produced in Shasta County almost continuously since 1902. For many years California has been one of the four principal pyrite producing states. Most of California's production of pyrite comes from the Hornet Mine in Shasta County. The principal use of the pyrite is in the production of sulphuric acid. The Hornet Mine was originally developed near the turn of the century to produce sulphuric acid for the manufacture of superphosphate fertilizer. However, the increasing production of petroleum, with its requirement of large quantities of sulphuric acid during refining, developed a market for the high-grade pyrite that eventually far exceeded the expected demand of the fertilizer business.

Large deposits of diatomite, iron ore, and lignite, occur in Shasta County. These can provide raw material for future industries, but past development and production has been negligible.

As reported by the California State Division of Mines, the total value of the 1954 mineral production in Shasta County was $1,580,233, of which $583,000 was credited to sand and gravel production, and the remainder to "other minerals" including chromite, copper, gold, iron ore, pyrites, silver, stone and volcanic cinders.

Recreation. Shasta County is bountifully endowed with recreational resources and is visited by thousands of vacationers traveling through northern California.

Among the most important aspects of these resources are the mountain streams. Some of these include Hat, Burney and Squaw Creeks, and Fall and Rising Rivers. McCloud and upper Sacramento Rivers are larger streams that are also good trout fishing streams. McCloud River traverses private lands most of its length, and its development has been limited to private sportsmen's clubs. Fall River and Rising River are also excellent fishing streams. However, there is practically no access available to the public because they course through private lands.

Shasta Reservoir is an outstanding example of a multipurpose water development project from which recreational benefits are derived. Surface water sports and fishing have grown in importance. Warmwater and coldwater fish both thrive in the lake, which provides different habitats. Kokanee salmon and king salmon have been planted, as well as a variety of rainbow trout known as "Kamloops". Releases from Shasta Reservoir have made the Sacramento River below Keswick Dam a prime fishery for king salmon. Operation of Shasta and Keswick Reservoirs maintains adequate flows of water with temperatures at the optimum for these anadromous fish. The numbers of salmon and steelhead in the river are greater now than before the dams were built, due to improved natural spawning conditions and to hatchery propagation.

Deer hunting is an important big game sport in the county, and waterfowl and upland game birds provide some hunting.

Shasta County contains many areas that are suitable for camping, hiking, and picnicking. Lassen Volcanic National Park is mostly within the county and is known worldwide for unique scenic, geologic, and natural history features. Besides a number of United States Forest Service campgrounds in the county, the State Division of Beaches and Parks maintains Castle Crags, Shasta and McArthur-Burney Falls Memorial State Parks.

Sierra County

Sierra County was a part of Yuba County until its creation by the Legislature in 1852. The 1956 population was estimated to be 2,400, the smallest within the northeastern counties. The 1950 population was shown as all rural. The county lies in the Sierra Nevada and its area of 950 square miles is entirely mountainous, except for the part of Sierra Valley within its borders. It is an area of rugged mountains and deep stream cut canyons. The terrain rises from approximately 1,800 feet on the west to over 8,600 feet on the crest of the Sierra Nevada. Sierra Valley in the northeast lies at an elevation of approximately 5,000 feet. The summers throughout the county are cool, while the winters are severe. Seasonal precipitation ranges from about 10 inches in Sierra Valley to in excess of 70 inches on the west slope of the Sierra Nevada. Much of the precipitation falls in the form of snow. The growing season for frost tolerant crops extends from early May to late in September.

It is not known who the first white men were to explore the wilderness of Sierra County, but the lure of gold beckoned early prospectors. Under the leadership of Major William Downie an expedition up the Yuba River in 1849 established a settlement and discovered gold. The gold rush was on, and thousands made their way up river into the rugged interior. Fabulous wealth was extracted from the placer diggings which in turn gave way to quartz mining. Before the turn of the century there were over 200 miles of ditches conveying water to the mines and stamp mills.

Agriculture. Agricultural pursuits, principally in Sierra Valley, have provided a source of wealth for Sierra County. The availability of public lands for grazing, and the climatic limitation to forage crops, have made the production of livestock the major activity. The land use survey made under this investigation in 1955 and 1956 showed an irrigated area in Sierra County of about 21,600 acres. This included 20,700 acres of improved and meadow pasture. The remaining area was devoted to alfalfa and grain hay.

The County Agricultural Commissioner's report for 1955 shows the gross value of agricultural products for that year to be about $731,000. This is almost entirely from the sale of livestock and associated products.

Timber. At present the major factor of the county's economy is the production of timber. Commercial forests cover approximately 393,000 acres, or 64 per cent of the area. As reported by the California Forest and Range Experiment Station, 301,000 acres are public forest land and 92,000 acres are private forest land. In addition to the above area, there are approximately 122,000 acres of noncommercial forest land. In 1951 there were 11 active sawmills in the county producing 1.4 per cent of the State's timber crop. The production during that year comprised 66,600,000 board feet, including about 39,900,000 board feet of ponderosa pine, 17,600,000 board feet of true fir, and 3,300,000 board feet of Douglas fir. The remainder was in sugar pine and other soft woods.

Mining. The settlement of Sierra County began in 1849 as a result of the gold rush. But, unlike most other areas in California affected by the gold rush, gold production has remained continuous and relatively constant in value. Several of the towns established by the gold miners in the early 1850's are still occupied. The first gold production came from rich placers along the Yuba River and its tributaries. Drift mining of gold quartz veins and of ancient buried river channels was begun in the 1850's and '60's, even before many of the rich placers were worked out. A few of the oldest drift mines are still in operation. Of the producing gold mines in 1952, eight were lode mines and eight were placer. In that year the lode mines produced 12,534 ounces of gold against 231 ounces for the placer diggings. Some silver is obtained with the recovery of gold.

Chromite was produced during World War I, but the high cost of hauling has precluded much development. Significant development of the copper, iron, soapstone, limestone, marble, and zinc deposits in the county is prevented by this same handicap. Uranium discoveries have been reported near Sierra Valley but no production has been recorded.

As reported by the California State Division of Mines, the total value of mineral production in Sierra County during 1954 was $568,097. Gold production accounted for $468,400 of the 1954 total. Peak production of gold was reached in 1886, when nearly two million dollars worth was produced.

Recreation. The major recreational attraction of Sierra County is the variety and abundance of mountain streams and lakes. The major streams are the Middle and North Yuba Rivers which support large fish populations. The latter is heavily planted with catchable trout and is considered one of the major trout streams in the State. The Little Truckee River in the Lahontan Drainage Basin, and a portion of which is situated in Sierra County, is also a good trout stream.

There are several small lakes in the Lakes Basin area which afford good trout fishing. Weber Lake and Independence Lake are also heavily fished.

Deer hunting is important throughout the short season. A part of the inter-state Washoe-Lassen herd migrates through the eastern end of the county.

There is some waterfowl hunting in Sierra Valley and minor shooting of quail and pheasant.

The rugged timber-covered mountains of Sierra County make them an attractive vacationland, although they have been exploited only to a limited degree because of lack of accessibility. The Lake Basin area could support considerably more resorts than at present. The United States Forest Service maintains a number of public camp and picnic grounds in the county.

One of the recreational attractions of Sierra County is the presence of former gold mining towns along State Highway 49. Among the picturesque remains of the gold rush days can be found a rich history of the Mother Lode.

Siskiyou County

Siskiyou County is the center county of the three forming the northernmost tier of the State. It was originally part of Shasta County, out of which it was created by the Legislature in 1852. The county area was reduced in size to its present 6,340 square miles when Modoc County was formed in 1874. The 1956 population was estimated to be about 31,500. According to the 1950 Census about 20 per cent of the population is urban and 80 per cent is rural.

The terrain is one of rugged mountains and deep stream-cut canyons in the west, with large valleys and volcanic plateaus in the central and eastern portion. Elevations range from approximately 500 feet in the canyon of the Klamath River, where it leaves the county in the west, to the 14,161-foot summit of Mt. Shasta in the south-central part of the county. Warm days and cool nights are typical in the lower valleys in the summer, with cooler days and nights on the higher plateaus. Winters range from moderate to severe with increase in elevation. Seasonal precipitation varies from in excess of 110 inches on the western mountain slopes to less than 15 inches in the county's eastern extremity. The growing season, depending on elevation, varies from 140 to 200 days.

The first known white men to enter the area were trappers from the Hudson's Bay Company. In 1827, Alexander McLeod conducted a party through the area on its way from Oregon to the head of the Sacramento Valley. It was not until Major Pearson B. Reading's discovery of gold on Clear Creek in Shasta County in 1848, however, that attention was called to the Siskiyou County area. Immigrants from Oregon stopped enroute to the California gold fields to prospect the northern streams. The resulting discoveries brought thousands of seekers into the Scott Valley and Yreka diggings. As elsewhere in California, the easy placer methods gave way to larger scale quartz mining and hydraulicking, and the small operators turned to other pursuits.

Early in the 1850's land grants were taken up in Scott and Shasta Valleys, and the raising of hay and cattle followed. Grist mills were constructed to mill the grains produced. As in other gold fields, sawmills were built to furnish the timber for the mines; the timber industry eventually surpassing mining in economic importance.

Agriculture. The ease with which streams in the valley floor could be diverted over the adjacent natural pasture land brought early irrigation to the valleys. The developments were first made by individual ranchers with some cooperative efforts. Later the need for organized districts became apparent. The first such public district formed in the county was the Scott Valley Irrigation District in 1917. The period 1920-1927 saw three irrigation districts formed in Shasta Valley and one in Butte Valley .

Reclamation of lands in the Lower Klamath Lake and Tule Lake areas has played an important part in the economy of the county's development. The Klamath Project was authorized by the Secretary of the Interior in 1905 as a flood control and irrigation project for lands in Oregon and California. Leasing of reclaimed lands, and later homesteading, has developed the area until it was considered desirable to organize an irrigation district. In 1952, the Tulelake Irrigation District was formed in Siskiyou and Modoc Counties to enter into contractual agreement with the United States for a water supply and project repayment for development of Lost and Klamath Rivers. The principal agencies serving irrigation water are listed in Table 7.

TABLE 7

PRINCIPAL IRRIGATION WATER SERVICE AGENCIES IN SISKIYOU COUNTY

Name	Location	Irrigated area, in acres*
Mutual Water Companies		
Farmers Ditch Company	Etna	500
Forks of Salmon Water Supply	Forks of Salmon	50
Klamath River Cooperative Ditch	Klamath River	325
Shasta River Water Users Association	Montague	3,895
Irrigation Districts		
Big Springs	Grenada	2,100
Butte Valley	Mt. Hebron	3,647
Grenada	Grenada	1,394
Montague Water Conservation District	Montague	3,950
Scott Valley	Fort Jones	3,650
Tule Lake	Tule Lake	See Modoc County
United States Bureau of Reclamation		
Klamath Project	Tule Lake	79,350

* (Information for period from 1950 through 1954.)

Much of the irrigated land in Siskiyou County receives water diverted from unregulated streams. In Shasta Valley where water rights have been adjudicated by the courts, distribution of available water is administered by the State Watermaster Service.

Early in its history the valley agricultural areas of Siskiyou County produced a variety of truck, field, and orchard crops to meet the demand of local markets. However, the natural characteristics of the area made it most suitable for livestock. After the establishment of effective transportation and local markets were able to be supplied from outside sources, most of the agriculture was devoted to livestock. The irrigated valley areas primarily produced pasture, alfalfa, grass, and grain hay. The largest livestock areas are in Scott and Shasta Valleys, where there are large areas of irrigated pasture and hay lands on the valley floors and extensive areas of range land surrounding the valleys. In Butte Valley and the Tulelake areas livestock is supplemented by specialty crops including potatoes, barley, and seed crops.

The irrigated area within Siskiyou County as determined in the land use survey made in 1955 and 1956 was about 136,200 acres. This included about 74,000 acres of irrigated pasture, 35,500 acres of irrigated grain, 20,200 acres of alfalfa, and 6,500 acres of truck crops.

Timber. As previously stated, timber was developed to meet the mining needs, but has since surpassed mining in importance to become the major industry of Siskiyou County. Approximately 58 per cent of the land area of the county is covered with commercial forests. Of the total 2,323,000 acres of commercial forest, 1,605,000 acres are publicly owned and 718,000 acres are privately owned. In addition to the commercial forest area, there are approximately 1,047,000 acres of non-commercial forest land, including land withdrawn from timber utilization by statute or administrative order, or because of adverse site accessibility. In 1951 there were 30 active sawmills in the county. These mills produced 374,172,000 board feet or 7.7 per cent of the total cut in the State, ranking Siskiyou County third in production. The volumes of the various species include 173,237,000 board feet of ponderosa pine, 96,569,000 board feet of true firs, 73,303,000 board feet of Douglas fir, 27,899 board feet of sugar pine, and 3,164,000 board feet of incense cedar.

Forest products shipped from Siskiyou County include finished lumber, rough lumber for remanufacturing elsewhere, sawlogs, veneer, and box shook.

Mining. Mute evidence of the extent of early gold mining operations in the 1850's is provided by vast piles of rock and debris which fill many of the canyons and gullies in Siskiyou County. Only a few reliable, but many legendary, records are available of gold production prior to 1880 when the program of keeping accurate comprehensive mineral production records was initiated. The peak in recorded gold production in Siskiyou County occurred in 1941. Economic factors and government restrictions forced many of the gold mines to shut down during World War II. Few have been reopened.

Silver in Siskiyou County is seldom produced for this metal alone, but rather is a by-product of gold and copper mining.

Only a little chromite was produced during World War I, and production ceased until World War II. Chromite mining has continued during recent years. Copper production was initially recorded during World War I, and has been rather sporadic since that time, reaching a peak during World War II. Most of the copper produced in Siskiyou County came from one mine. The ore body in that mine is now considered to be exhausted.

Limestone production has been recorded from time to time from large deposits favorably located near transportation. The limestone is processed and sold as agricultural limestone, road material, and for use in sugar refining. Pumice found in the extensive volcanic regions is cut into ''grill'' blocks, or is pulverized for lightweight aggregate.

As reported by the California State Division of Mines, the total value of mineral production in Siskiyou County during 1954 was $1,355,000. Gold production was valued at $489,000, followed by chromite ore and concentrate valued at $345,000. Commercial stone products, including sand, gravel, crushed stone, pumice, and volcanic cinders, reached a value of nearly $600,000.

Recreation. Siskiyou County is an area of outstanding recreational resources. Throughout the Klamath, Siskiyou, and Cascade Mountains, there are many excellent trout streams. These include the headwaters of the Sacramento, Klamath, and Rogue Rivers.

Streams and lakes in the rugged Marble Mountains are good trout fisheries, although access is only by horseback or by foot. The entire systems of the Salmon, Scott, and Shasta Rivers lie within Siskiyou County, and are important spawning streams for salmon and steelhead. The Klamath River supports a sizable trout population.

Medicine Lake in the eastern part of the county supports trout fishing, as does Lake Dwinnell, an artificial reservoir on the Shasta River. There are numerous small lakes high in the mountains west of the Sacramento River that are excellent trout fisheries, although there is limited accessibility.

Deer hunting is an important sport in Siskiyou County and large numbers are bagged. The eastern part of the county is inhabited by the Rocky Mountain mule deer, while most of the deer in the western portion are black tail deer. Bear are hunted to some extent and mountain lion, coyote, and bobcats, are hunted for bounty.

The United States Fish and Wildlife Service maintains wildlife refuges at Tule and Lower Klamath Lakes, where wetlands, food, and safety attract vast hordes of ducks and geese. The combination of lakes, swamps, and grassy meadows, provide resting and nesting places for the several million migrant birds. Approximately 20,000 acres are open to public shooting on these areas.

Upland game bagged in important numbers include quail, dove, and pheasant. Vacationers in great numbers are attracted to Siskiyou County by the abundant camping areas throughout the national forests. The Marble Mountain Wilderness Area, between the Salmon, Scott, and Klamath Rivers, provides a challenge to the more rugged outdoorsman. The United States National Park Service maintains the Lava Beds National Monument on the Siskiyou-Modoc County line.

Sutter County

Sutter County was one of the original 27 counties established by the Legislature in 1850, and at its creation contained areas which were later joined to Placer and Colusa Counties. Sutter County is now one of the smallest counties in the State containing some 610 square miles of land area. Its 1956 population was estimated to be 29,000. On the basis of the 1950

Census, the distribution would be 30 per cent urban and 70 per cent rural.

Except for the Sutter Buttes, which thrust themselves out of the valley floor to an elevation of 2,132 feet, the terrain is uniformly level and lies at an average elevation of less than 100 feet. The major portion of the county lies on the alluvial plain between the Sacramento and Feather Rivers. Located in the Sacramento Valley, Sutter County's climate is typified by hot, dry summers and mild winters. Rainfall over most of the area averages about 18 inches per season. There is no commerical forest area within the county.

The first white men to visit the area now known as Sutter County were probably Spanish explorers in the early 1800's, who were seeking sites to establish missions. It was Captain Sutter, however, who founded much of the early development after 1850. Sutter's farm on the banks of the Feather River was named after the Hock Indians who were the earlier inhabitants of the area. The rich soil produced good crops of grain and hay, with many vegetables grown along the stream bottoms.

Floods along the Feather and Sacramento Rivers made the construction of levees an expensive necessity following the early settlement. Reclamation commenced subsequent to the creation of the State Board of Swampland Commissioners in 1861. Works constructed by the original districts provided only minor protection from normal overflow of the streams, and it was not until after 1878 that major protective works were constructed following the organization of Reclamation Districts Nos. 1 and 9. Reclamation and land settlement followed the formation of subsequent reclamation districts. Flood waters have continued, however, to plague the residents of Sutter County to the present day. The devastating floods of December 1955, wrought the greatest havoc to the works of man in the area to date.

Agriculture. With the advent of the mechanical pumping plant, dry farming and subirrigation methods gave way to the more productive irrigation practices. The rivers bounding the area provided a dependable supply of water, and several mutual water companies as well as public districts were formed to exploit this resource. Many pits were dug and pumps installed to utilize underground water in the area. The development of the deep well turbine has caused the rapid expansion of ground water pumping.

Agriculture is the basic economy of Sutter County, placing this area among the leaders of California's agricultural counties. While Sutter County contains extensive orchards, and is known as the "Peachbowl of the World," the recent emphasis has been on better paying field crops, particularly beans and rice. The wide variety of crops produced in the county are listed in the County Agricultural Commissioner's report for 1955.

The leading orchard crops are peaches, prunes, almonds, and walnuts, with smaller acreages in apples, cherries, nectarines, olives, and pears, as well as vineyards. Truck crops include melons, squash, sugar beets, and tomatoes. Field crops include beans, rice, alfalfa, corn, safflower, and small grains. Seed crops are grown for a number of field and vegetable crops. The farm value of all agricultural produce in 1955 as reported by the agricultural commissioner is tabulated as follows:

Apiary	$151,559
Field crops	17,907,348
Horticultural crops	14,664,525
Livestock	3,412,900
Nursery stock	202,947
Poultry	1,671,094
Seed crops	1,237,902
Truck crops	3,721,915
Total	$42,970,190

Mining. Sutter County has never been noted for mineral wealth. The cumulative value of recorded output from 1908 through 1954 is only $2,424,113.

As reported by the California State Division of Mines, the minerals produced in Sutter County during 1954 were clay, natural gas, and sand and gravel. The one gas field in the county contains 880 proved acres from which 950,495,000 cubic feet of gas were produced during 1954. This was the peak in gas production. Sand and gravel production reached a peak during 1949 when the value was $258,197.

Recreation. Most of Sutter County lies as a wedge between the Sacramento and Feather Rivers adjacent to many miles of good fishing waters. Salmon, steelhead, shad, and sturgeon, are caught along their reaches, although public access to the rivers is extremely limited. Boating and water skiing are popular sports, although subject to the same access limitations.

Waterfowl and upland game bird hunting are very important recreational pursuits in Sutter County. There are two commercial duck clubs, and 18 commercial game bird clubs in the county, as well as several private clubs offering hunting areas to sportsmen.

The State Department of Fish and Game maintains the Sutter Waterfowl Management Area to reduce crop depredation by ducks, and the area is open to the public for controlled shooting.

Tehama County

Tehama County was created in 1856 by Act of Legislature which combined portions of Butte, Colusa, and Shasta Counties. It was named for an Indian tribe that inhabited the vicinity. There are 2,840 square miles within the county boundaries. The 1956 population was estimated to be about 20,700. The 1950 distribution was 40 percent urban and 60 percent rural.

The county extends from the crest of the Coast Range on the west across the floor of the Sacramento

Boat Docking Facilities on Shasta Lake

United States Bureau of Reclamation Photograph

Navigation on the Sacramento River

Sacramento Bee Photograph

Valley and well up the slope of the Sierra Nevada. The elevation on the valley floor is approximately 250 feet, while the highest point in elevation in the Coast Range is the 8,083-foot peak of South Yolla Bolly Mountain. Hot, dry summers and cool winters typify the valley floor portion of the county, while summer temperatures are much cooler at the higher elevations with winter temperatures quite severe. Precipitation varies from about 19 inches per season in the valley to 60 inches seasonally in the mountains to the east. Much of the precipitation falls in the form of snow at the higher elevations in the Sierra Nevada.

The first white men to enter the area, which later became Tehama County, were probably Spanish explorers traveling up the Sacramento River. However, except for occasional fur trappers who visited there, it was not until after 1843, and the explorations of Peter Lassen and General John Bidwell, that settlers were enticed to the area.

These early settlers, who were attracted by the abundance of game and luxuriant growth of grasses, came soon after Peter Lassen's acquisition of a Mexican land grant of over 22,000 acres. Their first agricultural pursuits were the raising of grain. The discovery of gold in neighboring counties had a substantial effect on Tehama County's population growth. Many of its people departed for the gold fields. As the easy digging began to wane, many miners returned to former activities and settlement again expanded. Sawmills and flour mills were constructed to process the raw materials produced in the county. The Lassen Ranch with other properties were later acquired by the Leland Stanford interests who developed the world famous Stanford Vina Ranch. There were 7,000 acres of grapes planted on this ranch, and it was the world's largest vineyard at that time.

Agriculture. The early grain farming showed that irrigation was needed for reliable crop production. The first irrigation consisted of diversions of unregulated flows from the streams requiring a minimum of development works. The development in the vicinity of Vina took advantage of the spring-fed flows of Mill and Deer Creeks. The first organized district was the Anderson-Cottonwood Irrigation District in 1914, with the majority of the acreage served being in Shasta County. Diversion was made from the Sacramento River at Redding, and the water was brought south into Tehama County by canal and siphon. The principal agencies serving irrigation water are listed in Table 8.

TABLE 8

PRINCIPAL IRRIGATION WATER SERVICE AGENCIES IN TEHAMA COUNTY

Name	Location	Irrigated area, in acres*
Mutual Water Companies		
Bend Water Users	Bend	360
Coneland Water Company	Los Molinos	350
Corning Irrigation Company	Corning	1,000
Los Molinos Mutual Water Company	Los Molinos	18,000
Stanford Vina Ranch Irrigation Company	Vina	5,412
Irrigation Districts		
Anderson-Cottonwood	Anderson	See Shasta County
Deer Creek	Corning	1,890
El Camino	Tehama	4,500

* (Information for period from 1950 through 1954.)

Agriculture is the leading industry in Tehama County, and livestock raising is the major segment of this agricultural economy. The climate, good soil, and a plentiful water supply, have combined to make the production of a wide variety of crops a profitable enterprise. The County Agricultural Commissioner's report shows that the value of agricultural production during 1955 amounted to nearly $16,300,000. The value of all agricultural products in 1955, as reported by the agricultural commissioner, is tabulated below:

Fruit and nut crops	$3,716,100
Truck crops	125,700
Field crops	3,159,800
Seed and nursery stock	1,463,900
Apiary products	72,100
Livestock and wool	6,548,000
Poultry	1,203,700
Total	$16,289,300

Fruit and nut crops include mostly olives, almonds, walnuts, prunes, peaches, apricots, and vineyards. Field crops include grain, alfalfa, corn, milo, safflower, and sugar beets.

The land use survey made in Tehama County in 1955 and 1956 under this investigation showed the total irrigated area to be 64,700 acres. This included 40,200 acres of pasture, 7,600 acres of deciduous orchard, 4,800 acres of sub-tropical orchard, 6,500 acres of alfalfa, 1,100 acres of grain, 1,500 acres of truck, and 3,100 acres of field crops.

Timber. The production of lumber in Tehama County also constitutes an important segment of the county's economy. Substantial precipitation in the mountains in the eastern and western extremities of the County is conducive to the growth of timber. Approximately 23 per cent of the area is in commercial forest land. Of the total of 436,000 acres, 206,000 acres are publicly owned and 230,000 acres are privately owned. In addition to the above, there are 942,000 acres of foothills and other lands with noncommercial forest cover.

In 1951, seven active sawmills in the county produced 60,527,000 board feet or about 1.2 per cent of the state's total timber crop. Nearly one-half of the cut was ponderosa pine and most of the remainder was Douglas fir and true firs. Some sugar pine and incense cedar were also cut.

Mining. The mineral industry in Tehama County has been of minor significance. A little gold was produced during the gold rush, but subsequent production has been small. Chromite production has been sporadic with peaks in 1895, 1918, 1944, and 1953. The annual value of sand and gravel production has been over $10,000 since 1931, but has exceeded $50,000 only a few times including the current production peak. Until the last half of 1954, the natural gas production in Tehama County has been negligible. The California State Division of Oil and Gas reported production of 507,154,000 cubic feet of natural gas from the two gas fields in the county during the period July-December, 1954. The proved acreage included in the two fields is 740 acres.

As reported by the California State Division of Mines, the total value of mineral production in Tehama County during 1954 was $505,889. The included value of sand and gravel was about $325,000 while chromite was valued at $72,000.

Recreation. Tehama County offers a variety of recreational activities. Among these is trout fishing in many of the mountain streams, the most important of which are Battle, Mill, and Deer Creeks, in the east, and the upper reaches of Cottonwood and Thomes Creeks in western Tehama County. The eastern Sierra Nevada streams spring from the volcanic formations and have substantial summer flows which make them particularly desirable for trout fishing.

The Sacramento River, which flows through the middle of the county, provides a great recreational resource in the form of salmon and steelhead angling. Many of the tributary streams along this reach of the river are used for spawning areas by these anadromous fishes.

Deer hunting is a major sport in the county, which ranks near the top in the state for the number bagged. A herd of deer which summers near Westwood, Lassen County, migrates into Tehama County, and winters in part of the Tehama Deer Winter Range maintained by the State Department of Fish and Game. Some black bear are also hunted in the higher Coast Range.

Goose hunting is a rewarding late season sport in the valley, and large numbers of pheasants and quail are bagged each year. Dove and bandtailed pigeon are also hunted.

A portion of Lassen Volcanic National Park is in Tehama County. This world-famous park attracts throngs of vacationists, and the surrounding area is attractive for camping. One of the major winter sports resorts in northern California is located at Mineral, near the southern entrance of the park.

Trinity County

Trinity County was one of the original 27 counties created by the Legislature in 1850, but then included parts of what are now Del Norte and Humboldt Counties. The present area is 3,200 square miles. The 1956 population was estimated to be about 6,900. Based on the 1950 Census, the population is entirely rural. The county was named for the Trinity River which was mistakenly believed to flow into the ocean at Trinity Bay near Trinidad.

Trinity County is a land of rugged mountains, deep canyons, and fast flowing streams. Elevations in the county range from less than 500 feet in the lower valleys to the peak of Mt. Eddy at an elevation of 9,038 feet in the northeast corner of the county. In the valleys, summer climate is warm and the winters are mild. The higher elevations are characterized by lower summer temperatures and more severe winters. Seasonal precipitation varies from approximately 32 inches in Hayfork Valley to in excess of 70 inches, much of the latter occurring in the form of snow. Growing season in the valleys generally extends from April into October.

Except for the occasional white fur trapper or explorer, Indians were the only inhabitants of the Trinity area until after the discovery of gold by P. B. Reading. In 1848 Reading made his first discovery on Clear Creek in Shasta County, and then pushed over the mountains to prospect the gravels along the river he named the Trinity. The lure of quick riches attracted hordes of miners into the canyons as it was doing elsewhere in California. As the easy diggings played out, many left the area and the small operations were replaced by hydraulic mining and dredging methods.

Agriculture. Stream-fed valleys nestling between mountain ridges attracted permanent settlers in the early 1850's near Hyampon and Hayfork. Some fruit growing was started in the Salyer and Hawkins Bar areas, but cattle raising became the dominant agricultural activity. Extensive agricultural development in Trinity County is limited by the small amount of valley farm land.

The land use survey made in 1955 and 1956 under this investigation showed the total irrigated area to be 3,470 acres. This included 3,300 acres of pasture, 150 acres of alfalfa, and 20 acres of grain.

Timber. The vast timber resources of Trinity County have made lumbering the major industry, surpassing mineral production in importance. Although access to much of this timber is a problem, most of the stand is old growth and ripe for harvesting. Approximately two-thirds of the county, about 1,357,000 acres, is commercial forest land. About 1,002,000 acres are publicly owned and 355,000 acres are privately owned. In addition to these there are approximately 602,000 acres of noncommercial forest land.

In 1951, there were 32 active sawmills in the county. In that year the timber production reached 172,887,000 board feet, giving Trinity County eighth rank in the State. Much of Trinity County's production is in the form of sawlogs which are transported to Shasta and Tehama Counties to be milled. About 65 per cent of the cut is Douglas fir, while the other leading species are ponderosa pine and sugar pine.

Mining. Following discovery of gold in Trinity County in 1848, gold seekers began to converge on the relatively inaccessible area. By the end of 1852, most of the gold-bearing sections of the county had been prospected, and there were claimants on every bar along the Trinity River from Salyer to Carville. The best of the small-scale placer deposits were considered worked out by 1853. Many streams were diverted to provide water for the hydraulic mining of large, ancient, placer deposits. The LaGrange Mine was opened in 1851 to produce gold from one such deposit. The supply of water from nearby streams eventually proved inadequate. Nearly 30 miles of ditch, flume, and tunnel were constructed in 1895 to bring water from Stuart Fork to the mine near Junction City. The mine was worked until 1918, and produced an estimated total of over $8,000,000 in gold. The unworked areas of the deposit are even larger than those already mined.

The value of the gold produced during the early years of the gold rush may be several times as high as the reported peaks, but records of this fantastically rich period were not kept. Two peaks in recorded annual production should be noted; one, a high of over $1,400,000 occurred in 1892; the second and highest peak occurred in 1940. Adverse economic factors, government restrictions, and a labor shortage during World War II, resulted in a reduction in the annual gold output to the all time low for the county of $19,250 in 1944. Gold production has risen since the war, but is still relatively low.

Mercury has been second to gold in total value of produced metal. Over 1,000 flasks had been produced before 1875 from shallow deposits. Production has been intermittent with peaks recorded in 1875 and 1898, and with no production recorded during the 1880's and 1920's. Other production peaks probably occurred during each World War. The recorded cumulative value of mercury production to 1913 was $1,293,099. The exact production figures for mercury have not been made available, but the cumulative production has been estimated to be over 32,000 flasks. Of this total, over 30,000 flasks are said to have come from one mine, the Altoona. Mercury production ended in 1946.

Sizable deposits of many useful minerals, including several strategic and critical minerals, are found in Trinity County. Little production has been recorded for many of these deposits, because of the long haul distance to railroads and the longer distance to markets. Production, usually minor but occasionally substantial, has been recorded for ores of the following strategic and critical materials: asbestos, chromite, copper, platinum-group metals (platinum, iridium, rhodium, osmium, palladium, and ruthenium), lead, and manganese. The costly transportation problem of the bulkier ores has hindered their development.

Coal, apparently higher in quality than any other coal or lignite in northern California, occurs near Big Bar. Some has been produced for local consumption, but the distance to a railroad precludes much development. Other large deposits of coal (lignite) are found near Hayfork and Hyampom Valleys.

A little soapstone of fair quality has been produced for use as fire proof material in fireplaces. Indians once quarried and carved soapstone from Trinity County for use as heating vessels and water containers.

High-calcium limestone and marble are common in the county; but only one deposit, situated conveniently near a railroad, has been mined.

Current production of the sand and gravel industry in Trinity County now places it second to gold in value. Continued increase in production and value is anticipated.

As reported by the California State Division of Mines, the value of mineral production in 1954 was as follows:

Product	*Unit*	*Quantity*	*Value*
Chromite ore and concentrate	Short tons	502	$35,463
Copper	Pounds	10,800	3,186
Gold	Fine ounces	6,126	214,410
Manganese ore	Long tons	273	31,991
Sand and Gravel	Short tons	70,873	81,639
Silver	Fine ounces	652	590
Other minerals			35,485
Total			$402,764

Recreation. The climate and physiography of Trinity County make recreation a major industry. The rugged mountains that are characteristic of the area give birth to many streams which are fed through the summer months by snowmelt draining from the higher elevations. The environment is conducive to trout production and the streams are heavily fished. The major streams that dissect the county are the Trinity and Mad Rivers, and the headwaters of the Van Duzen and Eel Rivers. Salmon and steelhead migrate from the ocean and spawn in the gravel beds of these rivers and their tributaries.

Deer hunting provides an important sport in Trinity County. However, the rugged terrain and dense growth of brush make it a difficult sport. Bear are also hunted, although in lesser amount. The only game bird bagged in significant numbers is quail.

Camping areas are abundant in the county throughout the national forests, and the United States Forest Service maintains many public camps. Two wilderness areas, Salmon-Trinity Alps and Middle Eel-Yolla Bolly, have been set aside to preserve the primeval state. There are a number of resorts near Minersville and Trinity Center and along the main highways, and there are possibilities for considerably more development. U. S. Highway 299, which extends from Redding to Arcata, passes through Trinity County along the rugged canyon of the Trinity River. This highway is used by a large number of tourists and sportsmen for access to Trinity County.

Yolo County

Yolo County, one of the original 27 counties created by the Legislature in 1850, contains an area of 1,020 square miles. The 1956 population was estimated to be about 54,000. The 1950 Census showed the population distribution to be 54 per cent urban and 46 per cent rural.

Yolo County lies primarily in the Sacramento Valley with its eastern border along the Sacramento River but rises abruptly into low foothills at its western extremity to include the lower drainage area of Cache Creek. The maximum elevation in the county is approximately 3,100 feet. There are no forests of commercial quality in Yolo County. The climate is typical of the Sacramento Valley, with hot, dry summers and mild winters. Seasonal precipitation ranges from 17 inches to 30 inches over most of the valley area. The growing season extends from March into November.

The earliest white men to visit the area were Spanish explorers, followed by fur trappers from the Hudson's Bay Company. Settlement began almost immediately after diversions of water were made along Cache Creek by William Gordon and later by James Moore. By 1860 several thousand acres were receiving service from ditches carrying water from Cache Creek.

Agriculture. The raising of dry-farmed grain was a flourishing activity until the need for crop rotation and subsequent irrigation requirement became evident. To increase the irrigation supply already developed in Yolo County, the predecessor of the Clear Lake Water Company built a dam on Cache Creek in 1864 to control the outflow from Clear Lake. Much litigation and strife with landowners around Clear Lake resulted from fluctuation of the lake level. The Yolo Water and Power Company, which formed to take over the systems diverting from Cache Creek, built the Clear Lake Dam on the creek in 1914, about 5 miles below the outlet of Clear Lake. They also proposed to raise the lake level and install a power plant. The power plant was never built, however, and litigation over the lake level was settled in 1920 in the case of M. M. Gopcevic vs. Yolo Water and Power Company filed in Mendocino County. The company, which also constructed a diversion dam on Cache Creek at Capay, sold its properties in 1924 to the Clear Lake Water Company.

The reclamation of overflow lands along the Sacramento River was a major factor in the development of Yolo County. Of the active districts today, the first to be formed was Reclamation District No. 108 in Colusa and Yolo Counties. A succession of district formations followed. Many of these districts provide not only drainage and protection from flooding, but irrigation water for thousands of acres as well. The principal agencies serving irrigation water in Yolo County are listed in Table 9.

TABLE 9

PRINCIPAL IRRIGATION WATER SERVICE AGENCIES IN YOLO COUNTY

Name	Location	Irrigated area, in acres*
Commercial Water Companies		
Clear Lake Water Company	Woodland	26,090
Mutual Water Companies		
Capay Valley Ditch Company	Capay	1,280
Rumsey Ditch Company	Rumsey	158
Sweetwater Company	Dixon	2,440
Reclamation Districts		
Number 108	Dunnigan	See Colusa County
Number 150	Sacramento	5,000
Number 307	Clarksburg	6,000
Number 999	Clarksburg	23,335
Number 2035	Woodland	7,418

* (Information for period from 1950 through 1954.)

The combination of good soil, water, and climate has made agriculture the most important contributor to Yolo County's economy. A wide variety of crops are grown as shown by the report of the County Agricultural Commissioner. The 1955 report shows the value of agricultural production for that year to be about $65,640,000. Nearly one half of the returns were from field crops which include rice, sugar beets, corn, safflower, grain, hay, and pasture. The next largest item, nearly 25 per cent of the total, was truck crops which includes mostly tomatoes. Large amounts of asparagus, spinach, peas, onions, and other vegetables were also grown. Orchard crops, mostly almonds, walnuts, apricots, and prunes, and livestock, also figure significantly in the total for agricultural production. The value of all agricultural produce in 1955 as reported by the agricultural commissioner is tabulated below:

Apiary	$389,800
Field crops	30,941,400
Horticultural (orchard)	8,458,540
Livestock	7,784,700
Poultry	1,442,200
Seed crops	2,072,880
Truck crops	14,569,100
Total	$65,638,620

Mining. Gold was probably the first mineral produced in Yolo County, but the first recorded production was of mercury. The early period of mercury production began in 1873 and ended in 1880. Subsequently, production was recorded during the first World War and intermittently since 1938.

Production of sand and gravel has been significant since 1920, rising to a peak in value in 1953.

Yolo County is the leading producer of natural gas among the fifteen Northeastern Counties. During 1954, production came from 1,704 proven acres in three gas fields and one exploratory area. A fourth gas field was abandoned during 1954. Gas production reached a peak during 1952, but production may be expected to increase as new fields are discovered.

As reported by the California State Division of Mines, Yolo County mineral production was limited to natural gas which was valued at $550,000, and sand and gravel valued at $932,600. The total value was $1,482,600.

Recreation. Yolo County as a recreational area is subject to heavy pressure from the populous Sacramento area to the east. The Sacramento River, which forms the eastern county boundary, supports heavy angling pressure and provides other water sports. Salmon, striped bass, black bass, catfish, shad, and sturgeon are all caught in the river. On the western side, Cache Creek is used for swimming and picknicking, as well as for fishing.

Lake Washington is used for fishing and boating activities, but this use may be adversely affected by the construction of the Sacramento-Yolo Port which will use this lake as a part of the ship turning basin.

The ridge of hills in western Yolo County near Rumsey and Guinda affords good deer hunting.

Duck hunting in the valley is a major sport, with approximately 19,000 acres available to sportsmen in one commercial hunting club alone.

Pheasants are important upland game birds in the county and are heavily hunted. There are several commercial game bird clubs that open several thousand acres to hunters.

Yuba County

Yuba County was one of the original 27 counties created by the Legislature in 1850. At the time of its founding it included Sierra and Nevada Counties and a portion of Placer County, but was later reduced in size to its present 640 square miles. The 1956 population was estimated to be about 28,000. The 1950 Census showed the population distribution to be 65 per cent urban and 35 per cent rural.

From the western border along the Feather River, the county extends across the valley and up the slope of the Sierra Nevada. The terrain rises from an elevation of less than 200 feet on the Sacramento Valley floor to more than 4,000 feet in the Sierra Nevada foothills. Seasonal precipitation varies with elevation from about 20 inches on the valley to in excess of 70 inches in the northeastern part of the county. The higher elevations are subject to heavy winter snowfall. The climate is hot and dry in the summer. In the winter, temperatures are moderate in the valley and more severe at the higher elevations. The average annual growing season extends from late March to early November in the valley, and is somewhat shorter in the foothill areas.

Before the coming of the white man, the area was inhabited by the Maidu Indians. Settlement began in the 1840's, following a series of land grants from the Mexican Government. Although early settlers pursued the raising of grain and livestock, it was the discovery of gold in 1848 that accelerated the growth of Yuba County. The gold bearing gravels along the Yuba River and its tributaries attracted thousands of miners. However, in a few years the hand placer operations gave way to extensive hydraulic operations. In the years that followed so much debris was washed down the Yuba River that the bed of the stream along its lower reaches was raised by as much as 50 to 60 feet. Prior to 1850, sailing ships could navigate the Bear River to the vicinity of Wheatland. Early settlers who had been attracted to the fertile bottom lands had their farms buried under tons of debris. Litigation that followed resulted in temporary suspension of hydraulic mining. However, in 1893, Congress passed the "Camanetti Act" which permitted partial resumption of operations provided proper storage of debris could be secured. With the stabilization of the Yuba River, development along the lower reaches was again possible.

Agriculture. Following the pattern typical of early California development, diversified agriculture began after dry farmed grain raising was found to be uncertain. A variety of more profitable crops were grown with irrigation. Diversions from the Yuba River for irrigation on the valley floor in the Cordua area date back to around 1874. The first organized effort toward development, however, was that of the Browns Valley Irrigation District in 1888. Like many of the early irrigation districts formed under the Wright Act, there was a lack of adequate engineering studies, resulting in considerable litigation and financial difficulties. In this district, though organized with an area of about 40,000 acres, less than one-tenth received an adequate irrigation supply. Water was diverted from the North Yuba River and brought to the lands through about 48 miles of main ditch. Early developments along the Bear River consisted of brush diversion dams. The Camp Far West Irrigation District, organized in 1924, later constructed a concrete dam for storage and regulation on the Bear River. The principal agencies serving irrigation water are listed in Table 10.

Most of the agricultural development in Yuba County is in the vicinity of Marysville and in a wide band along the Feather River for the full length of the county. The deep alluvial soils adjacent to the river are intensively farmed to fruit, truck, and field crops, while much of the heavier hardpan land outside the flood plain is adaptable to rice and pasture pro-

TABLE 10

PRINCIPAL IRRIGATION WATER SERVICE AGENCIES IN YUBA COUNTY

Name	Location	Irrigated area, in acres*
Mutual Water Companies		
Hallwood Irrigation Company	Marysville	7,036
Plumas Mutual Water Company	Marysville	1,244
Irrigation Districts		
Browns Valley	Browns Valley	3,300
Camp Far West	Sheridan	†2,085
Cordua	Marysville	5,090
Reclamation Districts		
Number 10	Marysville	9,800
Number 817	Wheatland	4,000
Water Districts		
Wheatland	Wheatland	8,000

* (Information for period from 1950 through 1954.)
† Includes area in Placer County.

duction. The foothill agriculture is mainly forage crops to sustain livestock. The principal irrigated crops as shown by the land use survey made in 1955 and 1956 under this investigation included 25,000 acres of pasture, nearly 20,000 acres of rice, and about 9,100 acres of deciduous orchard. Other leading irrigated crops included 4,700 acres of truck crops, 4,200 acres of alfalfa, and 3,600 acres of field crops.

Timber. Timber production has been a substantial contributor to Yuba County's economy. The heavy precipitation belt extending across the higher elevations in the eastern part of the county accounts for the productive forest stands. Approximately 116,000 acres, or 28 per cent of the county, is covered by commercial forests. This includes 45,000 acres in public ownership and 71,000 acres owned privately. In addition to the above area, there are approximately 83,000 acres in forest land classified as noncommercial.

In 1951 there were 15 active sawmills in the county with an output accounting for 2.2 per cent of the State's production. The volume produced by species was as follows:

Species	*Volume, in thousand board feet*
Douglas fir	26,501
Ponderosa pine	41,135
True fir	24,349
Sugar pine	14,572
Incense cedar	3,262
Total	109,819

Mining. Gold mining in Yuba County commenced in 1848. After 1857 hydraulic mining became important in the Sierra Nevada, when the early placer diggings played out. After legal action in 1884 forced the virtual cessation of hydraulic operations, gold production in Yuba County dropped. In 1905, the Yuba Consolidated Gold Fields began dredging operations near Hammonton, nine miles east of Marysville. Since that time the annual production of gold has been consistently high. Over $100,000,000 in gold has been produced by dredges in the Hammonton area alone. Even today, auriferous gravels remain the chief source of mineral wealth in Yuba County. Reserves of lode gold are considered high, but are not being exploited at the present time for economic reasons.

The dollar value of the sand and gravel recovered from tailings piles and used for aggregate and road material is second to gold. Silver and platinum follow in point of cumulative value. Production reported for other materials has been relatively insignificant.

As reported by the California State Division of Mines, Yuba County mineral production during the 1954 period was valued at $2,612,000 and gold production alone was valued at $2,378,000.

Recreation. Mountain streams in Yuba County are limited to Slate Creek and the North Yuba River above Bullards Bar Reservoir. These are heavily stocked with trout and are good fisheries. The Feather River, which forms the western county boundary, supports considerable fishing for salmon, steelhead, shad, catfish, and sturgeon.

Englebright Reservoir on the Yuba River, accessible from both Marysville and Grass Valley, supports extensive recreational use in the form of boating, swimming, and fishing. The water surface normally remains high to control hydraulic mining debris and to generate hydroelectric power.

Deer hunting is limited to the area generally northeasterly of Dobbins at the higher elevations.

Although there are no organized gun clubs, waterfowl shooting is a rewarding sport in the valley. Pheasants are a very important upland game bird, and there are several commercial and private game-bird clubs which provide shooting areas for sportsmen.

The Feather River, a Steep, Turbulent Stream Near Belden, Plumas County

Department of Water Resources Photograph

Dry Stream Channel of Cache Creek, Characteristic of Coast Range Streams in the Sacramento Valley

Department of Water Resources Photograph

CHAPTER II

NATURAL RESOURCES

The Northeastern Counties have extensive resources of agricultural, forest, and recreational lands as well as water that can be more intensively developed and used. The area is capable of future growth through increased irrigation of its agricultural lands, expanded utilization of its forest products, and development of its recreational potential. Full development of the water and land resources, utilization of the recreational potential, and a balanced economy of industry and services are basic requirements for creating the ultimate demand for water as evaluated in this bulletin.

In this chapter, the basic natural resources that affect the need for water are evaluated, and their potential development discussed, under the following headings: "Water Resources," "Land Resources," "Recreational Resources," and "Population and Employment."

WATER RESOURCES

The water resources of the Northeastern Counties originate almost exclusively from precipitation. In the Klamath River Basin, however, water which originates outside the study area flows into the region. Throughout the area, the water supply in excess of the amounts used or stored in the soil, or in surface and subsurface reservoirs, flows out of the Northeastern Counties. Surface streams carry water westward into the Pacific Ocean, southward into the Sacramento-San Joaquin Delta, and eastward into the closed Lahontan Basin.

Although the land area of the 15 counties is about one-fourth of the total for the State, the surface runoff is about 40 per cent of the state total. Even as the water supply of the entire State is subject to inequalities in its geographical and seasonal distribution, similar inequalities occur within the Northeastern Counties.

The Klamath, Trinity, Pit, Feather, and Sacramento Rivers are the major streams of the area. Nearly all of the unused runoff of the Northeastern Counties is discharged to the ocean by the Klamath and Sacramento Rivers. The Sacramento River flows through miles of flat valley land where it furnishes irrigation water to much of the Sacramento Valley. Contrariwise, the Klamath River flows through a rough, mountainous region containing little irrigable land, and is subject to only minor local development. The numerous tributaries of these streams constitute the source of water for most of the agricultural lands and urban areas. Many of the streams have watersheds of small size, limiting the total runoff available.

The runoff falls into several distinct patterns imposed by the distribution of precipitation and the physical characteristics of the watershed. In general, northern California streams maintain year around flow, although they are subject to high flows during the winter and spring, with low flows during the summer and fall.

The early agricultural and urban water developments were predicated upon diversion and use of the unregulated flows of the streams. As the growth of urban populations and irrigated areas created water demands in excess of the supplies available, more water was obtained by building reservoirs to regulate flood flows or by drilling wells to pump water from the natural underground reservoirs. In much of the area included in the Northeastern Counties there is an increasing need for new water supply developments to keep pace with demands of the growing population. While many areas have natural water supplies in tributary streams susceptible of development, there are others where the development of new water supplies will necessitate a high degree of regulation and conservation.

The water supply is considered and evaluated in this chapter to illustrate the principal characteristics which must be considered in planning for future development. The total amount of surface runoff tributary to the Northeastern Counties area is also discussed. After determination of the quantities of natural runoff susceptible of development, the available water supply may be compared to the ultimate consumptive water requirements to determine the adequacy of local supplies to meet local demands. By a similar process, the quantity of water surplus to the needs of the area may be determined. A further consideration in the evaluation of the available water supply is the potential regulatory storage capability of the ground water basins of the Northeastern Counties. These considerations are discussed under the general headings of "Precipitation," "Runoff," and "Ground Water."

Definitions. Definitions of terms used in discussions of water supply are given below:

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

Seasonal—Any 12-month period other than the calendar year.

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

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

Mean Period—A period which is believed to represent conditions of water supply and climate existing during a long period of years.

Mean—The arithmetical average of quantities occurring during the mean period.

Average—The arithmetical average of quantities occurring during other than mean periods.

Natural Runoff (Flow)—The flow of a stream as it would exist if unaltered by upstream diversion, storage, import, export, or change in upstream consumptive use caused by development. Natural runoff is reconstructed from measured (historical) runoff by adjusting for the quantitative effect of alterations in stream flow above the point where the flow is measured.

In studies for the Statewide Water Resources Investigation, it was determined that the 50-year period from 1897-98 through 1946-47 is the most representative of mean seasonal precipitation. Similarly, the 53-year period from 1894-95 through 1946-47 was selected for determining mean seasonal runoff. These periods were chosen to represent mean conditions of water supply and climate throughout the Northeastern Counties.

Studies were made to select a more recent period for which reliable data on stream flow were available. It was determined that the 34-year period from 1920-21 through 1953-54 was satisfactory for this purpose in most respects. Stream flow during this period averaged about 90 per cent of the mean, and other conditions of water supply and climate approximated mean conditions. During this period a critical series of dry years occurred. Runoff during the six consecutive seasons from 1928-29 through 1933-34 averaged only about 51 per cent of the mean.

Precipitation

The influence of topography upon the passage of the frontal type storms which originate in the North Pacific during the winter months is the major factor affecting precipitation in the Northeastern Counties. Air flow and thermodynamic characteristics of each storm contribute to variations in precipitation. However, the distribution of precipitation for individual storms generally shows striking similarity to the distribution of mean seasonal precipitation.

The variation of precipitation within each season is caused by a latitudinal migration of the weather circulation pattern and of the storm-producing centers of action. Although there is generally sufficient moisture throughout the year, conditions leading to condensation and precipitation rarely exist during the summer months. Average duration of the precipitation season, which normally extends from October through March, increases with latitude as does the mean seasonal amount of precipitation.

Not all precipitation is frontal or orographic in origin. Convergence in advance of low pressure systems, instability of air masses preceding or following a front, and localized temperature differentials contribute to variations in the precipitation averages and patterns. The orographic influences predominate, however, and maximum precipitation generally occurs in the higher elevations on the windward slopes of the mountain ranges, while the minimum occurs in the valley and plateau areas in the leeward "rain-shadows."

Precipitation Stations and Records. One hundred and fifty-one precipitation stations in the Northeastern Counties have continuous records of 10 years' duration or longer. However, these stations are poorly distributed throughout the area. Most stations are maintained in the valleys and lowlands, in or near the centers of population. Relatively few stations record precipitation in the mountainous areas where the greatest amount of precipitation occurs. Data from the 65 snow courses located within the area provide additional information, particularly for the higher elevations where few precipitation stations are located. To develop maps depicting lines of equal mean seasonal precipitation, or isohyets, it was necessary to consider many short-period records together with orographic factors, as well as the available data from the continuously operated precipitation stations and snow courses.

Almost all of the available records for precipitation stations have been published in the Bulletins of the United States Weather Bureau. The distribution of stations throughout the area of investigation, as stated above, is uneven, and more data would be desirable for hydrologic analysis. Most of the snow course records have been published in the annual series of reports of the Department of Water Resources entitled "Water Conditions in California."

The 28 precipitation stations in the North Coastal Drainage Basin within the Northeastern Counties result in an average coverage of one station for every 350 square miles. The precipitation stations represent mainly the valley areas. There are practically no stations located in the higher areas, however, 18 snow courses add to the precipitation data available for the mountainous areas.

In the Central Valley Drainage Basin within the investigational area there are 114 precipitation stations representing an average coverage of one station for every 197 square miles. Although records of precipitation at higher elevations are lacking, distribution throughout the area is good. Forty-five snow courses provide valuable additional data in the mountainous areas.

Nine precipitation stations in the Lahontan Drainage Basin of the Northeastern Counties, represent a coverage of but one station for every 470 square miles, and records of two snow courses were available to supplement the records at higher elevations.

Precipitation Characteristics. The mean seasonal precipitation pattern is indicated on Plate 3, entitled "Geographical Distribution of Precipitation in Northern California." This plate shows the 50-year mean seasonal isohyets for the period 1897-98 through 1946-47.

Throughout the Northeastern Counties the average amount of precipitation varies widely, from a maximum of over 100 inches per season in western Siskiyou County to a minimum of less than 10 inches per season in eastern Modoc and Lassen Counties. The higher zones of precipitation, varying from 50 to 70 inches seasonally, occur over the crests of the Klamath Mountains, Coast Range, and Cascade Mountains, and west of the crest of Sierra Nevada. Precipitation from storms passing eastward or southeastward over the Northeastern Counties decreases from the crest of the Coast Range to the Sacramento Valley floor, where it averages about 20 inches seasonally. As the air masses are swept up the profile of the Sierra Nevada, the precipitation increases to a maximum on the windward side of the crest, and then decreases rapidly as the storm passes over the crest and down the east side. Similarly, in the northern part of the area, the amount of precipitation drops off markedly as the storms pass over the Cascades in western Siskiyou and Shasta Counties. Modoc and Lassen Counties experience low precipitation throughout most of their area, with only a few places where the seasonal precipitation exceeds 15 inches.

In addition to the variations in precipitation throughout the area in an average season, there often occurs a series of years for which precipitation is significantly different from normal. One of the most severe recorded drought periods in the Northeastern Counties, as in most of California, extended from 1928-29 through 1933-34. The driest individual seasons within the 34-year base period were generally 1923-24 and 1930-31.

Seasonal distribution of precipitation is similar to that for other portions of California, with roughly three-quarters of the seasonal total occurring in the winter period from November through March. Some of the storms which pass over the area are of sufficient intensity and duration to produce major floods. The series of storms occurring during the period between December 18 and December 24, 1955, were the most severe in this regard in the recorded history of the area.

The mean seasonal precipitation in the North Coastal Drainage Basin of the Northeastern Counties averages about 50 inches, varying from over 100 inches to about 10 inches in various localities. The maximum recorded seasonal precipitation of 98.59 inches occurred at Forest Glen, in Trinity County, during the 1937-38 season, and the minimum recorded seasonal precipitation of 4.14 inches occurred at Montague, in Siskiyou County, during the 1897-98 season. The maximum recorded snow pack, with an average water content of 90.8 inches, was measured on the Marble Valley snow course in Siskiyou County on March 28, 1952. Weaverville and Yreka records were considered to be fairly representative of the variations which occur in precipitation from season to season and throughout the

TABLE 11

RECORDED AND ESTIMATED SEASONAL PRECIPITATION AT SELECTED STATIONS, NORTH COASTAL DRAINAGE BASIN

(In inches of depth)

Season	Weaverville	Yreka	Season	Weaverville	Yreka
1871-1872	54.57	14.25*	1914-1915	43.87	21.00†
73	21.06	12.04	16	34.60	17.29
74	40.24	12.77	17	26.17	12.67
			18	22.46	11.08
1874-1875	21.72	10.20	19	38.58	19.63
76	51.13	22.04			
77	32.24	14.02	1919-1920	20.52	9.25
78	60.70	18.73	21	50.41	21.96
79	38.21	13.32	22	25.48	14.61
			23	28.17	13.80
1879-1880	37.00	17.57	24	17.92	7.89
81	49.72	20.48			
82	28.93	13.08	1924-1925	46.62	26.25
83	31.32	12.16	26	28.08	11.83
84	38.09	16.20	27	51.54	27.38
			28	32.49	15.39
1884-1885	29.41	19.68	29	20.21	11.33
86	44.96	18.95			
87	31.35	19.03	1929-1930	28.04	14.88
88	37.54	15.70	31	22.85	13.46
89	29.74	10.42	32	27.68	15.32
			33	27.55	13.75
1889-1890	67.04	30.42*	34	25.65	11.07
91	30.18	12.92*			
92	36.51	14.12*	1934-1935	32.52	14.44
93	46.16	16.53	36	39.41	19.81
94	35.20†	30.50	37	26.40	13.85
			38	41.40	26.50
1894-1895	36.80†	19.75	39	26.15	10.16
96	41.80†	23.28			
97	36.70†	20.84	1939-1940	45.57	22.29
98	33.10†	13.05	41	52.24	20.28
99	21.40†	12.41	42	41.25	23.63
			43	38.03	21.85
1899-1900	49.80†	18.11	44	23.96	10.89
01	49.10†	23.55			
02	49.70†	19.34	1944-1945	32.04	15.68
03	46.60†	16.12*	46	35.27	17.37
04	51.50†	31.29*	47	28.47	11.61
			48	34.14	18.31
1904-1905	49.70†	20.28	49	31.80	15.30
06	41.80†	22.10			
07	45.00†	25.54*	1949-1950	31.27	14.21
08	40.60†	19.40†	51	46.88	24.60
09	50.40†	23.70†	52	49.02	24.42
			53	48.92*	24.23
1909-1910	36.50†	15.30†	54	44.83	20.50
11	42.00†	22.50†			
12	32.90†	24.90†	Mean for 50-year period from 1897-98 through 1946-47	35.99	18.16
13	31.55	22.20†			
14	46.02	30.00†			

* Partially estimated.
† Estimated.

mean season. Recorded and estimated seasonal precipitation values at these stations are shown in Table 11, and monthly distribution of the mean seasonal precipitation is shown in Table 12.

TABLE 12

MONTHLY DISTRIBUTION OF MEAN SEASONAL PRECIPITATION AT SELECTED STATIONS, NORTH COASTAL DRAINAGE BASIN

Month	Weaverville		Yreka	
	In inches of depth	In per cent of seasonal total	In inches of depth	In per cent of seasonal total
July	0.15	0.4	0.36	2.0
August	0.14	0.4	0.31	1.7
September	0.68	1.9	0.55	3.0
October	2.23	6.2	1.27	7.0
November	5.00	13.9	2.74	15.1
December	6.73	18.7	3.12	17.2
January	6.34	17.6	2.74	15.1
February	5.90	16.4	2.65	14.6
March	3.85	10.7	1.78	9.8
April	2.70	7.5	1.04	5.7
May	1.37	3.8	0.93	5.1
June	0.90	2.5	0.67	3.7
TOTALS	35.99	100.0	18.16	100.0

The mean seasonal precipitation in the Central Valley Drainage Basin of the Northeastern Counties averages about 30 inches, with a variation of from as high as 90 inches to as low as 15 inches. The maximum recorded seasonal precipitation of 165.05 inches occurred at La Porte, in Plumas County, during the 1910-11 season, and the minimum recorded seasonal precipitation of 3.90 inches occurred at Davis, in Yolo County, during the 1929-30 season. The maximum recorded snow pack, with an average water content of 152.5 inches, was measured on the Mount Lassen snow course in Plumas County on March 31, 1938. The Mount Shasta and Woodland records are considered to be fairly representative of the variations which occur in precipitation from season to season and throughout the mean season. Recorded seasonal precipitation values at these stations are shown in Table 13, and monthly distribution of the mean seasonal precipitation is shown in Table 14.

The mean seasonal precipitation in the Lahontan Drainage Basin of the Northeastern Counties averages about 10 inches, with a variation from over 50 inches to less than 10 inches. The maximum recorded seasonal precipitation of 36.26 inches occurred at Susanville, in Lassen County, during the 1889-90 season, and the minimum recorded seasonal precipitation of 4.05 inches occurred at Madeline, in Lassen County, during the 1932-33 season. The maximum recorded snow pack, with an average water content of 59.9 inches was measured on the Silver Lake snow course in Lassen County on March 28, 1952. The Cedarville and

TABLE 13

RECORDED SEASONAL PRECIPITATION AT SELECTED STATIONS, CENTRAL VALLEY DRAINAGE BASIN

(In inches of depth)

Season	Mt. Shasta	Woodland	Season	Mt. Shasta	Woodland
1873-1874		23.00			
75		14.18	1914-1915	42.59	17.92
76		22.14	16	33.85	15.35
77		10.67	17	22.86	13.05
78		26.69	18	18.47	9.67
79		15.93	19	29.44	16.72
1879-1880		21.67	1919-1920	15.99	7.85
81		17.87	21	33.33	16.20
82		12.05	22	28.00	13.72
83		16.95	23	26.48	16.31
84		23.74	24	13.85	8.75
1884-1885		10.82	1924-1925	37.50	17.62
86		23.20	26	24.50	18.06
87		13.07	27	44.95	19.28
88		12.79	28	28.95	14.94
89	28.23	21.42	29	24.60	11.24
1889-1890	73.47	30.69	1929-1930	29.50	15.62
91	19.64	13.80	31	18.25	11.05
92	28.93	13.92	32	30.10	17.15
93	43.02	21.03	33	32.53	9.68
94	30.98	12.80	34	27.85	11.21
1894-1895	34.71	25.88	1934-1935	34.46	20.13
96	38.58	24.65	36	31.00	18.95
97	30.54	17.91	37	37.48	17.92
98	28.31	6.43	38	52.42	24.93
99	15.97	15.15	39	20.12	7.03
1899-1900	48.21	15.53	1939-1940	47.11	20.32
01	45.17	19.63	41	67.31	33.52
02	49.63	17.12	42	45.44	23.39
03	44.62	14.34	43	22.76	17.19
04	50.14	18.30	44	24.25	15.64
1904-1905	48.71	28.29	1944-1945	34.72	14.30
06	38.76	25.33	46	36.07	14.55
07	42.30	24.53	47	29.46	12.72
08	37.24	10.79	48	35.12	14.91
09	49.70	23.00	49	30.91	14.38
1909-1910	30.19	14.92	1949-1950	23.61	11.62
11	38.61	22.37	51	41.58	17.16
12	27.99	7.85	52	46.53	21.08
13	30.23	8.86	53	43.62	17.34
14	48.66	23.62	54	36.96	14.27
			55	28.09	14.30
			Mean for 50-year period from 1897-98 through 1946-47	34.41	16.36

Susanville records were considered to be fairly representative of the variations which occur in precipitation from season to season and throughout the mean season. Recorded and estimated seasonal precipitation values at these stations are shown in Table 15, and monthly distribution of the mean seasonal precipitation is shown in Table 16.

Runoff

The runoff from the tributary watersheds of the Northeastern Counties constitutes the most important source of water supply to the irrigated lands within the area. Fundamentally, runoff consists of that por-

TABLE 14

MONTHLY DISTRIBUTION OF MEAN SEASONAL PRECIPITATION AT SELECTED STATIONS, CENTRAL VALLEY DRAINAGE BASIN

Month	Mount Shasta		Woodland	
	In inches of depth	In per cent of seasonal total	In inches of depth	In per cent of seasonal total
July	0.16	0.5	0.00	0.0
August	0.26	0.8	0.01	0.1
September	0.78	2.3	0.27	1.7
October	2.13	6.2	0.80	4.9
November	4.15	12.1	1.70	10.4
December	5.25	15.3	2.96	18.0
January	6.07	17.5	3.44	21.0
February	5.83	16.8	3.14	19.2
March	4.67	13.6	2.29	14.0
April	2.48	7.2	1.01	6.2
May	1.68	4.9	0.57	3.5
June	0.95	2.8	0.17	1.0
TOTALS	34.41	100.0	16.36	100.0

TABLE 15

RECORDED AND ESTIMATED SEASONAL PRECIPITATION AT SELECTED STATIONS, LAHONTAN DRAINAGE BASIN

(In inches of depth)

Season	Cedar-ville	Susan-ville	Season	Cedar-ville	Susan-ville
1889–1890		36.26	1924–1925	11.69	15.49†
91		20.31	26	10.76	13.88†
92		20.32	27	12.43	18.81†
93		31.55	28	10.87	14.33
94		20.23	29	10.39	9.74
95	9.18	28.07			
96	16.37	25.70	1929–1930	10.21	17.33
97	17.54	23.59	31	9.74	9.92
98	10.91	13.41	32	13.86	14.60
99	13.10	12.24	33	7.04	9.14
			34	8.83	12.66
1899–1900	14.22	19.59	35	11.10	16.90
01	16.01	21.05	36	14.00	17.43
02	12.50	18.31	37	9.44	14.19
03	12.48	15.65	38	21.17	32.82
04	18.62	24.27	39	9.55	9.30
05	12.20	15.50			
06	15.63	19.76	1939–1940	13.47	21.37
07	17.21	32.42	41	12.59	21.51
08	9.88	16.62	42	14.20	23.35
09	18.26	21.02	43	13.92	18.27
			44	9.64	13.31
1909–1910	13.60	13.46	45	15.36	11.46
11	15.04	26.00	46	11.09	12.24
12	9.21	9.44	47	10.24	10.99
13	10.63	24.90	48	14.51	9.08
14	15.63	25.69	49	11.49	6.39*
15	10.21	10.32			
16	10.02	21.40	1949–1950	11.63	8.21*
17	12.80	15.58†	51	13.91	14.97*
18	9.22	12.43	52	18.42	17.77*
19	9.34	21.96†	53	16.82	13.76*
			54	9.94	11.16*
1919–1920	11.36	18.01†	55	8.98	7.87*
21	13.33	15.13†			
22	10.31	23.12†	Mean for 50-year period 1897–98 through 1946–47	12.20	17.14
23	9.52	21.99†			
24	7.39	8.61†			

* Susanville station discontinued, record is for Susanville Airport.
† Estimated.

tion of the precipitation not used in watershed evaporation and transpiration, or not stored in the soil or in ground water reservoirs. The relationship of runoff to precipitation in individual basins is strongly influenced by the vegetation, soils, geology, and topography of the watershed. These factors determine the quantity of runoff that results from the rainfall and snowmelt.

TABLE 16

MONTHLY DISTRIBUTION OF MEAN SEASONAL PRECIPITATION AT SELECTED STATIONS, LAHONTAN DRAINAGE BASIN

Month	Cedarville		Susanville	
	In inches of depth	In per cent of seasonal total	In inches of depth	In per cent of seasonal total
July	0.25	2.1	0.18	1.1
August	0.16	1.3	0.14	0.8
September	0.49	4.0	0.48	2.8
October	1.01	8.3	0.91	5.3
November	1.48	12.1	1.94	11.3
December	1.51	12.4	2.79	16.3
January	1.73	14.2	3.36	19.6
February	1.54	12.6	2.59	15.1
March	1.43	11.7	2.25	13.1
April	0.94	7.7	1.01	5.9
May	0.96	7.9	0.96	5.6
June	0.70	5.7	0.53	3.1
TOTALS	12.20	100.0	17.14	100.0

The cyclic seasonal variation of runoff is caused by the effect of natural storage factors upon the precipitation distribution. One of the most striking of these factors is the storage of winter precipitation in the snow pack at elevations generally above 5,000 feet and subsequent release during the snowmelt period in the spring and early summer months. A number of watersheds have extensive capacity for ground water storage, particularly those which drain areas of volcanic formation. Where ground water is discharged through springs, the tributary streams have more uniform flow characteristics.

Stream Gaging Stations and Records. Available records of runoff of the principal streams of the Northeastern Counties were sufficient in number, length, and reliability to form the basis of estimates of runoff utilized in hydrologic studies for the current investigation. Runoff records for the area have been published either in the Water Supply Papers of the United States Geological Survey, or by the Department of Water Resources in the annual reports of the Sacramento-San Joaquin Water Supervision and in annual reports of the results of watermaster service in watermaster service areas.

Runoff Characteristics. The general mean seasonal runoff pattern is very similar to the mean seasonal precipitation pattern, and the most highly productive watersheds are necessarily those with high mean seasonal precipitation.

In addition to the mean seasonal variations, there occur series of years for which precipitation, and therefore runoff, is significantly different from the mean. The period from 1928 through 1934 was one of the most severe drought periods for which reliable records of runoff are available. This period is particularly significant in regard to studies of potential water development. Water supply projects which are able to sustain appreciable annual drafts throughout this period would generally experience no difficulties during the remainder of the period of record.

Seasonal distribution of runoff may be classified into three fairly distinct patterns, (1) runoff largely determined by rainfall distribution, (2) runoff largely determined by snowmelt distribution, and (3) runoff of relatively even distribution due to a large base flow or ground water flow contribution.

In the North Coastal Drainage Basin portion of the Northeastern Counties, streams may be found with each of the several distributional patterns. However, it should be noted that many streams drain complex basins and reflect a distribution influenced by combinations of these factors.

TABLE 17

ESTIMATED SEASONAL NATURAL RUNOFF AT SELECTED STATIONS, NORTH COASTAL DRAINAGE BASIN

(In acre-feet)

Season	Fall Creek at Copco	Trinity River at Lewiston	Eel River at Scotia
1920-21	26,500	1,795,000	7,815,000
1921-22	26,500	783,700	3,729,000
1922-23	26,500	686,200	2,755,000
1923-24	26,500	266,200	868,000
1924-25	26,500	1,499,000	7,176,000
1925-26	26,500	808,200	3,276,000
1926-27	26,500	1,826,000	7,862,000
1927-28	26,500	1,058,000	4,614,000
1928-29	25,400	528,500	1,908,000
1929-30	24,700	814,700	3,522,000
1930-31	22,900	401,800	1,612,000
1931-32	25,000	720,300	3,618,000
1932-33	24,000	803,200	3,640,000
1933-34	22,400	682,600	2,484,000
1934-35	23,700	965,600	5,075,000
1935-36	23,200	1,025,000	5,757,000
1936-37	22,500	999,400	3,572,000
1937-38	28,500	2,105,000	10,744,000
1938-39	21,600	573,300	2,678,000
1939-40	23,500	1,613,000	7,291,000
1940-41	22,200	2,547,000	8,235,000
1941-42	24,400	1,804,000	7,411,000
1942-43	31,700	1,108,000	5,691,000
1943-44	25,200	654,100	2,256,000
1944-45	28,200	1,048,000	4,769,000
1945-46	29,400	1,415,000	6,029,000
1946-47	25,200	732,400	2,654,000
1947-48	27,600	1,205,000	4,761,000
1948-49	26,000	1,091,000	4,149,000
1949-50	28,300	853,600	4,121,000
1950-51	30,800	1,610,000	7,158,000
1951-52	33,500	1,817,000	8,025,000
1952-53	33,800	1,612,000	7,099,000
1953-54	34,600	1,595,000	6,931,000
Average	26,500	1,148,400	4,979,000

TABLE 18

ESTIMATED MONTHLY DISTRIBUTION OF AVERAGE SEASONAL NATURAL RUNOFF AT SELECTED STATIONS, NORTH COASTAL DRAINAGE BASIN

Month	Fall Creek at Copco		Trinity River at Lewiston		Eel River at Scotia	
	In acre-feet	In per cent of seasonal total	In acre-feet	In per cent of seasonal total	In acre-feet	In per cent of seasonal total
October	2,000	7.5	17,800	1.5	40,400	0.8
November	2,100	7.9	49,400	4.3	293,000	5.9
December	2,400	9.1	83,800	7.3	819,900	16.5
January	2,500	9.4	93,300	8.1	1,068,600	21.5
February	2,500	9.4	130,800	11.4	1,095,600	22.0
March	2,800	10.6	158,800	13.8	785,100	15.8
April	2,500	9.4	217,700	19.1	534,100	10.7
May	2,100	7.9	225,900	19.7	223,100	4.5
June	1,900	7.2	115,700	10.1	81,500	1.6
July	1,900	7.2	34,800	3.0	22,100	0.4
August	1,900	7.2	11,800	1.0	9,100	0.2
September	1,900	7.2	8,600	0.7	6,500	0.1
TOTALS	26,500	100.0	1,148,400	100.0	4,979,000	100.0

The Eel River, above the gaging station at Scotia, has only a small portion of the drainage area above 5,000 feet in elevation and is a good example of a stream with a runoff distribution pattern largely determined by rainfall. The Trinity River above the gaging station at Lewiston has a large portion of the drainage area above 5,000 feet in elevation and is typical of streams with a runoff distribution pattern largely determined by snowmelt. Fall Creek above the gaging station at Copco has a drainage area largely composed of highly pervious volcanic materials, resulting in a large uniform base flow of runoff.

Continuous records of stream flow are available for the Eel River at Scotia for the period since October, 1916; for the Trinity River at Lewiston for the period since August, 1911; and for Fall Creek at Copco for the period since July, 1928. These stream gaging stations were established, and the records of runoff maintained, by the United States Geological Survey. Estimates of seasonal natural runoff for each of these stations for the period from October, 1920, through September, 1954, are shown in Table 17, and estimated monthly distribution of average seasonal natural runoff for the period are given in Table 18.

In the Central Valley Drainage Basin portion of the Northeastern Counties, streams generally reflect complex combinations of the several distributional patterns. Clear cut examples of each pattern are fewer here than in the North Coastal Area since most watersheds in this area have a runoff distribution reflecting a combination of factors.

Thomes Creek above the gaging station at Paskenta, for instance, has a significant portion of the drainage area in both the rainfall and snowmelt environmental zones, and consequently reflects a combination of rainfall and snowmelt runoff. The distribution is typical of the minor tributaries of the Sacramento River, many of which experience a double peak, one due primarily to rainfall runoff, and the other due primarily to snowmelt. The North Yuba River, above the gaging station near Goodyear's Bar, has a large portion of the drainage area in the snowmelt environment but reflects some rainfall runoff characteristics. It has a distribution of runoff which is typical of Sierra Nevada streams, many of which experience an upward trend due to rainfall, but do not peak until the snowmelt season. Hat Creek, above the gaging station near Hat Creek, has a drainage area largely composed of highly pervious volcanic materials. It gains most of its flow from spring discharge, but peaks during the snowmelt season. It has a distribution of runoff typical of many streams in the Pit River Basin with large base flow.

TABLE 19

ESTIMATED SEASONAL NATURAL RUNOFF AT SELECTED STATIONS, CENTRAL VALLEY DRAINAGE BASIN

(In acre-feet)

Season	North Yuba River below Goodyear's Bar	Thomes Creek at Paskenta	Hat Creek at Hat Creek
1920-21	712,600	302,200	110,800
1921-22	720,600	193,200	106,400
1922-23	499,200	145,500	93,700
1923-24	166,000	32,500	85,600
1924-25	465,800	284,000	86,400
1925-26	333,200	144,400	79,000
1926-27	769,100	337,100	91,700
1927-28	596,100	256,700	93,900
1928-29	245,600	55,400	80,500
1929-30	433,500	142,200	79,800
1930-31	173,400	53,700	65,000
1931-32	497,000	113,200	66,000
1932-33	281,000	88,300	60,200
1933-34	247,000	74,400	59,500
1934-35	533,200	154,000	66,500
1935-36	606,400	190,000	68,800
1936-37	436,000	112,200	68,600
1937-38	917,100	446,200	108,900
1938-39	219,100	64,700	90,300
1939-40	676,100	285,100	92,400
1940-41	707,700	431,800	105,500
1941-42	786,200	289,100	110,900
1942-43	733,400	201,700	115,000
1943-44	337,000	66,500	103,900
1944-45	498,800	122,800	101,400
1945-46	559,600	200,700	98,600
1946-47	317,000	80,100	91,200
1947-48	467,900	141,000	97,400
1948-49	334,300	132,700	86,100
1949-50	535,900	130,400	84,400
1950-51	827,500	220,600	99,000
1951-52	924,900	321,600	117,200
1952-53	623,500	252,000	118,800
1953-54	454,900	237,000	114,000
Average	518,700	185,400	91,100

Continuous records of stream flow are available for Thomes Creek at Paskenta for the period since October, 1920; the North Yuba River at and below Goodyears Bar for the period since November, 1910; and for Hat Creek near Hat Creek for the period since April, 1928. These stream gaging stations were established, and the records of runoff are maintained, by the United States Geological Survey. Estimates of seasonal natural runoff for each of these stations for the period from October, 1920, through September, 1954, are shown in Table 19, and estimated monthly distribution of average seasonal natural runoff for the period are shown in Table 20.

TABLE 20

ESTIMATED MONTHLY DISTRIBUTION OF AVERAGE SEASONAL NATURAL RUNOFF AT SELECTED STATIONS, CENTRAL VALLEY DRAINAGE BASIN

Month	North Yuba River below Goodyear's Bar		Thomes Creek at Paskenta		Hat Creek near Hat Creek	
	In acre-feet	In per cent of seasonal total	In acre-feet	In per cent of seasonal total	In acre-feet	In per cent of seasonal total
October	9,800	1.9	1,100	0.6	6,800	7.5
November	19,900	3.8	6,800	3.7	6,900	7.6
December	33,800	6.5	20,000	10.8	7,300	8.0
January	37,000	7.1	27,100	14.6	7,000	7.7
February	46,700	9.0	35,500	19.1	6,300	6.9
March	61,200	11.8	32,700	17.6	7,100	7.8
April	88,200	17.0	33,800	18.2	7,800	8.5
May	113,500	22.0	20,200	10.9	10,400	11.4
June	67,100	12.9	6,400	3.5	10,000	11.0
July	21,500	4.1	1,300	0.7	7,800	8.6
August	11,300	2.2	300	0.2	7,100	7.8
September	8,700	1.7	200	0.1	6,600	7.2
TOTALS	518,700	100.0	185,400	100.0	91,100	100.0

In the Lahontan Drainage Basin of the Northeastern Counties, there are few streams for which records are available for entire seasons during any continuous period. However, the records which are available furnish some understanding of runoff characteristics.

The Susan River above the gaging station near Susanville largely reflects snowmelt runoff, while Willow Creek above the gaging station near Susanville largely reflects prominent base flow characteristics.

Continuous records of stream flow are available for both the Susan River near Susanville and for Willow Creek near Susanville, for the period since October, 1950. These stations were established, and the records of runoff are maintained, by the United States Geological Survey. Records of stream flow for these two streams are also available for the irrigation season for the period since April, 1935, and for the entire

Water Measuring Devices
Used by Watermasters
to Control Distribution
of Irrigation Water

Department of Water Resources Photographs

Above: Continuous water
stage recorder

Right: Parshall flume with
continuous water
stage recorder

water year 1949-50, from stations established and maintained by the Department of Water Resources in the Susan River Watermaster Service Area. Estimates of seasonal natural runoff for each of these stations for the period from October, 1920, through September, 1954, are shown in Table 21, and estimated monthly distribution of average seasonal natural runoff for the period are given in Table 22.

Quantity of Runoff. Sufficient historical records of runoff were available to permit an estimate of the amount of runoff from each hydrographic unit in the Northeastern Counties. The available records are presented in Table 23, "Estimated Seasonal Natural Runoff of Major Streams and Principal Minor Streams Within the Northeastern Counties." The quantities shown are the average seasonal natural runoff for the 34 year base period October, 1920, through September, 1954; the average seasonal runoff for the critical period October, 1928, through September, 1934; and the maximum and minimum seasonal runoff values. The records of runoff at stations operated only for intermittent short periods of time were extended to obtain an estimated continuous record for the 34 year base period. This was done through correlation with records of flow at nearby stations with similar watershed and runoff characteristics for which continuous records were available.

The estimated average seasonal natural runoff for each hydrographic unit for the 34 year base period is presented in Table 24, "Estimated Average Seasonal Natural Runoff from Hydrographic Units, Northeastern Counties." Except for the hydrographic units on the Sacramento Valley floor, each unit represents a watershed or portion of a watershed for which the runoff could be measured at one or more points. The estimates for each hydrographic unit represent the runoff under natural conditions from that unit only which would occur at one or more lowermost measurement points. Accumulated flows from upstream units were subtracted and not included in the runoff values for each unit presented in Table 24. Estimated unit values of runoff from ungaged areas were determined by comparison with those from nearby measured watersheds having similar watershed and runoff characteristics. Quantities representing runoff from these ungaged areas were computed from the estimated unit values of runoff per square mile, multiplied by the area of the watershed.

TABLE 22

ESTIMATED MONTHLY DISTRIBUTION OF AVERAGE SEASONAL NATURAL RUNOFF AT SELECTED STATIONS, LAHONTAN DRAINAGE BASIN

Month	Susan River near Susanville		Willow Creek near Susanville	
	In acre-feet	In per cent of seasonal total	In acre-feet	In per cent of seasonal total
October	600	1.0	700	4.5
November	1,800	3.0	1,000	6.4
December	3,500	5.9	1,200	7.7
January	4,100	6.9	1,400	9.0
February	6,700	11.2	1,500	9.6
March	9,900	16.6	1,900	12.2
April	15,200	25.5	2,600	16.7
May	11,300	18.9	1,700	10.9
June	3,600	6.0	1,100	7.0
July	1,400	2.3	900	5.8
August	900	1.5	800	5.1
September	700	1.2	800	5.1
TOTALS	59,700	100.0	15,600	100.0

TABLE 21

ESTIMATED SEASONAL NATURAL RUNOFF AT SELECTED STATIONS, LAHONTAN DRAINAGE BASIN

(In acre-feet)

Season	Susan River near Susanville	Willow Creek near Susanville
1920-21	82,500	28,200
1921-22	92,600	25,300
1922-23	41,300	13,600
1923-24	15,200	5,100
1924-25	34,100	6,100
1925-26	49,700	10,100
1926-27	90,700	22,300
1927-28	54,100	16,400
1928-29	18,900	7,100
1929-30	65,500	14,200
1930-31	20,300	6,500
1931-32	47,100	9,700
1932-33	24,600	5,700
1933-34	22,200	3,600
1934-35	63,800	12,400
1935-36	54,800	13,800
1936-37	44,500	12,000
1937-38	152,600	36,300
1938-39	25,100	9,600
1939-40	86,400	20,100
1940-41	74,900	21,200
1941-42	95,300	26,000
1942-43	93,600	25,600
1943-44	43,400	13,800
1944-45	48,700	12,900
1945-46	64,600	16,300
1946-47	35,100	10,700
1947-48	42,300	11,200
1948-49	33,500	8,400
1949-50	52,100	11,800
1950-51	79,300	19,000
1951-52	147,000	38,200
1952-53	75,600	21,400
1953-54	58,100	16,600
Average	59,700	15,600

TABLE 23

ESTIMATED SEASONAL NATURAL RUNOFF OF MAJOR STREAMS AND PRINCIPAL MINOR STREAMS WITHIN THE NORTHEASTERN COUNTIES

Reference number*	Stream and station	Drainage area, in square miles	Seasonal natural runoff, in acre-feet			
			34 year average, 1920-21 through 1953-54	Maximum	Minimum	Average during critical period, 1928 through 1934
	North Coastal Drainage Basin					
1-1	Klamath River at Klamath Falls†	3,810	1,205,000	2,122,000	695,000	819,000
1-2	Lost River at Clear Lake Dam	550	112,000	295,000	18,000	53,000
1-4	Butte Creek near Macdoel	178	11,000	19,000	4,300	7,600
	Antelope Creek near Tennant	19	22,000	40,200	7,400	14,500
1-6	Klamath River at Keno ‡	3,920	1,216,000	2,137,000	705,000	829,000
1-8	Klamath River near Copco	4,370	1,428,000	2,475,000	860,000	1,019,000
1-21	Shasta River near Yreka	796	163,000	261,000	101,000	120,000
1-25	Scott River near Fort Jones	662	401,000	832,000	92,000	245,000
1-31	Salmon River at Somesbar	746	1,187,000	2,234,000	300,000	755,000
1-32	Klamath River at Somesbar	8,480	5,461,000	9,717,000	2,538,000	3,738,000
1-37	Trinity River at Lewiston	724	1,149,000	2,547,000	266,000	658,000
1-44	Trinity River at Hoopa	2,840	3,722,000	7,601,000	816,000	2,161,000
1-55	Eel River at Van Arsdale Dam	347	420,000	1,057,000	57,700	220,000
1-58	Eel River, Middle Fork, below Black Butte River near Covelo	367	616,000	1,279,000	141,000	363,000
1-62	Eel River at Scotia	3,070	4,979,000	10,744,000	868,000	2,797,000
1-63	Van Duzen River near Bridgeville	200	511,000	1,003,000	175,000	334,000
	Central Valley Drainage Basin					
	Inflow to Goose Lake §	1,200	208,000	490,000	60,000	110,000
5-29	Pit River near Canby	1,430	238,000	604,200	46,300	121,800
5-38	Pit River near Beiber	2,670	407,400	1,111,000	116,400	219,700
5-44	Pit River at Fall River Mills	3,890	1,316,000	2,336,000	807,000	986,000
5-61	Pit River below Pit No. 4 Dam	4,840	2,059,000	3,236,000	1,388,000	1,608,000
5-69	Pit River near Ydalpom	5,350	3,050,000	5,234,000	1,641,000	2,070,000
5-74	McCloud River at Baird	668	1,254,000	2,205,000	631,000	816,000
	Sacramento River at Antler	461	844,000	1,645,000	192,000	466,000
	Sacramento River at Shasta Dam	6,620	5,308,000	9,665,000	2,614,000	3,557,000
5-91	Cottonwood Creek near Cottonwood	940	524,800	1,658,000	82,500	223,200
5-79	Clear Creek near Igo	230	231,000	790,600	33,100	113,000
5-99	Thomes Creek at Paskenta	188	185,400	446,200	32,500	87,900
5-98A	Elder Creek near Paskenta	96	48,700	211,500	1,600	15,300
	Redbank Creek at foothills	100	20,300	88,000	700	6,300
	Stony Creek at canyon mouth	710	422,500	1,513,300	42,700	163,700
5-248	Cache Creek near Capay	1,052	562,000	1,656,800	92,500	272,300
5-252	Putah Creek near Guenoc	112	134,300	337,800	24,000	68,300
5-87	Battle Creek near Cottonwood	362	300,800	554,600	167,200	210,700
5-95B	Paynes Creek near Red Bluff	93	43,400	96,000	16,500	25,400
5-80A	Cow Creek near Millville	426	408,200	1,053,000	106,600	216,700
5-102	Deer Creek near Vina	200	214,400	420,800	73,600	120,500
5-97	Mill Creek near Los Molinos	134	205,000	410,100	87,500	127,300
5-95	Antelope Creek near Red Bluff	124	95,200	212,000	30,500	52,300
5-122	Butte Creek near Chico	148	233,100	508,500	84,100	135,200
5-105	Chico Creek near Chico	68	97,500	231,800	23,400	48,700
5-145	North Fork Feather River near Prattville	507	667,300	1,218,900	386,400	464,600
5-191	Feather River near Oroville	3,611	4,041,600	8,488,700	1,314,100	2,433,800
5-190	Middle Fork Feather River at Bidwell Bar	1,353	1,403,500	3,101,300	335,400	912,300
5-189	South Fork Feather River at Enterprise	134	251,100	516,900	63,800	160,000
	South Honcut Creek near Bangor	31	23,800	48,900	4,300	11,600
5-231	Dry Creek at Virginia Ranch	72	62,400	146,100	13,600	36,100
5-207	Oregon Creek near North San Juan	35	55,100	106,200	11,900	27,800
5-206	Middle Yuba River above Oregon Creek	170	291,600	534,200	68,500	170,900
5-200	North Yuba River below Goodyear's Bar	244	518,700	924,900	166,000	312,900
5-205	North Yuba River below Bullard's Bar Dam	481	1,015,000	1,795,000	273,000	596,800
5-228	Yuba River at Smartsville	1,201	2,221,300	4,118,000	603,000	1,274,700
5-94	Sacramento River at Red Bluff	9,220	7,478,000	14,730,000	3,179,000	4,624,000
	Lahontan Drainage Basin					
	Eagle Lake	435	39,200	92,300	12,700	23,100
6-22A	Willow Creek near Susanville	93	15,600	38,200	3,600	7,800
6-18	Susan River at Susanville	192	59,700	152,600	15,200	33,100
	Long Valley Creek near Scott	114	11,300	29,000	2,900	6,300

* From State Water Resources Board Bulletin No. 1, "Water Resources of California."
† Including Crater Lake.
‡ Not including Lost River, Lower Klamath Lake, and Butte Valley Basins.
§ Includes Oregon portion of basin.

TABLE 24

ESTIMATED AVERAGE SEASONAL NATURAL RUNOFF FROM HYDROGRAPHIC UNITS, NORTHEASTERN COUNTIES

(For 34-year period, 1920-21 through 1953-54)

Hydrographic unit: Reference number	Hydrographic unit: Name	Area, in square miles	Runoff, in acre-feet
	North Coastal Drainage Basin		
1	Tulelake[1]	1,703	220,000
2	Butte Valley[1]	606	100,000
3	Klamath River[1]	1,860	2,420,000
4	Shasta Valley	793	160,000
5	Scott Valley	662	400,000
6	Salmon River	742	1,190,000
7	Upper Trinity River	730	1,150,000
8	Lower Trinity River	1,019	1,220,000
9	South Fork Trinity River	796	920,000
10	Southern Trinity County	656	1,380,000
11	Lake Pillsbury	381	470,000
	SUBTOTALS	9,948	9,630,000
	Central Valley Drainage Basin		
12	Goose Lake[1]	367	50,000
13	Jess Valley	250	50,000
14	Alturas	1,177	190,000
15	Big Valley	1,243	180,000
16	McArthur	1,218	910,000
17	Hat Creek	952	740,000
18	Montgomery Creek	366	790,000
19	McCloud River	599	1,140,000
20	Dunsmuir	429	690,000
21	Shasta Lake	382	620,000
22	Clear Creek	230	230,000
23	Keswick	48	80,000
24	Cottonwood Creek	940	520,000
25	Olinda	80	60,000
26	Redbank Creek	241	50,000
27	Elder Creek	130	50,000
28	Thomes Creek	348	220,000
29	Stony Creek	745	430,000
30	Clear Lake	952	560,000
31	Middletown	206	250,000
32	Stillwater Plains	126	110,000
33	Cow Creek	426	410,000
34	Bear Creek	162	100,000
35	Battle Creek	362	300,000
36	Paynes Creek	134	60,000
37	Antelope Creek	204	140,000
38	Mill Creek	185	230,000
39	Deer Creek	251	240,000
40	Chico Creek	348	370,000
41	Paradise	182	150,000
42	North Fork Feather River	1,205	2,010,000
43	East Branch Feather River	1,022	640,000
44	Sierra Valley	526	130,000
45	Middle Fork Feather River	672	980,000
46	South Fork Feather River	158	290,000
47	North Yuba River	571	1,130,000
48	Challenge	181	210,000
49	Wyandotte	136	80,000
50	Anderson[2]	95	290,000
51	Corning	309	70,000
52	Los Molinos	284	40,000
53	Fruto	268	40,000
54	Orland	216	40,000
55	Durham	172	40,000
56	Colusa	920	130,000
57	Gridley	517	120,000
58	Brown's Valley	66	40,000
59	Cortina	452	60,000
60	Arbuckle	200	30,000
61	Sutter	129	20,000
62	Marysville	362	100,000
63	Pleasant Grove	29	10,000
64	West Yolo	98	30,000
65	Capay	91	30,000
66	Woodland	324	50,000
67	East Yolo	285	40,000
	SUBTOTALS	22,571	16,570,000

TABLE 24—Continued

ESTIMATED AVERAGE SEASONAL NATURAL RUNOFF FROM HYDROGRAPHIC UNITS, NORTHEASTERN COUNTIES

(For 34-year period, 1920-21 through 1953-54)

Hydrographic unit: Reference number	Hydrographic unit: Name	Area, in square miles	Runoff, in acre-feet
	Lahontan Drainage Basin		
68	Surprise Valley[1]	776	180,000
69	Madeline Plains	802	60,000
70	Eagle Lake	435	40,000
71	Willow Creek	145	20,000
72	Secret Valley	651	40,000
73	Susan River	580	100,000
74	Herlong	567	30,000
75	Little Truckee River	167	180,000
	SUBTOTALS	4,123	650,000
	TOTALS, NORTHEASTERN COUNTIES	36,642	26,850,000

[1] Only the portion of the watershed within California was considered in area and runoff computations.

[2] Includes accretion to Sacramento River between Keswick and Red Bluff of 250,000 acre-feet, not attributable to surface inflow.

Ground Water

The use of underground storage capacity in the control and regulation of water supplies is important in the development of the water resources of the Northeastern Counties. In nearly all cases the better valley agricultural lands are underlain by alluvium to appreciable depth.

The physical characteristics of these basins are often extremely complex. Where ground water has been developed in the past by drilling of wells in these basins, valuable information can be secured and used to evaluate the basins for water control purposes. Where little development has occurred, the potential capacity and value of the basins can be estimated by a study of surface features and conjecture as to subsurface characteristics. Information on ground water basins within the Northeastern Counties was compiled mainly from data gathered during previous investigations by State and Federal agencies. In addition to pertinent ground water resources investigations, a number of published and unpublished geologic investigations and reports were available for reference.

In the Budget Act of 1957, the Legislature provided funds for commencement of a three-year ground water investigation of the principal valley fill areas in Modoc, Lassen, Plumas, and Sierra Counties. The objective of the investigation is the collection and analysis of available geologic and hydrologic data concerning the individual ground water basins of these counties. It is anticipated that this investigation will provide valuable knowledge of the characteristics of the ground water basins, and that it will contribute to the development of this source of water supply.

In the portion of the Northeastern Counties lying in the North Coastal Drainage Basin, several ground water basins are found in areas tributary to the Klamath River. The principal basins are in the Tule Lake and Lower Klamath Lake areas, in Butte Valley, Shasta Valley, Scott Valley, and in Hayfork Valley. The Tule Lake and Lower Klamath Lake basins are composed mainly of old lake sediments and have relatively low yields. The City of Tulelake drilled a well to a depth of 1,600 feet, but was unable to obtain sufficient water from the well. In Butte Valley, a ground water basin, composed both of alluvial materials and fractured volcanic formations, constitutes the major source of irrigation water. The seasonal withdrawals from this basin are now considered to be nearly equal to its safe seasonal yield.

Shasta Valley also contains a ground water basin derived from volcanic and alluvial materials, but it does not generally comprise a good ground water pumping area. The Scott Valley ground water basin is an alluvium-filled depression. The fill materials are derived from both granitic and sedimentary formations. A recent geologic investigation showed the basin to have zones capable of producing good yields along main river channels and in the western stream fans. However, much of the area is relatively impermeable and produces only low yielding wells. Hayfork Valley in Trinity County contains a small basin composed of stream deposits. Little information is available at present regarding its potential for a source of water supply.

The portion of the Northeastern Counties lying in the Central Valley Drainage Basin contains a number of mountain valley ground water basins along the Pit River, in the Upper Feather River Basin, and in the Upper Cache Creek Basin, as well as the extensive Sacramento Valley ground water basin.

The Pit River basins consist of Goose Lake, South Fork of the Pit River, Big Valley, and the Fall River Mills valley area. These basins consist of old lake sediments, stream deposits, and fractured volcanic formations. Good domestic supplies have been developed, but there are very few irrigation wells in the area. In general, the best yielding wells have been located in the fractured volcanic formations. Additional data must be gathered to evaluate the potential of these basins as future sources of water supply.

The upper Feather River basin contains twelve ground water basins. The major, and most important, of these basins are Sierra Valley, Mohawk Valley, American Valley, Indian Valley, and Mountain Meadows Valley. Sierra Valley is the largest basin, encompassing a surface area of about 155 square miles. Most of the water-bearing sediments which fill the valley were deposited in a lake which covered the area until recent geologic times. A well has been drilled to a depth of 1,200 feet into this formation without striking bedrock. The other basins mentioned are smaller, generally less than 20 square miles, but have similar physical characteristics. The water-bearing materials consist of gravels, sands, silts, and clays laid down as stream deposits or lake sediments. Many of the valleys have high water tables. However, the specific yields of the materials are usually low.

In the Clear Lake drainage area small ground water basins occur in Scotts and Big Valley, and in the Upper Lake area. The Upper Lake area and Big Valley are alluvium-filled extensions of the basin occupied by Clear Lake. Basins of limited extent, formed by shallow bodies of unconsolidated stream channel and alluvial deposits, are found in Burns, Excelsior, High, and Long Valleys.

A ground water basin underlies the vicinity of Redding and Cottonwood, along the Sacramento River and the larger streams tributary to this area.

The most notable ground water basin in the Northeastern Counties area is the Sacramento Valley, lying between the Coast Range on the west and the Sierra Nevada on the east. Physically, it extends from Red Bluff on the north to Suisun Bay and is contiguous with the San Joaquin Valley ground water basin. For the purposes of this investigation, however, the southerly limit was assumed to be the southerly boundary of Yolo and Sutter Counties.

The valley trough has been filled to great depths with gravel, sand, silt, and clay, transported down from the adjacent hills and mountains. The most pervious areas occur where the tributary streams discharge on the valley floor. These areas constitute the principal recharge areas for the basin. Much of the valley floor is relatively impermeable because of surface deposits of clay and underlying hardpan formations. However, nearly all areas can obtain good ground water yields by tapping underlying aquifers of permeable sands and gravels.

The portion of the Northeastern Counties lying in the Lahontan Drainage Basin contains three significant alluvial fill areas, but information on the ground water potentials is very scarce. These ground water basins are Surprise Valley in Modoc County, and Madeline Plains and the Honey Lake area in Lassen County. They are sedimentary-filled depressions of rather impermeable character. There are very few wells in the basins, other than those developed for domestic use.

The characteristics of ground water basins within the Northeastern Counties are presented in Table 25.

...ting ...ors	Present general ground water quality	Present use of ground water		Overdraft present	Remarks
		Type	Degree		
...permeable ...e.	Generally high sodium content. Use limited in some portions of the basin.	Irrigation Domestic Stock	Minor Minor Minor	No	Land use presently limited by high water table and impermeable soils.
*	Upper zone water apparently of poor quality.	Irrigation Domestic Municipal	Minor Minor Minor	No	Deep wells apparently required for suitable quality water.
*	Generally suitable for major uses. High sodium content in vicinity of Miess Lake.	Irrigation Domestic Stock	Extensive Significant Significant	No	Increased use would reduce basin outflow thus increase basin yield. (1) Wells located in Quaternary basalt flows and pyroclastics. (2) Wells located in Recent alluvium and Quaternary lake sediments.
*	Inferior quality, limits use in some areas. Generally hard water. Locally high sodium, chloride, nitrate, boron, and/or potassium.	Irrigation Domestic Municipal Stock	Minor Significant Minor Extensive	No	Yields vary widely throughout area. Pluto's Cave basalt in east central valley forms best aquifer continued development from glacial deposits appears possible. (3) In Recent and older alluvium. (4) In glacial and fluio-glacial deposits. (5) In Quaternary volcanics. (6) In Tertiary-Quaternary volcanics.
...ments.	Generally suitable for all major uses.	Irrigation Domestic Stock	Minor Extensive Significant	No	Additional development capable in flood plain sediments. (7) Yield factor, max = 103, avg = 74.
*	Insufficient information.	Insufficient information.		Unknown	Development probably possible throughout area.
... miles ...ally cov- ...lake(8).	Generally suitable but inferior quality limits use in some areas.	Irrigation Domestic Stock	Minor Significant Minor		(8) Probably no continuous aquifers.
...factors.	Generally suitable but inferior quality limits use in some areas.	Stock All other uses.	Minor Significant		
*	Insufficient information.	Domestic Stock	Minor Minor		
...factors ...yield of ...ts.	Generally suitable but inferior quality limits use in some areas.	Irrigation Domestic Stock Municipal	Minor Significant Minor Minor		
*	Generally suitable but inferior quality limits use in some areas.	Irrigation Domestic	Significant Significant	No	Yields are generally low unless the well penetrates permeable volcanic flows.
*	Generally suitable except for saline water at shallow depths along northern edge of valley. Flowing saline wells known.	Irrigation Domestic Municipal Stock Industrial	Significant Intensive Minor Minor Minor	No	North of east-west line through Redding, ground water development is limited as a result of decreasing thickness of water-bearing units and presence of saline water-bearing sediments below fresh water.

TABLE 25

CHARACTERISTICS OF GROUND WATER BASINS WITHIN THE NORTHEASTERN COUNTIES

Ground water basin or reservoir			Water bearing units		Principal recharge areas		Subsurface inflow and outflow	Direction of ground water movement	Structures affecting ground water movement or storage	Pressure areas	Principal references	Data adequacy	Approximate depth to water in wells, in feet			Withdrawal capacity of wells					Storage interval capacity				Present general ground water quality	Present use of ground water		Overdraft present	Remarks
																Discharge, g.p.m.		Specific capacity											
Number shown on Plate No. 1	Name	Area, in square miles	Names	Thickness, in feet	Location	Recharge rates							Period	Maximum	Minimum	Max	Ave.	Max	Ave.	Number of data wells	Storage interval in feet	Total, ac. ft.	Usable ac. ft.	Limiting factors		Type	Degree		
1-2.01	Klamath River Basin, Oklahoma District	31	Qal Upper Pleistocene and Recent alluvial and lake deposits. TQv Tertiary-Quaternary volcanics along west side. Volcanic sands underlying tight diatomite deposits	0-400	Chief recharge in volcanics along west side of basin. Limited recharge along southwest flank of basin	*	Probable inflow through volcanics from Butte Valley	Probably toward marshlands around Lower Klamath and Indian Tom Lakes	Regional northeasterly dip of volcanics. Influence of northwesterly trending faults not known.	Generally confined by overlying diatomite	U.S.G.S. '55 U.S.B.R. '54	Incomplete, considerable estimation	1949 to 1952	106	Flowing	1,300	(Min. 10)		50	3 Flowing 1 (52 ft.)	*	*	*	Highly impermeable diatomite	Generally high sodium content. Use limited in some portions of the basin.	Irrigation Domestic Stock	Minor Minor Minor	No	Land use presently limited by high water table and impermeable soils
1-2.02	Klamath River Basin, Tule Lake Area	127	Qal Upper Pleistocene and Recent alluvial and lake deposits TQv Tertiary-Quaternary volcanics along margins and possibly at depth	0-1,600+	Younger and older volcanics within and surrounding the area.	Low	*	*	*	*	U.S.G.S., General field observation	Scant data available	Fall, 1953	.. (Based on one 2,674-ft well at Tulelake.)	11	*	*		15	1	*	*	*	*	Upper zone water apparently of poor quality	Irrigation Domestic Municipal	Minor Minor Minor	No	Deep wells apparently required for suitable quality water
1-3	Butte Valley	130	Qal Recent alluvium Ql Quaternary lake sediments Qv Quaternary basalt flows and pyroclastics TQv Tertiary-Quaternary volcanics, undifferentiated.	0-315+ 0-735+ 0-500+ 0-1,200+	Along streams and canals in southern valley. Alluvial fans along western margin. Through volcanics adjacent to valley floor.	Moderate to high.	Inflow chiefly from south and west. Outflow mainly northeasterly through volcanics	Toward the east and the northeast	Regional northeasterly dip of volcanics. Influence of northwest trending faults not known	In volcanics at depth. Local confinement in alluvium	U.S.G.S. '55 U.S.B.R. '54	Partially complete data	Summer 1954	68	Flowing	4,000	1,300	62	30	3 (1) 16 (2)	*	*	*	*	Generally suitable for major uses. High sodium content in vicinity of Meiss Lake	Irrigation Domestic Stock	Extensive Significant Significant	No	Increased use would reduce basin outflow thus increase basin yield (1) Wells located in Quaternary basalt flows and pyroclastics. (2) Wells located in Recent alluvium and Quaternary lake sediments
1-4	Shasta Valley	239	Qal Recent and older alluvium. Qm Glacial and glaciofluvial deposits. Qv Quaternary volcanics (Pluto's Cave Basalt) TQv Tertiary-Quaternary volcanics (Western Cascade Series)	0-140+ 0-300+ 0-400+ 0-15,000+	Recent basalt flows in east central valley. Some recharge in fans along western margin of valley.	High Low to moderate.	Inflow chiefly from valley margins. No appreciable outflow.	Northward from southern valley, converging toward Shasta River. Northern valley flows are northward to Willow Creek	Effect of northerly trending faults not known. A barrier may exist on east side of valley	Local confinement throughout area in various formations.	U.S.G.S. '55 U.S.B.R. '54	Partially complete data	Summer 1954	300 300	Flowing Flowing			62 60 139 280	27 26 57 31	8 (3) 4 (4) 8 (5) 17 (6)	*	*	*	*	Inferior quality, limits use in some areas. Generally hard water. Locally high sodium, chloride, nitrate, boron, and/or potassium	Irrigation Domestic Municipal Stock	Minor Significant Minor Extensive	No	Yields vary widely throughout area. Pluto's Cave basalt in east central valley forms best aquifer, continued development from glacial deposits appears possible (3) In Recent and older alluvium. (4) In glacial and fluvio-glacial deposits. (5) In Quaternary volcanics. (6) In Tertiary-Quaternary volcanics
1-5	Scott Valley	60	Qal Upper Pleistocene and Recent alluvial deposits.	0-100+	Chiefly from fans on south and west sides of the valley.	Low to moderate	No appreciable inflow or outflow	Toward Scott River and downstream along river	The principal faults are in bedrock. No known effect on ground water	Some aquifers from western fans. Artesian flow near Greenview	U.S.G.S. '55	Partially complete data	Summer 1951	25	Flowing	2,600	1,770	100	88	..(7)	5-15 to 160	100,000	300,000	Tight sediments	Generally suitable for all major uses	Irrigation Domestic Stock	Minor Extensive Significant	No	Additional development capable in flood plain sediments (7) Yield factor, max = 103, avg = 74.
1-6	Hayfork Valley	6.3	Qal Upper Pleistocene and Recent alluvial deposits, mainly channel deposits	No data	Probably stream channels, mainly Hayfork Creek.	Low to moderate.	Probably no appreciable inflow or outflow	Probably flanks toward center then west	*	*		Scant data available	*	*	*	*	*	*	*	*	*	*	*	*	Insufficient information.	Insufficient information.		Unknown	Development probably possible throughout area.
5-1	Goose Lake Valley	Approx. 156 (8)	Qal Upper Pleistocene and Recent alluvial and lake deposits. TQv Tertiary-Quaternary volcanics	Information incomplete. (9)	Alluvial fans at mouths of Davis, Willow, Lassen, and Pine Creek.	*	Inflow from contiguous terrane. Possible outflow through volcanics	* Probably flows towards Goose Lake	Basin formed by faulting. Effect of faults unknown.	*		Scant data available	Fall, 1957	65	Flowing	2,510	1,650	29	17	?	30 to 230	685,000		120 square miles periodically covered by lake(8)	Generally suitable but inferior quality limits use in some areas	Irrigation Domestic Stock	Minor Significant Minor		(8) Probably no continuous aquifers.
5-2	South Fork Pit River Valley	Approx. 93	Qal Upper Pleistocene and Recent alluvial and lake deposits TQv Tertiary-Quaternary volcanics	Information incomplete.	Channel and flood plain of South Fork east of Likely, North Fork east of Alturas.	*	Inflow from contiguous terrane. No evidence of outflow	South arm of valley toward Alturas, then west toward Canby	Effect of faulting unknown. Bedrock narrows restriction at T41N, R12E, S14, and T42N, R11E, S15.	Some flowing wells on west half of south arm		Incomplete data with considerable estimation.		20	Flowing	700	400			5	20 to 220	595,000		Economic factors	Generally suitable but inferior quality limits use in some areas	Stock All other uses	Minor Significant		
5-3	Jess Valley	9	Qal Upper Pleistocene and Recent alluvial and lake deposits.		Stream channels throughout the valley.	*	Negligible inflow. Outflow through ancient landslide	Westward toward valley outlet.	*	*	*	Scant data available.	*	*	*	*	*	*	*	*	*	*	*	*	Insufficient information	Domestic Stock	Minor Minor		
5-4	Big Valley	103	Qal Recent alluvial and lake deposits. TQ Pleistocene and Tertiary lake deposits	1,231+	Main and distributary channels of Pit River, Ash and Willow Creeks	*	* Outflow probable in outlet gravels	Towards valley outlet about four miles south of Bieber.	Northwest-southeast trending faults may have some effect	Present but not defined		Incomplete data with considerable estimation	Fall, 1957	40	Flowing	500	300		1	5	20 to 220	835,000	400,000	Economic factors and low yield of sediments.	Generally suitable but inferior quality limits use in some areas.	Irrigation Domestic Stock Municipal	Minor Significant Minor Minor		
5-5	Fall River Valley	Approx. 100	Qal Pleistocene and Recent lake and alluvial deposits TQv Tertiary-Quaternary volcanics beneath lake deposits	0-720+	Generally around margins of the valley.	Low	Considerable inflow. Insufficient data to evaluate outflow	Toward the Pit River from both the north and south	Basin formed by faulting. Effect of faults unknown	Confinement in volcanics beneath lake deposits		Scant data available	various	70	Flowing	1,160	450	60	17	15	*	*	*	*	Generally suitable but inferior quality limits use in some areas.	Irrigation Domestic	Significant Significant	No	Yields are generally low unless the well penetrates permeable volcanic flows.
5-6	Redding Basin	513	Qal Recent alluvium, Pleistocene Red Bluff formation. TQ Tertiary, Tertiary-Quaternary, Tuscan and Tehama formations.	0 to 2,700+	Throughout eastern portion, generally by infiltration of precipitation to shallow zones. In western portion, along upper Cottonwood Creek. Possible recharge from Anderson Valley irrigation.	Low to moderate	Inflow negligible in northern half. Possible significant inflow from east in south half. Outflow not evaluated	General trend is toward the Sacramento River, westward and southward along Cow Creek, eastward along Cottonwood Creek.	Red Bluff arch along south boundary	On west side in Tehama formation and in deep zones on east side beneath Stillwater Plains-Cow Creek area.		Incomplete data with considerable estimation	Fall 1955	200+	5	3,160	640	 200	.. 30	63 42	*	*	*	*	Generally suitable except for saline water at shallow depths along northern edge of valley. Flowing saline wells known	Irrigation Domestic Municipal Stock Industrial	Significant Intensive Minor Minor Minor	No	North of east-west line through Redding, ground water development is limited as a result of decreasing thickness of water-bearing units and presence of saline water-bearing sediments below fresh water.

iting tors	Present general ground water quality	Present use of ground water		Overdraft present	Remarks
		Type	Degree		
	Generally suitable for all major uses.	Domestic All others	Significant Minor		Most of valley inundated by Lake Almanor.
	Insufficient information	Domestic Stock	Significant Minor		Most of valley inundated by Mountain Meadows Reservoir.
	Generally suitable for all major uses.	Irrigation Domestic Other uses	Significant Significant Minor		
	Generally suitable for all major uses.	Stock All others	Minor Significant		
	Generally suitable, inferior quality limits use in some areas.	Irrigation Domestic Stock	Minor Minor Minor		
lity at Thick tuf- silts be- aquifers it recharge	Generally suitable, inferior quality, limits use in some areas.	Irrigation Domestic Stock	Significant Significant Significant		Some high boron water. High fluoride and/or warm to hot well waters in central area.
poorer lake water.	Generally suitable except high boron in some areas to west and south.	Irrigation Domestic Stock Others	Intensive Intensive Significant Minor	No	Many wells in pressure areas flow at least part of the year. Gas bubbles in some wells.
iments.	Generally suitable for all major uses.	Irrigation Domestic Stock Others	Intensive Intensive Significant Minor	No	Most wells in pressure area flow at least part of year. (10) Developed artesian aquifers mostly between 50 and 100 feet.
poorer lake water ssibly from ics.	Generally suitable except for high boron areas particularly in east and north.	Irrigation Domestic Stock Industrial	Intensive Intensive Intensive Minor	No	(11) Few good aquifers at greater depth or between terrane in south valley in Tertiary, Tertiary-Quaternary and Lower Pleistocene deposits. (12) Most development in shallow Upper Pleistocene and Recent deposits.
iments.	Insufficient information. Probably generally suitable.	Domestic Stock	Minor Minor		Two successful deep irrigation wells reported drilled since 1955.
boron de- ion from Lake. Tight nts.	High boron water from lake limits use in some areas.	Irrigation Domestic Stock	Minor Significant Minor	No	
iments.	Generally suitable for all major uses.	Irrigation Domestic	Minor Significant	No	Increase development possible with no apparent water problems.
iments.	Generally suitable for all major uses.	Irrigation Domestic Stock	Minor Significant Significant	No.	Probably some usable storage below 100 feet.

...iting ...tors	Present general ground water quality	Present use of ground water: Type	Present use of ground water: Degree	Overdraft present	Remarks
	Generally suitable for all major uses.	Domestic All others	Significant Minor		Most of valley inundated by Lake Almanor.
	Insufficient information	Domestic Stock	Significant Minor		Most of valley inundated by Mountain Meadows Reservoir.
	Generally suitable for all major uses.	Irrigation Domestic Other uses	Significant Significant Minor		
	Generally suitable for all major uses.	Stock All others	Minor Significant		
	Generally suitable, inferior quality limits use in some areas.	Irrigation Domestic Stock	Minor Minor Minor		
lity at Thick tuf- silts be- aquifers it recharge	Generally suitable, inferior quality, limits use in some areas.	Irrigation Domestic Stock	Significant Significant Significant		Some high boron water. High fluoride and/or warm to hot well waters in central area.
poorer lake water.	Generally suitable except high boron in some areas to west and south.	Irrigation Domestic Stock Others	Intensive Intensive Significant Minor	No	Many wells in pressure areas flow at least part of the year. Gas bubbles in some wells.
liments.	Generally suitable for all major uses.	Irrigation Domestic Stock Others	Intensive Intensive Significant Minor	No	Most wells in pressure area flow at least part of year. (10) Developed artesian aquifers mostly between 50 and 100 feet.
poorer lake water ssibly from ics.	Generally suitable except for high boron areas particularly in east and north.	Irrigation Domestic Stock Industrial	Intensive Intensive Intensive Minor	No	(11) Few good aquifers at greater depth or between terrane in south valley in Tertiary, Tertiary-Quaternary and Lower Pleistocene deposits. (12) Most development in shallow Upper Pleistocene and Recent deposits.
liments.	Insufficient information. Probably generally suitable.	Domestic Stock	Minor Minor		Two successful deep irrigation wells reported drilled since 1955.
boron de- ion from Lake. Tight nts.	High boron water from lake limits use in some areas.	Irrigation Domestic Stock	Minor Significant Minor	No	
liments.	Generally suitable for all major uses.	Irrigation Domestic	Minor Significant	No	Increase development possible with no apparent water problems.
liments.	Generally suitable for all major uses.	Irrigation Domestic Stock	Minor Significant Significant	No.	Probably some usable storage below 100 feet.

TABLE 25—Continued

CHARACTERISTICS OF GROUND WATER BASINS WITHIN THE NORTHEASTERN COUNTIES

Ground water basin or reservoir			Water bearing units		Principal recharge areas		Subsurface inflow and outflow	Direction of ground water movement	Structures affecting ground water movement or storage	Pressure areas	Principal references	Data adequacy	Approximate depth to water in wells, in feet			Withdrawal capacity of wells					Storage interval capacity				Present general ground water quality	Present use of ground water		Overdraft present	Remarks
Number shown on Plate No. 1	Name	Area, in square miles	Names	Thickness in feet	Location	Recharge rates							Period	Maximum	Minimum	Discharge, g.p.m. Max.	Discharge, g.p.m. Ave.	Specific capacity Max.	Specific capacity Ave.	Number of data wells	Storage interval in feet	Total, ac. ft.	Usable, ac. ft.	Limiting factors		Type	Degree		
5-7	Lake Almanor Valley	7 not inundated	Qal Recent alluvium Qv Quaternary volcanics	135+ 300+	Feather River flood plain near Chester. Numerous small fans around basin.	Low	Probable inflow from surrounding volcanic terrane	Probably from basin periphery toward Lake Almanor.	*	No important areas known.	DWR '55	Incomplete data with considerable estimation		120	12	300	No data.	--	--	--	10 to 210	45,000		--	Generally suitable for all major uses	Domestic All others	Significant Minor		Most of valley inundated by Lake Almanor.
5-8	Mountain Meadows Valley	10 not inundated	Qal Recent alluvium and Pleistocene glacio-fluvial deposits	No data	Minor fans at mouths of small streams	Low.	*	From periphery towards reservoir	*	None known	DWR '55	Scant data available	*	*	*	*	*	*	*	*	Insufficient			information	Insufficient information	Domestic Stock	Significant Minor		Most of valley inundated by Mountain Meadows Reservoir.
5-9	Indian Valley	20	Qal Recent alluvium	263+	Indian Creek near Taylorsville. Wolf Creek near Greenville	Moderate. Low.	Possible inflow along Indian Creek and Lights Creek. No outflow.	Follows surface drainage towards valley outlet.	*	Center of valley	DWR '55	Incomplete data with considerable estimation.		10	Flowing	500	No data	30	No data	--	10 to 210	100,000			Generally suitable for all major uses.	Irrigation Domestic Other uses	Significant Significant Minor		
5-10	American Valley	7	Qal Recent alluvium	225+	Along Spanish Creek throughout most of valley.	High.	Inflow and outflow along Spanish Creek.	Follows surface drainage towards valley outlet.	*	No important areas known.	DWR '55	Incomplete data with considerable estimation.		49	8	975	250	--	11.4		10 to 210	50,000			Generally suitable for all major uses	Stock All others	Minor Significant		
5-11	Mohawk Valley	8	Qal Recent alluvium, Pleistocene lake and glacio-fluvial sediments	No data	Southeast end of valley	Low.	Inflow probable from glacial deposits along southwest margin. Possible outflow in old lake sediments	Toward Middle Fork Feather River, then northwest toward valley outlet.	*	*	DWR '55	Scant data available		22			160		2	1	Insufficient			information	Generally suitable, inferior quality limits use in some areas.	Irrigation Domestic Stock	Minor Minor Minor		
5-12	Sierra Valley	137	Qal Recent alluvium TQ Tertiary-Pleistocene lake deposits with interbedded stream deposits	0-1,200	Generally around the margins of the valley.	Low to high.	Possible inflow from surrounding volcanics. Probably no outflow.	Minor movement, probably to the northwest.	Probably fault along west margin, possible faults along north margin. Other faulting may also effect ground water movement.	Almost entire valley except north of Highway 40 Alternate and south of Sierraville and Loyalton.	DWR '55	Incomplete data with considerable estimation.		10	Flowing	*	*	*	*	*	10 to 210	500,000		Poor quality at depth. Thick tuffaceous silts between aquifers will limit recharge rate.	Generally suitable, inferior quality, limits use in some areas	Irrigation Domestic Stock	Significant Significant Significant		Some high boron water. High fluoride and/or warm to hot well waters in central area
5-13	Upper Lake Valley	15	Qal Recent alluvium and lake deposits. Some Pleistocene sediments.	0-200+	Northern part of basin, particularly along Middle, Clover, and Alley Creeks	Low to moderate	Possible minor inflow south of Upper Lake from southwest. Outflow to Clear Lake.	Southward toward Clear Lake	Bedrock highs, principally in Bachelor Valley and along Scott Creek	Community of Upper Lake and southward, also Lower Clo-Valley	SWRB Bulletin No. 14, '55	Good coverage of adequate data	Summer 1953	17	Flowing	475	270			9	10 to 100	10,000	5,000	Inflow of poorer quality lake water	Generally suitable except high boron in some areas to west and south.	Irrigation Domestic Stock Others	Intensive Intensive Significant Minor	No	Many wells in pressure areas flow at least part of the year. Gas bubbles in some wells.
5-14	Scotts Valley	3.5	Qal Recent alluvium. Some lake sediments	0-260 (10)	Southern part of basin, particularly along Scott Creek	Low to moderate.	Minor inflow and outflow beneath Scott Creek. Inflow from eastern terrace.	Northwestward toward lower end of valley.	No known barrier effect	All of valley except 700 acres in southern part of valley	SWRB Bulletin No. 14, '55	Good coverage of adequate data	Summer 1953	20	Flowing	710	500			4	10 to 100	5,000	4,500	Tight sediments	Generally suitable for all major uses	Irrigation Domestic Stock Others	Intensive Intensive Significant Minor	No	Most wells in pressure area flow at least part of year. (10) Developed artesian aquifers mostly between 50 and 100 feet.
5-15	Kelseyville Valley	31	Qal Recent alluvium and lake deposits TQ Tertiary-Quaternary deposits, principally Cache formation, includes volcanic ash.	0-75± 0-400±	Southern part of basin along Kelsy and Adobe Creeks	Mostly Moderate.	Apparently no significant inflow, outflow to Clear Lake.	Northward toward Clear Lake.	No known barrier effect.	North of T13-14N line. Local pressure.	SWRB Bulletin No. 14, '55	Good coverage of adequate data.	Summer 1951 Summer 1953	100+ 21	Shallow Flowing	 1,350	 450			67(11) ..(12)	10 to 100	105,000	90,000	Inflow of poorer quality lake water and possibly from volcanics	Generally suitable except for high boron areas particularly in east and north	Irrigation Domestic Stock Industrial	Intensive Intensive Intensive Minor	No	(11) Few good aquifers at greater depth or between terraces in south valley in Tertiary, Tertiary-Quaternary and Lower Pleistocene deposits. (12) Most development in shallow Upper Pleistocene and Recent deposits.
5-16	High Valley	3.1	Qal Upper Pleistocene and Recent alluvial fan and lake deposits	0-100+	Limited to some alluvial fans.	Low to very low	No appreciable inflow; probably moderate outflow to east	Probably nearly all easterly.	No known barrier affects.	Possibly confined water beneath upper fine-grained deposits.	U.S.G.S. WSP 1297, '55	Incomplete data with considerable estimation	Summer 1950	21.5	2.5		Generally low				10 to 100	9,000	900	Tight sediments	Insufficient information. Probably generally suitable.	Domestic Stock	Minor Minor		Two successful deep irrigation wells reported drilled since 1955.
5-17	Burns Valley	1.6	Qal Recent channel gravels, and flood plain deposits TQ Tertiary-Quaternary deposits, principally Cache formation.	0-200+	Principally stream channels	Low, some moderate	Appreciable inflow from Cache Creek, outflow to lake	Probably southwest toward Clear Lake.	Possible fault across valley trending to northwest.	Probably some in Cache formation only.	U.S.G.S. WSP 1297, Brice, '53	Partially complete data.	Summer 1951	15	3		350			1	10 to 00	4,000	1,100	Possible boron degradation from Clear Lake. Tight sediments.	High boron water from lake limits use in some areas	Irrigation Domestic Stock	Minor Significant Minor	No	
5-18	Coyote Valley	5.5	Qal Upper Pleistocene and Recent Flood plain, channel, alluvial fan and lake deposits TQ Tertiary-Quaternary deposits, principally Cache formation.	0-100+	Along Putah Creek, marginal alluvial fans and areas adjacent to Cache formation along northeastern valley border.	Moderate.	Possible inflow from Cache formation and basalt along northeast valley margin. Outflow possible to basalt.	Probably in direction of surface water movement	Effects of indicated barrier unknown.	Apparently none, deeper strata in lower end of valley may be confined.	U.S.G.S. WSP 1297, '55, Brice '53	Partially complete data.	Summer 1951	13.5	0.5	1,200	190			5	10 to 100	29,000	7,000	Tight sediments	Generally suitable for all major uses	Irrigation Domestic	Minor Significant	No	Increase development possible with no apparent water problems.
5-19	Collayomi Valley	0.75	Qal Upper Pleistocene and Recent alluvial fans, terraces, channel, and lake deposits	0-220	Principally stream channels	Low, some moderate	Negligible.	Probably in general direction of surface drainage	Collayomi fault a possible barrier on west part of north valley edge.	Apparently none.	U.S.G.S. WSP 1297, '55, Brice '53	Partially complete data.	Summer 1951	13.5	0.5	1,200	400			5	10 to 100	29,000	7,000	Tight sediments	Generally suitable for all major uses	Irrigation Domestic Stock	Minor Significant Significant	No.	Probably some usable storage below 100 feet.

…iting …tors	Present general ground water quality	Present use of ground water		Overdraft present	Remarks
		Type	Degree		
…lity and …	Generally suitable except high chloride in area south of Sutter Buttes between Feather and Sacramento Rivers. Moderately high boron in Woodland area.	Irrigation Domestic Stock Industrial Municipal	Intensive Intensive Intensive Intensive Intensive		
*	Generally suitable for irrigation but quality limits use in some areas.	Irrigation Domestic Stock	Minor Minor Minor		Stream diversion main source of water. Some utilization made of hot and warm springs.
*	Insufficient information.	Stock	Minor		Limited domestic use from springs.
	Inferior quality limits use in some areas.	Irrigation Domestic Stock	Minor Significant Significant		Numerous hot wells in eastern portion of basin. Internal drainage.
	Inferior quality limits use in some areas.	Domestic Stock	Minor Minor		Well logs show much clay and lava. Internal drainage.
	Generally suitable for all major uses.	Domestic Stock	Minor Minor		Surface diversion used for most present water requirements.
	Inferior quality limits use in some areas.	All uses	Significant		Internal drainage.

...iting ...tors	Present general ground water quality	Present use of ground water		Overdraft present	Remarks
		Type	Degree		
...lity and ...	Generally suitable except high chloride in area south of Sutter Buttes between Feather and Sacramento Rivers. Moderately high boron in Woodland area.	Irrigation Domestic Stock Industrial Municipal	Intensive Intensive Intensive Intensive Intensive		
*	Generally suitable for irrigation but quality limits use in some areas.	Irrigation Domestic Stock	Minor Minor Minor		Stream diversion main source of water. Some utilization made of hot and warm springs.
*	Insufficient information.	Stock	Minor		Limited domestic use from springs.
	Inferior quality limits use in some areas.	Irrigation Domestic Stock	Minor Significant Significant		Numerous hot wells in eastern portion of basin. Internal drainage.
	Inferior quality limits use in some areas.	Domestic Stock	Minor Minor		Well logs show much clay and lava. Internal drainage.
	Generally suitable for all major uses.	Domestic Stock	Minor Minor		Surface diversion used for most present water requirements.
	Inferior quality limits use in some areas.	All uses	Significant		Internal drainage.

TABLE 25—Continued

CHARACTERISTICS OF GROUND WATER BASINS WITHIN THE NORTHEASTERN COUNTIES

Ground water basin or area			Water-bearing units		Principal recharge areas		Subsurface inflow and outflow	Direction of ground water movement	Structures affecting ground water movement or storage	Pressure areas	Principal references	Data adequacy	Approximate depth to water in wells, in feet			Withdrawal capacity of wells					Storage interval capacity				Present general ground water quality	Present use of ground water		Overdraft present	Remarks
Number shown on Plate No. 1	Name	Area, in square miles	Names	Thickness in feet	Location	Recharge rates							Period	Maximum	Minimum	Discharge, g.p.m. Max.	Discharge, g.p.m. Ave.	Specific capacity Max.	Specific capacity Ave.	Number of data wells	Storage interval in feet	Total, ac. ft.	Usable, ac. ft.	Limiting factors		Type	Degree		
[illegible]	Sacramento Valley	5000	Qal Upper Pleistocene and Recent alluvium and terrace deposits TQ Tertiary and Lower Pleistocene deposits Tehama, Victor and Laguna formations Tv Tertiary volcanics Mehrten and Tuscan formations	[illegible]	Areas adjacent to foothills on the east and west.	Low to moderate	Some inflow in the Tehama, Victor, and Laguna formations in the upland areas. Apparently no appreciable outflow.	Area north of Sutter Buttes flow generally southwest in east valley and southeast in west valley. South of Sutter Buttes flow also toward valley axis	Sutter Buttes alter normal movement of ground water. No known fault barriers	The pressure areas that do exist are usually semi-confined	U S G.S. '56 SWRB Bulletin No. 1 '51	Partially complete data.	Summer 1953	250	0			530			20 to 200	33,[illegible]	22,000,000	Permeability and quality.	Generally suitable except high chloride in area south of Sutter Buttes between Feather and Sacramento Rivers. Moderately high boron in Woodland area	Irrigation Domestic Stock Industrial Municipal	Intensive Intensive Intensive Intensive Intensive		
5-33	Warm Springs Valley	34	Qal Recent alluvium. TQ Tertiary-Quaternary lake sediments. TQv Tertiary-Quaternary volcanics.	Probably thin	Insufficient information.		*	Probably analogous to Pit River surface drainage towards valley center, then westward.	*	Insufficient information.	U S G S WSP 335 15	Scant data available	*	*	Flowing	*	*	*	*	*	*	*	*	*	Generally suitable for irrigation but quality limits use in some areas.	Irrigation Domestic Stock	Minor Minor Minor		Streams in season main source of water. Some utilization made of hot and warm springs.
5-34	Grizzly Valley	15	Qal Recent and older alluvium and lake sediments	Probably thin	Insufficient information.		*	Probably analogous to Big Grizzly Creek surface drainage south eastward to valley outlet	*	Insufficient information.		Scant data available.	*	*	*	*	*	*	*	*	*	*	*	*	Insufficient information.	Stock	Minor		Limited domestic use from springs
6-1	Surprise Valley	240	Qal Upper Pleistocene and Recent alluvium and lake sediments	0-800+	Fans of Warner Range and Bidwell Creek area	Low	No known inflow or outflow	Generally from west to basin center	North trending system of faults may have some effect.	Most of area near valley center	DWR '56	Scant data available	Summer 1954	63	Flowing	1,000	900	75	30	10	20 to 220	3,680,000			Inferior quality limits use in some areas	Irrigation Domestic Stock	Minor Significant Significant		Numerous hot wells in eastern portion of basin. Internal drainage.
6-2	Madeline Plains Basin	225	Qal Pleistocene and Recent lake sediments ?TQv Possibly Tertiary-Quaternary volcanics	0-850+	Red Rock Creek area surrounding volcanic flows and alluvial fans of Bailey and Van Loan Creek areas.	Low	No known inflow or outflow	Insufficient data.	*	Insufficient information	DWR WQ '53	Incomplete data with considerable estimation.	Summer 1952	90	4	110	80			2	30 to 230	1,758 000			Inferior quality limits use in some areas.	Domestic Stock	Minor Minor		Well logs show much clay and lava. Internal drainage
6-3	Willow Creek	32	Qal Recent alluvium. ?TQv Possibly Tertiary-Quaternary volcanics.	0-13+	Fans surrounding basin.	Low	Inflow from Eagle Lake. Outflow possibly toward Honey Lake	To north side of basin.	*	Insufficient information.	DWR '56	Scant data available.		7 9	Surface	Unknown					20 to 120	204 800			Generally suitable for all major uses.	Domestic Stock	Minor Minor		Surface diversion used for most present water requirements
6-4	Honey Lake Basin	395	Qal Pleistocene and Recent alluvial and lake sediments	0-500+	Fans of Sierra Nevada, Susan River, Long Valley, and Peters Valley Creeks	Low	Possible inflow from Willow Creek. Outflow unknown	Towards Honey Lake.	Honey Lake fault	Area northeast of Wendel	DWR '56	Scant data available.	Summer 1954	202	Flowing	2,100	1,157		*	4	20 to 220	5,000,000			Inferior quality limits use in some areas	All uses	Significant		Internal drainage.

* No information

Water Quality

The water quality objectives of this investigation include determination of the mineral characteristics of the surface and ground waters and a survey of water quality problems. An evaluation has been made of the usability of the surface and ground water supplies for existing and potential beneficial uses, including domestic and municipal, irrigation, fish and aquatic life, industrial and recreation.

Water Quality Criteria. Water quality criteria presented in the following sections are those presently used by the Department of Water Resources. They should not be considered absolute limits; and waters exceeding these values should not be completely eliminated from consideration as sources of supply. However, where these criteria cannot be met, it may be advisable to explore the possibility of obtaining waters of better quality.

Domestic and Municipal Supplies. The United States Public Health Service has published recommendations for quality of drinking water which have been adopted by the State of California. Table 26 gives the limiting concentrations of mineral constituents.

TABLE 26

UNITED STATES PUBLIC HEALTH SERVICE DRINKING WATER STANDARDS, 1946

Mineral constituent	Concentration, in parts per million
Mandatory limits:	
Lead (Pb)	0.1
Fluoride (F)	1.5
Arsenic (As)	0.05
Selenium (Se)	0.05
Hexavalent chromium (Cr^{+6})	0.05
Nonmandatory, but recommended, limits:	
Copper (Cu)	3.0
Iron (Fe) and Manganese (Mn) together	0.3
Magnesium (Mg)	125
Zinc (Zn)	15
Chloride (Cl)	250
Sulfate (SO_4)	250
Phenolic compounds in terms of phenol	0.001
Total solids, desirable	500
Total solids, permitted	1,000

Although hardness of water is not included in the above drinking water standards, it is of importance in domestic and industrial uses. Excessive hardness in water used for domestic purposes causes increased consumption of soap and formation of scale in pipes and fixtures. The following tabulation for degrees of hardness has been suggested by the United States Geological Survey:

Class	*Range of hardness in parts per million*
1	0- 55 Soft
2	56-100 Slightly hard
3	101-200 Moderately hard
4	201-500 Very hard

Class 1 and 2 waters generally require no softening, while those of class 3 and 4 ordinarily require softening to some degree, depending upon use. A water exceeding 500 parts per million hardness would probably require softening by other than conventional means.

Irrigation Supplies. Suitability of water for irrigation is evaluated by criteria suggested by Dr. L. D. Doneen of the University of California at Davis. The principal factors considered in this classification include: (1) total dissolved mineral solids; (2) chloride concentration; (3) percent sodium; and (4) boron concentration. Irrigation waters are divided into the following groups:

Class I. Excellent to good, or suitable under most conditions.

Class II. Good to injurious, or harmful to some plants under certain conditions.

Class III. Injurious to unsatisfactory, or harmful to most plants under most conditions.

The limits for these classes are presented in Table 27.

Class I irrigation water is usually suitable for all types of crops. Class II irrigation water is of doubtful suitability, under certain conditions, for low salt-tolerant crop plants, including citrus and deciduous fruit, certain vegetables, and most clover grasses. Class III water is ordinarily unsatisfactory for any except the more tolerant plants such as cotton, beets, and salt-tolerant forage grasses.

TABLE 27

QUALITATIVE CLASSIFICATION OF IRRIGATION WATERS

Chemical property	Class I	Class II	Class III
	Excellent to good	Good to injurious	Injurious to unsatisfactory
Total dissolved solids:			
In parts per million	Less than 700	700-2,000	More than 2,000
In conductance EC × 10^6 at 25° C	Less than 1,000	1,000-3,000	More than 3,000
Chloride in parts per million	Less than 175	175- 350	More than 350
Sodium in per cent of base constituents	Less than 60	60- 75	More than 75
Boron in parts per million	Less than 0.5	0.5- 2.0	More than 2.0

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Arsenic (As)	0.05
Selenium (Se)	0.05
Hexavalent chromium (Cr^{+6})	0.05
Nonmandatory, but recommended, limits:	
Copper (Cu)	3.0
Iron (Fe) and Manganese (Mn) together	0.3
Magnesium (Mg)	125
Zinc (Zn)	15
Chloride (Cl)	250
Sulfate (SO_4)	250
Phenolic compounds in terms of phenol	0.001
Total solids, desirable	500
Total solids, permitted	1,000

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In conductance EC × 10^6 at 25° C	Less than 1,000	1,000-3,000	More than 3,000
Chloride in parts per million	Less than 175	175- 350	More than 350
Sodium in per cent of base constituents	Less than 60	60- 75	More than 75
Boron in parts per million	Less than 0.5	0.5- 2.0	More than 2.0

The application of these criteria to specific conditions is subject to several limitations. In many instances a water may be wholly unsuitable for irrigation under certain conditions of use, and yet be completely satisfactory under other circumstances. Soil permeability, temperature, humidity, rainfall, and other contributing conditions, must also be considered in addition to quality classification.

Industrial Supplies. The requirements for quality of water used for industrial purposes are many and diverse, depending on the type of industry and the use to which it is applied.

Requirements for food-processing plants, in general, conform to the United States Public Health Service's drinking water standards set forth in Table 26. Cooling waters used in many industrial processes ordinarily are the least exacting as to quality requirements.

Table 28 provides water quality values for various industrial uses as suggested by the Committee on Quality Tolerance for Industrial Uses. These requirements should serve only as a guide to a selection of the best or most economical source of water supply for a particular industry.

Preservation and Protection of Fish and Aquatic Life. Studies by various state and federal agencies have definitely ascertained that water used for fish and aquatic life propagation should be free of excessive turbidity or toxic or harmful concentrations of mineral and organic substances. The following water quality criteria are recommended by the State Department of Fish and Game:

1. Dissolved oxygen content not less than 85 per cent saturation.

2. Hydrogen-ion concentration (pH) ranging between 7.0 and 8.5.

3. Conductivity between 150 and 500 micromhos at 25° C, and in general not exceeding 1,000 micromhos.

Other factors that create serious problems to the existence of fish and aquatic life are listed as follows:

1. Mineral salts of high toxicity to fish are those of silver, mercury, copper, lead, zinc, cadmium, aluminum, nickel, trivalent and hexavalent chromium,

TABLE 28

WATER QUALITY TOLERANCE FOR INDUSTRIAL USES [a]

ALLOWABLE LIMITS IN PARTS PER MILLION

Use	Turbidity	Color	Hardness as $CaCO_3$	Iron [c] as Fe	Manganese as Mn	Total solids	Alkalinity as $CaCO_3$	Odor taste	Hydrogen sulfide	Miscellaneous requirements: Health	Miscellaneous requirements: Other
Air conditioning	----	----	----	0.5	0.5	----	----	Low	1	----	No corrosiveness, slime formation.
Baking	10	10	----	0.2	0.2	----	----	Low	0.2	Potable [b]	
Brewing:											
Light Beer	10	----	----	0.1	0.1	500	75	Low	0.2	Potable [b]	NaCl less than 275 ppm (pH 6.5-7.0).
Dark beer	10	----	----	0.1	0.1	1,000	150	Low	0.2	Potable [b]	NaCl less than 275 ppm (pH 7.0 or more).
Canning:											
Legumes	10	----	25–72	0.2	0.2	----	----	Low	1	Potable [b]	
General	10	----	----	0.2	0.2	----	----	Low	1	Potable [b]	
Carbonated beverages	2	10	250	0.2	0.2	850	50–100	Low	0.2	Potable [b]	Organic color plus oxygen consumed less than 10 ppm.
Confectionery	----	----	----	0.2	0.2	100	----	Low	0.2	Potable [b]	pH above 7.0 for hard candy.
Cooling	50	----	50	0.5	0.5	----	----	----	5	----	No corrosiveness, slime formation.
Food: General	10	----	----	0.2	0.2	----	----	Low	----	Potable [b]	
Ice	5	5	50	0.2	0.2	----	----	Low	----	Potable [b]	SiO_2 less than 10 ppm.
Laundering	----	----	50	0.2	0.2	----	----	----	----	----	
Plastics, clear, uncolored	2	2	----	0.02	0.02	200	----	----	----	----	
Paper and pulp:											
Groundwood	50	20	180	1.0	0.5	----	----	----	----	----	No grit, corrosiveness.
Kraft pulp	25	15	100	0.2	0.1	300	----	----	----	----	
Soda and sulfide	15	10	100	0.1	0.05	200	----	----	----	----	
High-grade light papers	5	5	50	0.1	0.05	200	----	----	----	----	
Rayon (viscose):											
Pulp production	5	5	8	0.05	0.03	100	total 50; hydroxide 8	----	----	----	Al_2O_3 less than 8 ppm, SiO_2 less than 25 ppm, Cu less than 5 ppm.
Manufacture	0.3	----	55	0.0	0.0	----	----	----	----	----	pH 7.8 to 8.3.
Tanning	20	10–100	50–135	0.2	0.2	----	total 135; hydroxide 8	----	----	----	
Textiles: General	5	20	----	0.25	0.25	----	----	----	----	----	
Dyeing	5	5–20	----	0.25	0.25	200	----	----	----	----	Constant composition. Residual alumina less than 0.5 ppm.
Wool scouring	----	70	----	1.0	1.0	----	----	----	----	----	
Cotton bandage	5	5	----	0.2	0.2	----	----	Low	----	----	

[a] Moore, E. W., Progress Report of the Committee on Quality Tolerances of Water for Industrial Uses: Journal, New England Water Works Association, Volume 54, page 271, 1940.
[b] Potable water, conforms to U.S.P.H.S. standards.
[c] Limit given applies to both iron alone and the sum of iron and manganese.

tin, iron, gold, cerium, platinum, thorium, and palladium.

2. Many detergents and agricultural poisons and insecticides which are toxic to fishlife are being used in increasing quantities.

3. Normal range of water temperature for cold-water fish lies between 32° and 70° F., with an extreme maximum of 81° F. For warm-water species, a temperature range from 32° to 86° F. and a high of 91° F. is generally considered acceptable.

4. Waters containing more than 15 parts per million of ether soluble material are deleterious to most fish and aquatic life.

Recreational Uses. There are no generally accepted mineral criteria governing waters used for recreation. Mineral content of water used for recreational purposes rarely presents a problem; rather, sanitary factors are of primary significance.

Water Quality Conditions. A discussion of present quality of surface and ground waters, and a discussion of water quality problems for the portions of the North Coastal, Central Valley, and Lahontan Drainage Basins in Northeastern Counties are presented in the following sections. Inasmuch as most of the surface and ground water resources in these basins are of good to excellent mineral quality, much of the discussion pertains to those areas which have water quality problems. Mineral analyses of surface and ground waters in these basins are presented in Tables 29 and 30.

North Coastal Drainage Basin. With few exceptions, surface waters in the portion of the North Coastal Drainage Basin in Northeastern Counties are generally calcium or calcium-magnesium-bicarbonate in type. They are of excellent quality and suitable for all ordinary beneficial uses. The Klamath River, in its upper reaches, differs from the ordinary surface streams in this basin in that it is generally a sodium bicarbonate type water. Further downstream, the Klamath River near Somesbar appears to be of a calcium bicarbonate nature, due principally to the tributary inflow of calcium bicarbonate waters below Copco. The upper Trinity River drainage is principally magnesium bicarbonate type water thus differing from most of the waters found in the North Coastal Drainage Basin.

Notable exceptions to the good quality of surface waters in the North Coastal Drainage Basin are found in Meiss Lake in the northwestern section of Butte Valley, Tule Lake, and Indian Tom Lake.

Meiss Lake contains water of a sodium bicarbonate nature, with high concentrations of total dissolved solids and an excessive percentage of sodium. Present quality of Meiss Lake indicates a Class II irrigation water, generally usable only under the best soil conditions and for the more salt-tolerant crops.

Tule Lake water consists of a mixture of flood waters, local drainage, and irrigation return flows; and its quality falls between Class I and II irrigation water. Considerable concentrations of sulfates are present, which might create a problem for domestic or municipal use. Excessive concentrations of chloride, boron, and total dissolved solids and high per cent sodium are found in the waters of Indian Tom Lake.

Ground water in the North Coastal Drainage Basin, with a few exceptions, is good to excellent in quality except for hardness, and reflects the character of surface streams recharging the ground water basins. Ground waters in the several basins are frequently moderately to very hard, thus limiting their suitability for domestic uses without softening.

Fair to poor quality ground waters are found in portions of large valleys in the North Coastal Drainage Basin. Excessive nitrates are observed in a number of wells during the spring season possibly due, in part, to leaching from applied organic fertilizers.

In Butte Valley, occasional high concentrations of sulfates, boron, total dissolved solids, and high per cent sodium create scattered water quality problems. The better quality ground water is generally found in the southwestern portion of the valley.

In the vicinity of Lower Klamath and Tule Lakes there are large areas of soils consisting largely of decomposed organic materials. Evidence of organic substances in ground water is indicated by analysis of a single sample collected from a medium-depth well near the City of Tulelake which shows an excessive concentration of ammonium.

In the Little Shasta area in Shasta Valley, and the Willow Creek drainage area near Ager, poor quality ground water is found. Fault zones in these areas probably permit deep seated highly mineralized waters to commingle with and degrade usable ground waters. High concentrations of boron, total dissolved solids, and per cent sodium, make waters in these two localized areas undesirable for irrigation of any but the most salt-tolerant crops.

Water quality problems in the North Coastal Drainage Basin stem from three or four principal causes, and are not ordinarily concentrated in any one specific area. Drainage and leaching from abandoned copper, gold, and silver mines are major sources of surface water quality impairment. Although only a small number of existing mines are presently in operation, an increase in this activity might occur in the future. Mine leaching ordinarily causes a considerable increase in mineral content and turbidity. Minor dredging operations on the Scott and Trinity Rivers also create a quality impairment of these major streams similar in nature to that caused by mine waste discharges.

3—16762

TABLE 29

MINERAL ANALYSES OF SURFACE WATER WITHIN THE NORTHEASTERN COUNTIES[a]

Source	Location number MDB&M	Date sampled	Discharge in second-feet	Temp. in °F.	Specific conductance (micromhos at 25°C.)	pH	Mineral constituents in parts per million / equivalents per million: Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Boron (B)	Silica (SiO_2)	Other constituents[c]	Total[b] dissolved solids in ppm	Per cent sodium	Hardness as $CaCO_3$: Total ppm	Hardness as $CaCO_3$: N.C. ppm	Remarks
NORTH COASTAL DRAINAGE BASIN																								
Tule Lake																								
Antelope Creek south of Tennant	43N/1W-25C1S	2/26/53	22	37	55	7.1	6.0	1.5	3.6	0.9	0	34	1.8	0.8	0.2	0.1	0.02	28		60	26	21	0	
							0.30	0.12	0.16	0.02	0.00	0.56	0.04	0.02	0.00									
Butte Creek south of Macdoel	45N/1W-30H1S	9/25/53	4.7	56	78	7.1	6.9	3.6	4.1	1.4	0	49	1.6	1.0	0.3	0.2	0.01	27		70	21	32	0	
							0.34	0.30	0.18	0.04	0.00	0.80	0.03	0.03	0.01									
Meiss Lake northwest side	46N/2W-2E1S	5/ 5/54	------	------	1,100	8.1	18	12	232	14	0	696	8.1	28	1.3	0.5	0.00	36		693	82	94	0	
							0.90	0.99	10.09	0.36	0.00	11.41	0.17	0.79	0.02									
		9/21/54	------	------	1,920	9.0	16	18	432	30	110	1,050	14	48	4.0	1.4	0.11	24		1,210	86	112	0	
							0.80	1.44	18.79	0.77	3.67	17.21	0.29	1.35	0.06									
Indian Tom Lake near Dorris	48N/1E-17Q1S	8/13/54	------	-----	4,110	9.5	8.0	7.8	891	163	362	1,090	173	388	1.5	1.6	3.4	9.6		2,540	88	52	0	
							0.40	0.64	38.74	4.17	12.06	17.86	3.60	10.94	0.02									
Klamath River																								
Klamath River near Copco	48N/5W-36G1S	5/12/55	2,920	50	179	7.1	5.1	10	14	2.5	0	73	18	4.0	2.9	0.1	0.14	19		112	34	55	0	P.S.S.P. Sta. #1[d]
							0.25	0.85	0.61	0.06	0.00	1.20	0.37	0.11	0.05									
		9/13/55	1,560	62	191	7.3	13	7.2	15	2.5	0	92	13	3.2	2.6	0.3	0.06	35		137	33	62	0	
							0.65	0.59	0.65	0.06	0.00	1.51	0.27	0.09	0.04									
Klamath River north of Yreka	46N/6W-18N1S	4/24/53	4,000	51	155	7.2	12	6.1	11	2.0	0	67	20	2.2	1.0	0.2	0.03	19		106	29	55	0	
							0.60	0.50	0.48	0.05	0.00	1.10	0.42	0.06	0.02									
Klamath River east of Gottville	46N/8W-1M1S	5/27/53	7,400	54	207	7.8	12	9.0	17	2.4	0	94	20	4.5	1.5	0.0	0.06	24		137	35	67	0	
							0.60	0.74	0.74	0.06	0.00	1.54	0.42	0.13	0.02									
		10/ 2/53	2,800	58	196	7.4	13	7.3	16	2.5	0	95	10	5.2	4.9	0.1	0.06	38		144	35	62	0	
							0.65	0.60	0.70	0.06	0.00	1.56	0.21	0.15	0.08									
Klamath River west of Hamburg	46N/11W-35H1S	10/12/50	1,250	76	285	7.8	16	8.8	27	11	0	112	39	11	2.1	------	0.20	28		198	39	76	0	
							0.80	0.72	1.17	0.28	0.00	1.84	0.81	0.31	0.03									
Klamath River at Happy Camp Bridge	16N/7E-11K1S[f]	10/12/50	2,980	60	280	8.1	16	9.2	27	7.2	0	114	38	11	0.6	------	0.20	28		193	40	78	0	
							0.80	0.76	1.17	0.18	0.00	1.87	0.79	0.31	0.01									
Klamath River at Spillup Creek	14N/6E-10Q1S[f]	10/12/50	2,610	60	270	7.4	16	9.7	25	4.8	0	108	36	10	0.5	------	0.20	23		178	39	80	0	
							0.80	0.80	1.09	0.12	0.00	1.77	0.75	0.28	0.01									
Klamath River near Somesbar	11N/6E-4H1S[f]	5/ 9/55	9,860	62	95	6.8	11	3.1	3.6	0.9	0	52	5.5	1.5	0.5	0.0	0.09	5.3		57	16	40	0	P.S.S.P. Sta. #2[d]
							0.55	0.25	0.16	0.02	0.00	0.85	0.12	0.04	0.01									
		9/14/55	2,070	62	193	7.7	15	7.9	12	2.1	0	99	11	5.7	0.9	0.4	0.09	26		130	26	70	0	
							0.75	0.65	0.52	0.05	0.00	1.62	0.23	0.16	0.02									

TABLE 27—Continued

MINERAL ANALYSES OF SURFACE WATER WITHIN THE NORTHEASTERN COUNTIES [a]

Source	Location number MDB&M	Date sampled	Discharge in second-feet	Temp. in °F.	Specific conductance (micromhos at 25°C.)	pH	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Boron (B)	Silica (SiO_2)	Other constituents [c]	Total[b] dissolved solids in ppm	Per cent sodium	Hardness as $CaCO_3$ Total ppm	Hardness as $CaCO_3$ N.C. ppm	Remarks
							Mineral constituents in parts per million / equivalents per million																	
NORTH COASTAL DRAINAGE BASIN—Continued																								
Klamath River—Continued																								
Shovel Creek northwest of Macdoel	47N/3W-25P1S	10/14/52	5	43	118	8.1	11	6	4	------	0	76	1.0	1.0	------	------	0.00	------		60	13	53	0	
							0.57	0.49	0.17	------	0.00	1.25	0.02	0.03	------									
Willow Creek near Ager Bridge	46N/5W-6J1S	5/27/53	20	45	296	8.0	32	9.7	18	1.4	0	167	15	2.2	2.5	0.3	0.04	27		190	24	120	0	
							1.60	0.80	0.78	0.04	0.00	2.74	0.31	0.06	0.04									
Beaver Creek west of Gottville	46N/8W-6B1S	5/27/53	150	45	127	7.8	11	7.9	3.6	0.8	0	77	3.0	1.8	0.4	0.0	0.04	14		80	11	60	0	
							0.55	0.65	0.16	0.02	0.00	1.26	0.06	0.05	0.01									
Horse Creek above confluence with Klamath River	46N/10W-16R1S	5/28/53	40	51	111	7.6	11	3.8	5.8	0.5	0	48	6.2	6.5	0.4	0.0	0.12	9.3		67	22	43	4	
							0.55	0.31	0.25	0.01	0.00	0.79	0.13	0.18	0.01									
Scott River east of Hamburg	45N/10W-6B1S	5/27/53	1,900	47	150	8.0	16	8.8	2.2	0.7	0	92	3.5	1.5	0.4	0.2	0.02	19		98	6	76	1	
							0.80	0.72	0.10	0.02	0.00	1.51	0.07	0.04	0.01									
		10/ 2/53	280	55	249	7.7	26	13	6.3	1.2	0	143	6.0	4.5	0.8	0.0	0.10	15		143	10	118	1	
							1.30	1.07	0.27	0.03	0.00	2.34	0.13	0.13	0.01									
Canyon Creek 15 mi. west of Ft. Jones	44N/11W-27N1S	5/22/53	259	41	111	7.6	15	3.8	0.9	0.9	0	68	2.6	0.0	0.3	0.0	0.01	7.7		65	3	53	0	
							0.75	0.31	0.04	0.02	0.00	1.11	0.05	0.00	0.01									
Shasta Valley																								
Shasta River north of Edgewood	42N/5W-20J1S	5/27/53	125	50	209	8.0	5.8	22	5.2	0.7	0	134	2.9	2.5	0.5	0.1	0.04	34		140	10	105	0	
							0.29	1.81	0.23	0.02	0.00	2.20	0.06	0.07	0.01									
		10/ 1/53	11	58	252	7.6	10	19	16	2.0	0	152	3.6	6.0	0.4	0.2	0.09	46		178	25	103	0	
							0.50	1.56	0.70	0.05	0.00	2.49	0.08	0.17	0.01									
Shasta River below Dwinnell Reservoir	43N/5W-25L1S	10/ 2/53	1	------	293	7.7	12	25	12	1.6	0	178	5.4	5.8	0.8	0.2	0.10	29		180	16	133	0	
							0.60	2.06	0.52	0.04	0.00	2.92	0.11	0.16	0.01									
Shasta River east of Grenada	44N/6W-23H1S	10/ 3/53	100	55	496	7.9	26	30	37	3.2	0	276	8.1	23	1.1	0.2	0.39	56		321	29	188	0	
							1.30	2.47	1.61	0.08	0.00	4.52	0.17	0.65	0.02									
Shasta River 7 mi. north of Yreka	46N/7W-24H1S	5/28/53	462	59	515	8.2	22	38	36	3.0	0	312	10	16	1.2	0.3	0.19	40		320	27	211	0	
							1.10	3.12	1.57	0.08	0.00	5.11	0.21	0.45	0.02									
		10/ 2/53	141	55	549	8.4	34	30	42	3.4	10	296	7.8	26	0.4	0.3	0.52	54		351	30	208	0	
							1.70	2.47	1.83	0.09	0.33	4.85	0.16	0.73	0.01									
Eddy Creek south of U.S. Highway 99	41N/5W-9P1S	10/ 1/53	15	61	259	8.2	3.5	32	1.8	0.3	0	172	2.3	1.8	0.2	0.0	0.10	28		155	3	140	0	
							0.18	2.63	0.08	0.01	0.00	2.82	0.05	0.05	0.00									
Carrick Creek at Edgewood-Big Springs Road	42N/5W-22N1S	5/27/53	6	50	514	8.3	33	30	39	3.7	0	297	21	17	0.5	0.5	0.15	75		366	29	206	0	
							1.65	2.17	1.70	0.09	0.00	4.87	0.44	0.48	0.01									
		10/ 1/53	3	55	711	8.0	43	42	56	4.6	0	408	26	24	0.5	0.3	0.10	60		457	30	280	0	
							2.15	3.45	2.44	0.12	0.00	6.69	0.54	0.68	0.01									

TABLE 29—Continued

MINERAL ANALYSES OF SURFACE WATER WITHIN THE NORTHEASTERN COUNTIES [a]

Source	Location number MDB&M	Date sampled	Discharge in second-feet	Temp. in °F.	Specific conductance (micromhos at 25°C.)	pH	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Boron (B)	Silica (SiO_2)	Other constituents [c]	Total[b] dissolved solids in ppm	Per cent sodium	Hardness as $CaCO_3$ Total ppm	Hardness as $CaCO_3$ N.C. ppm	Remarks
							Mineral constituents in parts per million / equivalents per million																	
NORTH COASTAL DRAINAGE BASIN—Continued																								
Shasta Valley—Continued																								
Parks Creek north Steward Springs Road	41N/6W-1A1S	5/27/53	182	44	217	8.3	6.7	25	3.1	0.3	0	143	2.0	2.2	0.2	0.1	0.02	28		138	5	120	2	
							0.33	2.06	0.14	0.01	0.00	2.34	0.04	0.06	0.00									
		10/ 1/53	2	55	334	8.0	11	35	7.4	0.4	0	208	3.9	7.5	0.3	0.0	0.27	31		199	9	171	1	
							0.55	2.88	0.32	0.01	0.00	3.41	0.08	0.21	0.01									
Willow Creek west of Gazelle	42N/6W-19A1S	5/27/53	22	54	432	8.2	30	40	5.4	0.6	0	268	23	2.0	0.8	0.1	0.04	33		267	5	240	20	
							1.50	3.29	0.23	0.02	0.00	4.39	0.48	0.06	0.01									
		10/ 2/53	2	55	528	7.9	40	47	6.0	1.2	0	334	19	2.0	1.7	0.1	0.08	37		318	4	294	20	
							2.00	3.87	0.26	0.03	0.00	5.47	0.40	0.06	0.03									
Little Shasta River above Harp Ditch	45N/4W-15C1S	5/27/53	111	41	76	7.3	7.5	2.7	4.3	0.9	0	46	3.2	0.0	0.5	0.1	0.04	29		71	23	30	0	
							0.37	0.22	0.19	0.02	0.00	0.75	0.07	0.00	0.01									
Cleland Springs east of Little Shasta	45N/4W-20B1S	3/24/53	11	46	89	7.4	7.2	3.2	6.9	1.3	0	58	0.6	0.5	0.0	0.0	0.05	47		95	31	31	0	
							0.36	0.26	0.30	0.03	0.00	0.95	0.01	0.01	0.00									
Greenhorn Creek south of Yreka	45N/7W-34E1S	5/28/53	9	55	356	8.1	37	23	4.5	1.1	0	211	22	1.2	0.2	0.0	0.00	17		210	5	187	14	
							1.85	1.89	0.20	0.03	0.00	3.46	0.46	0.03	0.00									
Yreka Creek county fair ground	45N/7W-34L1S	5/27/53	15	60	525	8.2	35	52	4.1	0.7	0	364	6.5	1.2	2.4	0.0	0.02	28		309	3	302	3	
							1.75	4.28	0.18	0.02	0.00	5.97	0.14	0.03	0.04									
Grass Lake at S.P.R.R. X-over	44N/3W-21R1S	10/ 3/53	--	--	257	6.9	22	12	12	3.1	0	157	0.6	2.0	1.7	0.2	0.06	17		148	19	104	0	
							1.10	0.99	0.52	0.08	0.00	2.57	0.01	0.06	0.03									
"West Lake" east of Grenada	44N/5W-29C1S	5/27/53	--	--	1,770	9.5	15	86	300	11	205	394	11	255	0.8	0.3	4.0	13		1,100	62	391	0	
							0.75	7.07	13.05	0.28	6.83	6.46	0.23	7.19	0.01									
"East Lake" east of Grenada	44N/5W-29G1S	5/27/53	--	--	1,750	9.3	13	199	184	23	260	834	3.6	88	1.4	0.2	3.6	0.9		1,190	31	851	0	
							0.65	16.37	8.00	0.59	8.67	13.67	0.07	2.48	0.02									
Scott Valley																								
Scott River north of Callahan	40N/8W-8Q1S	5/25/53	480	44	151	7.7	10	13	1.8	0.5	0	94	3.2	1.5	0.5	0.2	0.00	23		100	5	78	1	
							0.50	1.07	0.08	0.01	0.00	1.54	0.07	0.04	0.01									
		9/30/53	20	60	240	7.8	15	20	4.3	0.8	0	144	4.9	5.0	0.4	0.0	0.00	21		142	7	120	2	
							0.75	1.65	0.19	0.02	0.00	2.36	0.10	0.14	0.01									
Scott River 5 mi. southeast of Etna	41N/9W-2B1S	5/25/53	12	42	140	7.9	12	11	2.0	0.7	0	88	3.6	1.2	0.5	0.1	0.00	15		89	5	75	3	
							0.60	0.91	0.09	0.02	0.00	1.44	0.08	0.03	0.01									
		9/30/53	10	56	329	7.9	35	19	5.8	1.2	0	196	10	4.5	1.8	0.1	0.16	21		195	7	165	5	
							1.75	1.56	0.25	0.03	0.00	3.21	0.21	0.13	0.3									

TABLE 29—Continued

MINERAL ANALYSES OF SURFACE WATER WITHIN THE NORTHEASTERN COUNTIES [a]

Source	Location number MDB&M	Date sampled	Discharge in second-feet	Temp. in °F.	Specific conductance (micromhos at 25°C.)	pH	Mineral constituents in parts per million / equivalents per million: Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Boron (B)	Silica (SiO_2)	Other constituents [c]	Total[b] dissolved solids in ppm	Per cent sodium	Hardness as $CaCO_3$ Total ppm	Hardness as $CaCO_3$ N.C. ppm	Remarks
NORTH COASTAL DRAINAGE BASIN—Continued																								
Scott Valley—Continued																								
Scott River 10 mi. below Fort Jones	44N/10W-28D1S	5/22/53	1,600	46	112	7.4	11	6.4	2.0	0.5	0	66	4.0	0.5	1.0	0.1	0.03	13		71	7	54	0	
							0.55	0.53	0.09	0.01	0.00	1.08	0.08	0.01	0.02									
		9/30/53	105	62	281	7.8	32	14	4.9	0.7	0	167	6.6	4.0	2.2	0.0	0.00	19		166	7	137	1	
							1.60	1.15	0.21	0.02	0.00	2.74	0.14	0.11	0.04									
East Fork Scott River north of Callahan	40N/8W-16N1S	5/25/53	254	43	173	7.8	12	14	2.2	0.4	0	105	5.8	0.2	0.6	0.2	0.01	19		106	5	88	1	
							0.60	1.15	0.10	0.01	0.00	1.72	0.12	0.01	0.01									
		9/30/53	9	58	257	7.8	19	20	4.5	0.9	0	157	6.1	3.5	0.2	0.1	0.04	22		154	7	130	1	
							0.95	1.65	0.20	0.02	0.00	2.57	0.13	0.10	0.00									
South Fork Scott River south of Callahan	40N/8W-20Q1S	5/25/53	222	39	97	7.7	4.6	9.3	1.7	0.6	0	61	1.6	0.2	0.5	0.0	0.00	16		64	7	50	0	
							0.23	0.77	0.07	0.02	0.00	1.00	0.03	0.01	0.01									
		9/30/53	11	54	219	7.4	12	17	6.5	1.2	0	116	6.3	8.0	1.7	0.0	0.00	21		131	12	100	5	
							0.60	1.40	0.28	0.03	0.00	1.90	0.13	0.23	0.03									
Wildcat Creek northwest of Callahan	40N/8W-17C1S	5/25/53	15	50	258	8.0	20	22	2.8	1.2	0	168	3.0	1.5	0.5	0.1	0.01	37		171	4	140	3	
							1.00	1.81	0.12	0.03	0.00	2.75	0.06	0.04	0.01									
		9/30/53	5	64	331	7.8	29	24	4.5	1.7	0	218	3.7	0.5	0.2	0.0	0.02	31		202	5	171	0	
							1.45	1.97	0.20	0.04	0.00	3.57	0.08	0.01	0.00									
Sugar Creek northwest of Callahan	40N/9W-12B1S	5/25/53	42	41	81	7.4	8.4	4.9	1.9	0.6	0	50	2.1	1.2	0.2	0.2	0.04	17		61	9	41	0	
							0.42	0.40	0.08	0.02	0.00	0.82	0.04	0.03	0.00									
		9/30/53	0.4	58	210	7.6	19	14	5.0	1.3	0	134	3.5	0.5	0.1	0.0	0.02	19		128	9	105	0	
							0.95	1.15	0.22	0.03	0.00	2.20	0.07	0.01	0.00									
French Creek south of Etna	41N/9W-22F1S	2/27/53	53	42	68	7.2	7.4	2.1	3.8	0.7	0	40	2.0	1.8	0.3	0.1	0.03	15		53	23	27	0	
							0.37	0.17	0.17	0.02	0.00	0.66	0.04	0.05	0.01									
		9/30/53	4	61	112	7.3	11	4.3	5.9	0.6	0	58	1.7	5.0	0.0	0.0	0.00	20		77	22	45	0	
							0.55	0.35	0.26	0.02	0.00	0.95	0.04	0.14	0.00									
Etna Creek east of Etna	42N/9W-28R1S	5/26/53	100	41	39	7.3	5.8	0.4	1.5	0.3	0	23	2.7	0.0	0.2	0.1	0.02	10		32	16	16	0	
							0.29	0.03	0.07	0.01	0.00	0.38	0.06	0.00	0.00									
		9/30/53	1	62	66	6.9	8.4	1.2	3.4	0.7	0	38	2.7	1.0	0.2	0.0	0.08	9.5		46	22	26	0	
							0.42	0.10	0.15	0.02	0.00	0.62	0.06	0.03	0.00									
Patterson Creek north of Etna	42N/9W-8K1S	5/26/53	39	41	62	7.5	8.8	2.0	1.8	0.1	0	38	1.5	1.2	0.1	0.2	0.00	17		51	11	30	0	
							0.44	0.16	0.08	0.00	0.00	0.62	0.03	0.03	0.00									
		9/30/53	3	67	76	7.2	10	2.0	2.4	0.2	0	46	2.3	0.0	0.2	0.0	0.04	14		51	13	33	0	
							0.50	0.16	0.10	0.01	0.00	0.75	0.05	0.00	0.00									

TABLE 29—Continued

MINERAL ANALYSES OF SURFACE WATER WITHIN THE NORTHEASTERN COUNTIES[a]

Source	Location number MDB&M	Date sampled	Discharge in second-feet	Temp. in °F.	Specific conductance (micromhos at 25°C.)	pH	Mineral constituents in parts per million / equivalents per million: Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Boron (B)	Silica (SiO_2)	Other constituents[c]	Total[b] dissolved solids in ppm	Per cent sodium	Hardness as $CaCO_3$: Total ppm	N.C. ppm	Remarks
NORTH COASTAL DRAINAGE BASIN—Continued																								
Scott Valley—Continued																								
Kidder Creek south of Greenview	43N/9W-29Q1S	5/26/53	80	42	38	7.4	5.8	1.1	1.2	0.3	0	24	1.5	1.0	0.2	0.2	0.00	11		34	12	19	0	
							0.29	0.09	0.05	0.01	0.00	0.39	0.03	0.03	0.00									
		9/30/53	2	61	53	7.1	7.5	1.0	2.0	0.4	0	30	2.0	0.8	0.7	0.0	0.08	11		40	16	23	0	
							0.37	0.08	0.09	0.01	0.00	0.49	0.04	0.02	0.01									
Moffett Creek west of Fort Jones	43N/9W-2L1S	5/22/53	25	58	362	8.1	19	35	4.3	0.7	0	224	16	0.5	2.5	0.0	0.04	16		204	5	191	8	
							0.95	2.88	0.19	0.02	0.00	3.67	0.33	0.01	0.04									
Shackleford Creek north of Mugginsville	44N/10W-35B1S	9/30/53	10	--	115	7.5	10	7.2	2.4	0.6	0	68	3.5	1.0	0.0	0.0	0.10	16		74	9	55	0	
							0.50	0.59	0.10	0.02	0.00	1.11	0.07	0.03	0.00									
Mill Creek north of Mugginsville	43N/10W-14B1S	5/26/53	40	43	75	7.3	8.4	3.2	1.8	0.6	0	42	4.0	1.0	0.2	0.2	0.00	16		56	10	34	0	
							0.42	0.26	0.08	0.02	0.00	0.69	0.08	0.03	0.00									
		9/30/53	8	58	93	7.4	11	3.1	2.8	0.7	0	53	4.1	0.5	0.1	0.0	0.04	14		62	13	40	0	
							0.55	0.26	0.12	0.02	0.00	0.87	0.09	0.01	0.00									
Salmon River																								
Salmon River at Cecilville bridge	38N/11W-29L1S	10/12/50	38	55	100	8.3	11	3.9	3.5	1.3	0	53	4.0	3.0	0.0	--	0.02	12		65	15	44	0	
							0.55	0.32	0.15	0.03	0.00	0.87	0.08	0.08	0.00									
Salmon River at forks of Salmon	10N/7E-13Q1S[f]	10/12/50	129	60	119	8.5	15	4.5	3.2	5.6	0	68	5.2	1.8	0.0	--	0.04	11		80	10	56	0	
							0.75	0.37	0.14	0.14	0.00	1.11	0.11	0.05	0.00									
Salmon River at Somesbar	11N/6E-3G1S[f]	10/12/50	254	62	120	8.5	16	4.1	3.4	3.2	0	67	4.9	2.5	0.0	--	0.04	14		81	11	57	2	
							0.80	0.34	0.15	0.08	0.00	1.10	0.10	0.07	0.00									
North Fork Salmon River at Sawyer Bar bridge	40N/11W-28N1S	10/12/50	38	58	94	8.3	14	2.6	3.2	5.6	0	56	5.1	1.2	0.0	--	0.00	11		70	12	46	0	
							0.70	0.21	0.14	0.14	0.00	0.92	0.11	0.03	0.00									
Trinity River																								
Trinity River at Lewiston bridge	33N/8W-19H1S	5/12/55	4,660	52	77	7.4	4.6	6.4	1.6	0.4	0	48	1.8	0.8	0.2	0.2	0.02	14		54	8	38	0	P.S.S.P. Sta. #4A[d]
							0.23	0.53	0.07	0.01	0.00	0.79	0.04	0.02	0.00									
		9/12/55	115	69	157	8.1	12	9.8	4.1	0.7	0	85	2.0	6.2	0.1	0.1	0.02	18		95	11	70	0	
							0.60	0.81	0.18	0.02	0.00	1.39	0.04	0.18	0.00									
Trinity River northwest of Douglas	33N/10W-35P1S	10/18/50	494	65	168	8.3	11	12	6.3	5.0	0	86	6.4	7.8	0.0	--	0.50	15		106	14	77	6	
							0.55	0.99	0.27	0.13	0.00	1.41	0.13	0.22	0.00									
Hayfork Trinity River near Hyampom	3N/6E-25C1S[f]	10/22/50	40	58	335	8.3	3.4	16	14	2.2	0	156	8.4	28	0.0	--	0.06	19		198	17	151	23	
							1.70	1.32	0.61	0.06	0.00	2.56	0.18	0.79	0.00									

TABLE 29—Continued

MINERAL ANALYSES OF SURFACE WATER WITHIN THE NORTHEASTERN COUNTIES [a]

Source	Location number MDB&M	Date sampled	Discharge in second-feet	Temp. in °F.	Specific conductance (micromhos at 25°C.)	pH	Mineral constituents in parts per million / equivalents per million: Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Boron (B)	Silica (SiO_2)	Other constituents [c]	Total[b] dissolved solids in ppm	Per cent sodium	Hardness as $CaCO_3$: Total ppm	N.C. ppm	Remarks
NORTH COASTAL DRAINAGE BASIN—Continued																								
Trinity River—Continued																								
South Fork Trinity River near Hyampom	3N/6E-25F1S [f]	10/22/50	36	59	222	8.8	27	9.5	6.6	2.1	7.0	101	14	8.5	0.0	--	0.20	12		136	12	106	12	
							1.35	0.78	0.29	0.05	0.23	1.66	0.29	0.24	0.00									
South Fork Trinity River near Salyer	6N/5E-27A1S [f]	10/18/50	113	60	336	8.6	31	12	8.0	4.4	26	88	13	10	0.2	--	0.08	16		164	12	126	11	
							1.55	0.99	0.35	0.11	0.87	1.44	0.27	0.28	0.00									
Southern Trinity County																								
Mad River near Ruth	2S/7E-11D1S [f]	10/21/50	------	------	84	7.1	11	2.2	3.3	1.9	0	44	6.5	3.5	0.3	--	0.04	7.4		58	16	36	0	
							0.55	0.18	0.14	0.05	0.00	0.72	0.14	0.10	0.01									
Mad River near Mad River	1N/6E-21K1S [f]	10/24/50	------	------	109	8.2	14	3.0	3.6	2.4	0	56	8.1	1.9	0.04	--	0.04	4.5		65	13	47	1	
							0.70	0.25	0.16	0.06	0.00	0.92	0.17	0.05	0.00									
Lake Pillsbury																								
East Fork Russian River at Potter Valley powerhouse (Eel River water from Lake Pillsbury through Eel River diversion) in Mendocino County	17N/11W-6F1S	5/ 2/55	------	58	148	6.9	18	4.9	5.3	0.8	0	79	8.4	4.2	0.2	0.1	0.23	9.3		90	15	65	0	P.S.S.P. Sta #10A [d]
							0.90	0.40	0.23	0.02	0.00	1.30	0.18	0.12	0.00									
		9/12/55	230	74	175	7.1	21	5.4	5.7	0.7	0	96	7.0	3.4	0.3	0.1	0.35	7.7		99	14	75	0	
							1.05	0.45	0.25	0.02	0.00	1.57	0.15	0.10	0.01									
CENTRAL VALLEY DRAINAGE BASIN																								
Goose Lake																								
Goose Lake near Davis Creek	45N/13E-14L2S	5/ 5/54	------	63	1,310	8.8	13	4.7	292	32	30	566	51	98	1.9	0.4	2.1	64	Fe=0.18 ppm; As=0.00 ppm	868	87	52	0	
							0.65	0.39	12.70	0.82	1.00	9.28	1.06	2.76	0.03									
Alturas																								
North Fork Pit River near Alturas	42N/13E-4D1S	5/ 4/56	------	45	116	6.6	14	3.6	4.9	1.7	0	70	4.8	0.4	0.3	0.0	0.00	27	Fe=0.7 ppm	92	17	51	0	[e]
							0.72	0.30	0.21	0.04	0.00	1.14	0.10	0.01	0.01									
South Fork Pit River near Likely	39N/13E-14J1S	5/ 3/56	243	------	85	6.6	8.6	2.8	3.9	1.9	0	46	6.2	0.4	0.6	0.0	0.00	27	Fe=0.6 ppm	75	19	33	0	[e]
							0.43	0.23	0.17	0.05	0.00	0.76	0.13	0.01	0.01									
Pit River near Canby	41N/9E-10	5/11/55	224	59	177	7.5	15	5.0	15	3.7	0	97	7.1	3.0	1.3	0.4	0.13	34		133	34	58	0	P.S.S.P. Sta. #17a [d]
							0.75	0.41	0.65	0.10	0.00	1.59	0.15	0.08	0.02									
		9/14/55	64	60	275	7.4	22	10	21	5.1	0	160	5.0	4.0	0.6	0.5	0.10	32		179	31	96	0	
							1.10	0.82	0.91	0.13	0.00	2.62	0.10	0.11	0.01									
Big Valley																								
Ash Creek at Adin	39N/9E-21P1S	5/ 4/56	240	------	100	6.6	9.0	3.2	5.2	1.3	0	57	3.8	0.4	0.0	0.0	0.00	27	Fe=0.3 ppm	78	23	36	0	[e]
							0.45	0.26	0.23	0.04	0.00	0.93	0.08	0.01	0.00									

TABLE 29—Continued

MINERAL ANALYSES OF SURFACE WATER WITHIN THE NORTHEASTERN COUNTIES [a]

Source	Location number MDB&M	Date sampled	Discharge in second-feet	Temp. in °F.	Specific conductance (micromhos at 25°C.)	pH	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Boron (B)	Silica (SiO_2)	Other constituents [c]	Total[b] dissolved solids in ppm	Per cent sodium	Hardness as $CaCO_3$ Total ppm	Hardness as $CaCO_3$ N.C. ppm	Remarks
							Mineral constituents in parts per million / equivalents per million																	
CENTRAL VALLEY DRAINAGE BASIN—Continued																								
McArthur																								
Fall River at Pit #1 Intake	37N/4E-25M1S	3/17/52	......	......	152	8.1	10	6.6	11	2.2	0	87	2.8	5.0	0.2	0.0	0.00	29		110	30	52	0	
							0.50	0.54	0.48	0.06	0.00	1.43	0.06	0.14	0.00									
		11/ 3/52	......	......	160	7.8	8.8	7.8	12	2.6	0	94	2.8	3.5	0.4	0.1	0.16	36		120	31	54	0	
							0.44	0.64	0.52	0.07	0.00	1.54	0.06	0.10	0.01									
Pit River south of Fall River Mills	36N/5E-6B1S	3/17/52	......	......	223	7.8	16	7.3	18	3.2	0	104	18	7.0	1.2	0.2	0.00	28		150	35	70	0	
							0.80	0.60	0.78	0.08	0.00	1.70	0.38	0.20	0.02									
		11/ 3/52	190	......	255	7.6	18	8.7	23	4.5	--	140	9.3	5.2	1.3	0.1	0.04	32		171	37	81	0	
							0.90	0.72	1.00	0.12		2.29	0.19	0.15	0.02									
Hat Creek																								
Hat Creek near old station	33N/5E-28Q1S	2/18/55	153	44	155	7.5	11	7.4	9.4	2.9	0	94	4.4	1.5	0.2	0.1	0.07	47		130	25	58	0	
							0.55	0.61	0.41	0.07	0.00	1.54	0.09	0.04	0.00									
Burney Creek near Burney	35N/3E-18	5/11/55	......	50	49.5	7.2	5.1	1.8	2.4	0.8	0	32	0.5	0.8	0.1	0.2	0.02	18		46	20	20	0	P.S.S.P. Sta. #17c[d]
							0.25	0.15	0.10	0.02	0.00	0.52	0.01	0.02	0.00									
		9/14/55	50	55	108	7.2	11	4.6	4.3	1.0	0	70	0.0	0.0	0.2	0.0	0.00	29		84	16	46	0	
							0.55	0.38	0.19	0.03	0.00	1.15	0.00	0.00	0.00									
Montgomery Creek																								
Montgomery Creek near Montgomery Creek	35N/1W-36P1S	10/31/52	35	......	97.8	7.5	11	3.2	5.0	0.8	--	62	0.9	0.2	0.5	0.0	0.00	31		83	21	41	0	
							0.55	0.26	0.22	0.02		1.02	0.02	0.01	0.01									
Pit River near Montgomery Creek	35N/1W-32	5/13/53	4,840	55	156	7.6	11	5.1	8.2	1.7	0	75	4.0	3.2	0.6	0.0	0.05	28		99	26	48	0	P.S.S.P. Sta. #17[d]
							0.55	0.42	0.36	0.04	0.00	1.23	0.08	0.09	0.01									
		9/15/53	2,660	64	155	7.6	11	6.4	11	2.0	0	88	2.9	3.5	0.3	0.0	0.08	35		115	30	54	0	
							0.55	0.53	0.48	0.05	0.00	1.44	0.06	0.10	0.01									
McCloud																								
McCloud River above Shasta Lake	36N/3W-28D	5/16/55	1,790	55	92.7	7.5	11	2.6	4.0	0.9	0	57	2.3	1.0	0.2	0.0	0.02	27		77	18	38	0	P.S.S.P. Sta. #18[d]
							0.55	0.21	0.17	0.02	0.00	0.93	0.05	0.03	0.00									
		9/13/55	916	54	96.5	7.7	11	2.1	4.6	1.5	0	57	1.6	0.9	0.1	0.0	0.00	33		83	21	36	0	
							0.55	0.17	0.20	0.04	0.00	0.93	0.03	0.02	0.00									
Upper Sacramento																								
Castle Creek near Castella	38N/4W-16R1S	3/30/55	......	44	60.4	7.0	1.1	7.1	1.8	0.6	0	34	--	0.6	--	--	0.00	--		......	11	32	4	
							0.06	0.58	0.08	0.02	0.00	0.56		0.02										
Flume Creek at Flume Creek Lodge	37N/4W-5J1S	3/30/55	......	44	32.1	6.8	0.7	3.5	0.8	0.1	0	22	--	0.3	--	--	0.00	--		......	10	16	0	
							0.04	0.28	0.04	0.00	0.00	0.36		0.01										

TABLE 29—Continued

MINERAL ANALYSES OF SURFACE WATER WITHIN THE NORTHEASTERN COUNTIES [a]

Source	Location number MDB&M	Date sampled	Discharge in second-feet	Temp. in °F.	Specific conductance (micromhos at 25°C.)	pH	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Boron (B)	Silica (SiO_2)	Other constituents [c]	Total[b] dissolved solids in ppm	Per cent sodium	Hardness as $CaCO_3$ Total ppm	Hardness as $CaCO_3$ N.C. ppm	Remarks
							Mineral constituents in parts per million / equivalents per million																	
CENTRAL VALLEY DRAINAGE BASIN—Continued																								
Upper Sacramento—Continued																								
Mears Creek near Hazel Creek	37N/4W-17D1S	3/30/55	50	44	71.8	6.9	0.9	8.5	0.7	0.1	0	43	--	0.6	--	--	0.00	--		------	4	37	2	
							0.04	0.70	0.03	0.00	0.00	0.70		0.02										
Shotgun Creek south of Hazel Creek	37N/4W-19M1S	3/30/55	60	42	81.9	7.0	0.9	11	0.5	0.1	0	60	--	0.0	--	--	0.03	--		------	2	48	0	
							0.04	0.92	0.02	0.00	0.00	0.98		0.00										
Slate Creek near Lamoine	36N/5W-22D1S	3/30/55	50	44	91.2	7.3	1.7	9.2	2.7	0.3	0	54	--	2.0	--	--	0.00	--		------	12	42	0	
							0.08	0.76	0.12	0.01	0.00	0.88		0.06										
Sacramento River at Delta	36N/5W-35E	5/16/55	1,290	54	87.2	7.5	5.7	6.0	3.2	0.4	0	53	2.5	2.0	0.1	0.1	0.04	18		64	15	39	0	P.S.S.P. Sta. #11[d]
							0.28	0.50	0.14	0.01	0.00	0.87	0.05	0.05	0.00	0.01								
		9/13/55	158	62	163	8.0	11	6.4	15	1.5	0	84	50	8.9	0.1	0.1	0.25	29		118	37	54	0	
							0.55	0.52	0.65	0.04	0.00	1.38	0.10	0.25	0.00	0.01								
Clear Creek-Cottonwood Creek																								
Spring Creek near Keswick	32N/5W-17M1S	3/21/52	30	------	765	3.0	10	8.0	5.0	0.4	0	0	229	4.0	1.2	0.0	0.00	22	Fe=6.0 ppm; Al=18 ppm	359	16	58	58	
							0.50	0.66	0.22	0.01	0.00	0.00	4.77	0.11	0.02									
		10/30/52	3	------	2,450	2.7	34	43	7.4	1.0	0	0	1,320	7.0	1.0	0.1	0.07	32	Fe=278 ppm; Al=93 ppm	1,820	1	1,530	1,530	
							1.70	3.51	0.32	0.03	0.00	0.00	27.48	0.20	0.02									
		2/28/55	25	42	1,300	2.7	15	13	4.1	0.1	0	0	367	10	2.1	0.4	0.00	22	Fe=12 ppm; Al=15 ppm; Cu=4.2 ppm; Zn=16 ppm	485	2	92	92	
							0.75	1.09	0.18	0.00	0.00	0.00	7.64	0.28	0.03									
Clear Creek near Igo	31N/6W-27H1S	2/11/52	------	------	67.2	7.9	7.4	1.8	3.9	0.8	0	30	6.6	2.1	0.2	0.0	0.03	14		52	24	26	1	
							0.37	0.15	0.17	0.02	0.00	0.49	0.14	0.06	0.00									
		10/31/52	------	------	183	7.4	10	7.2	14	1.0	0	54	14	19	0.4	0.0	0.00	16		108	35	35	10	
							0.50	0.59	0.61	0.03	0.00	0.88	0.29	0.54	0.01									
North Fork Cottonwood Creek at Musselbeck Dam	31N/7W-31C1S	2/28/52	------	------	76.7	7.7	6.0	3.9	3.4	2.2	0	46	1.8	1.5	0.0	0.0	0.01	25		66	18	31	0	
							0.30	0.32	0.15	0.06	0.00	0.75	0.01	0.04	0.00									
		10/31/52	5	------	98.6	7.6	10	3.6	4.5	1.5	0	61	2.3	0.5	0.2	0.1	0.04	27		92	19	40	0	
							0.50	0.30	0.20	0.04	0.00	1.00	0.05	0.01	0.00									
North Fork Cottonwood Creek at Gas Point	30N/6W-34C1S	3/ 2/52	------	------	129	8.0	12	5.5	5.6	2.1	0	64	11	3.0	0.0	0.0	0.03	23		94	18	53	0	
							0.60	0.45	0.24	0.05	0.00	1.05	0.23	0.08	0.00									
		10/31/52	15	------	161	7.5	15	5.6	9.6	1.5	0	79	6.1	8.5	0.1	0.0	0.08	24		110	25	61	0	
							0.75	0.46	0.42	0.01	0.00	1.30	0.13	0.24	0.01									
South Fork Cottonwood Creek west of Red Bluff	28N/5W-19P1S	4/23/56	480	60	161	6.9	20	5.1	4.8	0.9	0	81	10	3.2	0.2	0.0	0.01	13	Fe=5 ppm	98	13	71	5	
							0.98	0.44	0.21	0.02	0.00	1.32	0.21	0.09	0.00									

TABLE 29—Continued

MINERAL ANALYSES OF SURFACE WATER WITHIN THE NORTHEASTERN COUNTIES [a]

Source	Location number MDB&M	Date sampled	Discharge in second-feet	Temp. in °F.	Specific conductance (micromhos at 25°C.)	pH	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Boron (B)	Silica (SiO_2)	Other constituents [c]	Total[b] dissolved solids in ppm	Per cent sodium	Hardness as $CaCO_3$ Total ppm	Hardness as $CaCO_3$ N.C. ppm	Remarks
							Mineral constituents in parts per million / equivalents per million																	
CENTRAL VALLEY DRAINAGE BASIN—Continued																								
Thomes Creek																								
Thomes Creek near Paskenta	23N/6W-4	2/ 1/55	205	40	203	7.4	27	6.2	6.2	0.9	0	103	16	4.0	0.5	0.1	0.14	13		125	13	93	9	
							1.35	0.51	0.27	0.02	0.00	1.69	0.33	0.11	0.01									
Elder Creek 11 mi. north of Paskenta	25N/6W-14	2/ 3/55	35	36	402	8.0	32	24	17	0.9	0	196	20	22	0.5	0.1	0.16	17		230	17	178	17	
							1.60	1.96	0.74	0.02	0.00	3.21	0.42	0.62	0.01									
Stony Creek																								
Big Stony Creek near Elk Creek	20N/6W-3N1S	2/23/55	20	------	662	8.1	57	20	48	1.0	0	202	44	86	0.2	0.0	0.06	12		368	31	226	60	
							2.84	1.68	2.09	0.03	0.00	3.31	0.92	2.43	0.00									
Cache Creek																								
Scotts Creek near Lakeport	14N/10W-14E1S	4/17/52	10	------	214	7.8	24	7.2	11	1.2	0	122	8.1	3.4	0.2	0.1	0.25	15		130	21	90	0	
							1.20	0.59	0.48	0.03	0.00	2.00	0.17	0.10	0.00									
Clear Lake at Lakeport	14N/10W-24J	5/17/55	------	66	288	8.2	24	17	11	2.1	0	166	10	6.0	0.5	0.0	0.70	1.9		155	15	129	0	P.S.S.P. Sta. #41[d]
							1.20	1.38	0.48	0.05	0.00	2.72	0.21	0.17	0.01									
		9/20/55	------	76	337	8.2	28	19	12	2.5	0	195	11	7.2	0.1	0.4	1.1	7.2		184	15	147	0	
							1.40	1.54	0.52	0.06	0.00	3.20	0.23	0.20	0.00									
Clear Lake at Clear Lake Oaks	14N/8W-27	5/17/55	------	63	294	8.1	25	17	11	2.2	0	168	12	6.0	0.4	0.0	0.87	0.9		158	15	131	0	P.S.S.P. Sta. #40[d]
							1.25	1.37	0.48	0.06	0.00	2.75	0.25	0.17	0.01									
		9/20/55	------	72	321	8.0	20	22	13	2.5	0	175	15	7.5	3.7	0.2	1.4	4.8		176	16	141	0	
							1.00	1.82	0.56	0.06	0.00	2.87	0.31	0.21	0.06									
Cache Creek below Lower Lake	12N/6W-6	5/17/55	------	62	322	7.8	34	14	13	2.3	0	183	12	7.5	0.8	0.0	0.96	2.5		177	16	144	0	P.S.S.P. Sta. #42[d]
							1.70	1.18	0.56	0.06	0.00	3.00	0.25	0.21	0.01									
		9/20/55	78	66	349	7.5	27	20	13	2.9	0	200	11	7.5	0.1	0.5	1.2	2.7		185	16	148	0	
							1.35	1.61	0.56	0.07	0.00	3.28	0.23	0.21	0.00									
North Fork Cache Creek near Lower Lake	14N/6W-31L	5/17/55	------	70	352	8.2	25	20	20	1.3	5	174	11	14	0.5	0.0	1.4	21		205	23	143	0	P.S.S.P. Sta. #79[d]
							1.25	1.61	0.87	0.03	0.17	2.85	0.23	0.40	0.01									
		9/20/55	1.7	69	672	7.7	21	46	44	2.0	0	257	13	87	0.3	0.1	4.5	21		366	28	243	32	
							1.05	3.81	1.91	0.05	0.00	4.21	0.27	2.45	0.01									
Bear Creek near Leeville	15N/5W-7H1S	4/17/52	10	62	783	8.7	13	95	24	0.6	35	430	3.7	41	0.3	0.1	0.11	40		465	11	423	70	
							0.65	7.81	1.04	0.02	1.17	7.05	0.08	1.16	0.01									
Bear Creek southeast of Wilbur Springs	14N/5W-36P1S	4/17/52	30	66	1,440	8.5	21	104	138	3.8	16	582	35	179	6.9	0.0	5.8	29		825	38	480	0	
							1.05	8.55	6.00	0.10	0.53	9.54	0.73	5.05	0.11									
Bear Creek above Wilbur Bridge	14N/5W-22N1S	7/ 7/39	1.54	------	1,340	------	23	102	117	--	64	413	TR.	202	TR.	--	4.3	--		------	35	------	------	
							1.17	8.39	5.08		2.13	6.78		5.71										

TABLE 29—Continued

MINERAL ANALYSES OF SURFACE WATER WITHIN THE NORTHEASTERN COUNTIES [a]

Source	Location number MDB&M	Date sampled	Discharge in second-feet	Temp. in °F.	Specific conductance (micromhos at 25°C.)	pH	Mineral constituents in parts per million / equivalents per million: Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Boron (B)	Silica (SiO_2)	Other constituents [c]	Total[b] dissolved solids in ppm	Per cent sodium	Hardness as $CaCO_3$: Total ppm	N.C. ppm	Remarks
CENTRAL VALLEY DRAINAGE BASIN—Continued																								
Cache Creek—Continued																								
Bear Creek below Wilbur Bridge	14N/5W-27M1S	7/ 7/39	1.65	......	3,780	......	26	111	670	--	85	678	21	848	13	--	21	--		......	72	......	......	
							1.28	9.11	27.38		2.83	11.13	0.44	23.86	0.21									
Putah Creek																								
Putah Creek 3 mi. northeast of Middletown	11N/6W-19L1S	4/ 9/52	100	60	273	7.9	14	24	6.1	0.9	0	154	17	5.0	0.2	0.0	0.57	25		168	9	134	7	
							0.70	1.97	0.26	0.02	0.00	2.52	0.35	0.14	0.00									
Soda Creek 3 mi. southeast of Lower Lake	12N/6W-16K1S	4/ 9/52	4	......	1,460	8.0	88	81	127	9.3	0	423	367	76	4.1	0.2	3.0	14		978	33	552	206	
							4.39	6.66	5.52	0.24	0.00	6.93	7.64	2.14	0.07									
Battle Creek																								
Paynes Creek northeast of Red Bluff	28N/3W-22	2/ 4/55	78	42	126	7.5	8.5	6.0	8.6	0.8	0	72	1.8	5.0	0.3	0.1	0.29	36		102	28	46	0	
							0.42	0.50	0.37	0.02	0.00	1.18	0.04	0.14	0.01									
Battle Creek near Coleman Fish Hatchery	29N/2W-6E1S	1/28/55	300	46	133	7.2	11	5.8	7.6	2.0	0	80	3.3	1.5	0.5	0.2	0.06	40		111	23	52	0	
							0.55	0.48	0.33	0.05	0.00	1.31	0.07	0.04	0.01									
North Cow Creek east of Ingot	33N/1W-6K1S	2/19/52	150	......	108	7.9	15	2.0	4.1	1.8	0	58	5.0	2.5	0.0	0.0	0.06	21		80	16	46	0	
							0.75	0.16	0.18	0.05	0.00	0.95	0.10	0.07	0.00									
		10/30/52	20	......	111	7.6	12	2.2	7.0	0.6	0	58	1.4	4.4	0.4	0.0	0.04	26		83	28	39	0	
							0.60	0.18	0.30	0.02	0.00	0.95	0.03	0.12	0.01									
Cedar Creek east of Ingot	34N/2W-36R1S	2/19/52	50	......	84.5	8.0	9.6	2.9	4.0	1.0	0	45	4.8	2.1	0.0	0.0	0.04	20		67	19	36	0	
							0.48	0.24	0.17	0.03	0.00	0.74	0.10	0.06	0.00									
		10/30/52	5	......	345	7.7	47	2.2	20	1.2	0	132	18	32	0.1	0.2	0.23	22		208	25	126	18	
							2.34	0.18	0.87	0.03	0.00	2.16	0.38	0.90	0.00									
North Cow Creek south of Ingot	33N/2W-15N1S	2/19/52	200	......	81.6	7.5	9.1	3.0	3.7	2.0	0	46	5.1	1.0	0.0	0.0	0.02	22		69	18	35	0	
							0.45	0.25	0.16	0.05	0.00	0.75	0.11	0.03	0.00									
		10/30/52	25	......	166	7.4	19	3.3	9.6	0.6	0	76	6.4	8.5	0.4	0.0	0.08	24		109	25	61	0	
							0.95	0.27	0.42	0.02	0.00	1.25	0.13	0.24	0.01									
Salt Creek east of Bella Vista	32N/3W-3F1S	1/23/52	40	......	106	7.9	10	2.9	6.3	0.5	0	36	16	4.6	0.2	0.0	0.15	18		76	27	37	7	
							0.50	0.24	0.27	0.01	0.00	0.59	0.33	0.13	0.00									
North Cow Creek east of Palo Cedro	31N/3W-5Q1S	2/15/52	......	......	102	8.0	9.1	3.7	5.6	1.8	0	48	8.0	3.5	0.2	0.0	0.09	21		76	23	38	0	
							0.45	0.30	0.24	0.05	0.00	0.79	0.17	0.10	0.00									
		10/30/52	20	......	200	7.5	19	5.0	14	0.7	0	77	10	15	0.7	0.0	0.12	19		121	31	68	5	
							0.95	0.41	0.61	0.02	0.00	1.26	0.21	0.42	0.01									

TABLE 29—Continued

MINERAL ANALYSES OF SURFACE WATER WITHIN THE NORTHEASTERN COUNTIES [a]

Source	Location number MDB&M	Date sampled	Discharge in second-feet	Temp. in °F.	Specific conductance (micromhos at 25°C.)	pH	Mineral constituents in parts per million / equivalents per million: Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Boron (B)	Silica (SiO_2)	Other constituents [c]	Total[b] dissolved solids in ppm	Per cent sodium	Hardness as $CaCO_3$: Total ppm	N.C. ppm	Remarks
CENTRAL VALLEY DRAINAGE BASIN—Continued																								
Battle Creek—Continued																								
Oak Run Creek near Estep	33N/2W-25C1S	2/ 8/52	30	......	55.3	7.2	3.4	3.5	2.5	2.0	0	34	1.2	1.5	0.0	0.0	0.01	24		55	18	23	0	
							0.17	0.29	0.11	0.05	0.00	0.56	0.02	0.04	0.00									
		10/30/52	5	......	98.2	7.5	9.3	4.3	4.8	0.6	0	61	0.3	1.5	0.6	0.0	0.02	31		82	20	41	0	
							0.46	0.35	0.21	0.02	0.00	1.00	0.01	0.04	0.01									
Clover Creek at Millville	31N/3W-10J1S	2/ 8/52	100	......	108	7.6	9.9	4.7	4.8	2.4	0	54	8.9	1.5	0.0	0.0	0.06	26		85	18	44	0	
							0.49	0.39	0.21	0.06	0.00	0.88	0.18	0.04	0.00									
		10/30/52	5	......	120	7.6	12	4.1	6.5	1.3	0	69	4.0	2.5	0.2	0.0	0.14	25		90	23	47	0	
							0.60	0.34	0.28	0.03	0.00	1.13	0.08	0.07	0.00									
Cow Creek east of Palo Cedro	31N/3W-8A1S	2/ 2/52	......	......	109	8.0	11	3.8	5.0	1.3	0	57	6.0	1.2	0.0	0.0	0.06	25		81	20	43	0	
							0.55	0.31	0.22	0.03	0.00	0.93	0.12	0.03	0.00									
		10/30/52	40	......	141	7.8	14	5.4	7.8	0.8	0	80	2.0	5.0	0.6	0.0	0.05	30		105	23	57	0	
							0.70	0.44	0.34	0.02	0.00	1.31	0.04	0.14	0.01									
Mill Creek																								
Deer Creek 6 mi. northeast of Vina	25N/1W-23	2/21/55	175	40	135	7.0	11	5.5	8.4	1.3	0	70	1.6	6.5	0.2	0.2	0.03	40		109	26	50	0	
							0.55	0.45	0.36	0.03	0.00	1.15	0.03	0.18	0.00									
Antelope Creek 6 mi. east of Red Bluff	27N/2W-7	2/21/55	......	46	446	7.7	36	20	27	4.8	0	191	29	32	1.2	0.1	0.00	63		307	25	171	14	
							1.80	1.62	1.17	0.12	0.00	3.13	0.60	0.90	0.02									
Butte Creek																								
Butte Creek near Chico	22N/2E-36D	5/12/55	......	58	67.6	7.4	6.8	3.4	2.5	0.7	0	41	1.3	0.5	0.3	0.0	0.06	20		56	15	31	0	P.S.S.P. Sta. #84[d]
							0.34	0.28	0.11	0.02	0.00	0.67	0.03	0.01	0.01									
		9/15/55	164	58	108	7.4	12	4.2	3.3	0.9	0	66	1.2	0.0	0.1	0.1	0.00	23		78	13	47	0	
							0.60	0.35	0.14	0.02	0.00	1.08	0.02	0.00	0.00									
Big Chico Creek near Chico	22N/2E-9	5/12/55	......	61	130	7.9	11	6.0	6.9	0.9	0	71	3.6	6.0	0.1	0.0	0.02	34		104	22	52	0	P.S.S.P. Sta. #85[d]
							0.55	0.49	0.30	0.02	0.00	1.16	0.08	0.17	0.00									
		9/15/55	37	62	210	7.3	17	8.2	14	1.6	0	110	4.6	10	0.2	0.2	0.00	42		152	28	76	0	
							0.85	0.67	0.61	0.04	0.00	1.80	0.10	0.28	0.00									
North Fork Feather River																								
Indian Creek near Crescent Mills	26N/9E-25	5/10/55	1,140	51	81.3	7.2	9.3	2.1	3.8	1.1	0	48	2.2	0.5	0.4	0.2	0.03	21		65	20	32	0	P.S.S.P. Sta. #17d[d]
							0.46	0.18	0.16	0.03	0.00	0.79	0.05	0.01	0.01									
		9/13/55	4.9	62	363	6.8	36	12	21	1.6	0	201	10	12	0.3	0.0	0.14	29		221	24	139	0	
							1.80	0.98	0.91	0.04	0.00	3.29	0.21	0.34	0.01									
East Branch North Fork Feather River near Paxton	25N/9E-8R1S	4/27/56	......	46	67	6.7	7.0	2.8	2.8	0.8	0	37	1.4	0.0	0.2	0.0	0.06	18	Fe=3.7 ppm	52	17	29	0	
							0.35	0.23	0.12	0.02	0.00	0.61	0.03	0.00	0.00									

TABLE 29—Continued

MINERAL ANALYSES OF SURFACE WATER WITHIN THE NORTHEASTERN COUNTIES [a]

Source	Location number MDB&M	Date sampled	Discharge in second-feet	Temp. in °F.	Specific conductance (micromhos at 25°C.)	pH	Mineral constituents in parts per million / equivalents per million: Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Boron (B)	Silica (SiO_2)	Other constituents [c]	Total[b] dissolved solids in ppm	Per cent sodium	Hardness as $CaCO_3$: Total ppm	N.C. ppm	Remarks
CENTRAL VALLEY DRAINAGE BASIN—Continued																								
North Fork Feather River—Continued																								
Mountain Meadows Reservoir near Westwood	28N/8E-13J1S	4/26/56	......	52	57	6.4	5.4	2.7	2.1	0.6	0	31	0.5	0.0	0.3	0.0	0.00	11	Fe=0.5 ppm	38	15	25	0	
							0.27	0.22	0.09	0.02	0.00	0.51	0.01	0.00	0.01									
Lake Almanor at Feather River outlet	27N/8E-21	6/10/53	......	56	89.2	7.8	8.9	3.7	4.5	1.0	0	55	2.1	0.8	0.5	0.0	0.01	6.8		48	15	37	0	
							0.44	0.30	0.20	0.03	0.00	0.90	0.04	0.02	0.01									
North Fork Feather River east of Rich Bar	25N/7E-20	10/ 3/52	600	63	114	7.3	11	4.9	5.8	1.1	0	68	2.3	2.3	0.3	0.0	0.03	15		76	20	48	0	
							0.55	0.40	0.25	0.03	0.00	1.11	0.05	0.06	0.01									
North Fork Feather River at Pulga	23N/5E-31	10/ 3/52	1,000	61	98.8	7.5	9.1	4.3	5.4	1.2	0	60	1.7	1.8	0.4	0.0	0.05	15		68	22	40	0	
							0.45	0.35	0.24	0.03	0.00	0.98	0.04	0.05	0.01									
West Branch North Fork Feather River near Stirling City	24N/4E-22	10/ 1/52	25	57	82.8	7.5	10	2.7	4.5	0.8	0	52	1.2	1.5	0.0	0.1	0.05	25		71	21	36	0	
							0.50	0.22	0.20	0.02	0.00	0.85	0.02	0.04	0.00									
Middle Fork Feather River																								
Middle Fork Feather River near Vinton	23N/16E-33B1S	4/27/56	60	39	105	6.8	10	4.4	4.8	1.3	0	60	1.4	0.4	0.4	0.0	0.00	8	Fe=3.2 ppm	61	19	44	0	
							0.52	0.36	0.21	0.03	0.00	0.99	0.03	0.01	0.01									
Big Grizzly Creek east of Portola	23N/14E-28D1S	5/27/55	15	56	90.3	7.1	9.3	3.6	4.5	1.3	0	54	1.9	0.2	0.5	0.3	0.02	23		72	20	38	0	
							0.46	0.30	0.20	0.03	0.00	0.88	0.04	0.01	0.01									
Middle Fork Feather River at Cleo	22N/12E-25	10/ 3/52	......	57	177	7.5	21	4.2	9.8	2.0	0	100	5.5	2.2	0.1	0.0	0.05	22		116	23	70	0	
							1.05	0.34	0.43	0.05	0.00	1.64	0.12	0.06	0.00									
Middle Fork Feather River at Bidwell Bar	20N/5E-32	10/ 2/52	......	66	128	7.6	15	3.4	7.8	1.1	0	70	5.8	3.5	0.0	0.1	0.08	16		87	24	51	0	
							0.75	0.28	0.34	0.03	0.00	1.15	0.12	0.10	0.00									
South Fork Feather River																								
South Fork Feather River near Enterprise	19N/5E-1	10/ 2/52	......	66	106	7.3	8.4	3.6	9.0	0.7	0	48	8.1	6.0	0.0	0.1	0.11	23		82	35	36	0	
							0.42	0.30	0.39	0.02	0.00	0.79	0.17	0.17	0.00									
Honcut																								
South Honcut Creek near Bangor	18N/5E-35R	5/12/55	......	73	147	7.6	12	5.8	9.8	0.5	0	78	7.9	4.5	0.1	0.1	0.03	27		106	28	54	0	P.S.S.P. Sta. #90[d]
							0.60	0.48	0.43	0.01	0.00	1.28	0.16	0.13	0.00									
		7/14/55	......	84	321	7.4	23	11	29	0.1	0	134	--	19	--	--	0.14	--		......	38	101	0	
							1.15	0.87	1.26	0.01	0.00	2.20		0.54										
Feather River near Oroville	19N/4E-211	5/12/55	9,450	55	59.1	7.4	6.8	2.2	2.3	0.5	0	36	1.7	0.5	0.5	0.0	0.12	14		47	16	26	0	P.S.S.P. Sta. #19[d]
							0.34	0.18	0.10	0.01	0.00	0.59	0.04	0.01	0.01									
		9/15/55	1,840	66	129	7.4	14	4.4	5.1	1.4	0	74	5.2	0.7	0.5	0.2	0.00	21		89	17	53	0	
							0.70	0.36	0.22	0.01	0.00	1.21	0.11	0.02	0.01									

TABLE 29—Continued

MINERAL ANALYSES OF SURFACE WATER WITHIN THE NORTHEASTERN COUNTIES [a]

Source	Location number MDB&M	Date sampled	Discharge in second-feet	Temp. in °F.	Specific conductance (micromhos at 25°C.)	pH	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Boron (B)	Silica (SiO_2)	Other constituents [c]	Total[b] dissolved solids in ppm	Per cent sodium	Hardness as $CaCO_3$ Total ppm	Hardness as $CaCO_3$ N.C. ppm	Remarks
							Mineral constituents in parts per million / equivalents per million																	
CENTRAL VALLEY DRAINAGE BASIN—Continued																								
Yuba River																								
Middle Yuba River near North San Juan	18N/8E-28K1S	4/30/56	......	49	65	6.4	7.0	2.3	2.1	0.8	0	32	2.9	0.7	0.0	0.1	0.02	12		44	14	27	1	
							0.35	0.19	0.09	0.02	0.00	0.52	0.06	0.02	0.00									
North Yuba River at Downieville	20N/10E-35	10/ 3/52	......	55	167	8.1	27	4.5	2.8	0.3	0	101	6.2	4.5	0.1	0.0	0.02	11		106	7	86	3	
							1.35	0.37	0.12	0.01	0.00	1.66	0.13	0.13	0.00									
North Yuba River northeast of Camptonville	19N/9E-18G1S	10/ 3/52	100	......	138	7.9	20	3.8	3.4	0.4	0	80	5.0	0.0	0.0	0.0	0.04	14		89	10	66	0	
							1.00	0.31	0.15	0.01	0.00	1.31	0.10	0.00	0.00									
Redding																								
Sacramento River at Keswick	32N/5W-28D	5/12/55	6,370	50	127	7.6	11	4.8	7.3	1.5	0	67	8.0	3.0	0.2	0.1	0.06	25		94	24	47	0	P.S.S.P. Sta. #12[d]
							0.55	0.39	0.32	0.04	0.00	1.10	0.17	0.08	0.00									
		9/13/55	7,680	52	119	7.2	12	3.7	5.6	1.3	0	66	3.0	1.8	0.1	0.1	0.09	24		85	21	45	0	
							0.60	0.30	0.24	0.03	0.00	1.08	0.06	0.05	0.00									
Sacramento River at Redding	31N/4W-18G	5/11/55	5,400	54	135	7.6	11	4.8	7.4	1.4	0	66	8.5	3.2	0.2	0.1	0.06	25		95	25	47	0	P.S.S.P. Sta. #12a[d]
							0.55	0.39	0.32	0.04	0.00	1.08	0.18	0.09	0.00									
		9/12/55	6,600	52	117	7.1	13	3.0	6.0	1.3	0	66	3.0	2.0	0.4	0.1	0.05	23		85	20	45	0	
							0.65	0.24	0.26	0.03	0.00	1.08	0.06	0.06	0.01									
Olney Creek north of Girvan	31N/5W-24C1S	10/31/52	8	......	106	7.2	8.6	4.8	6.1	1.3	0	58	5.8	1.0	0.6	0.0	0.16	22		79	24	41	0	
							0.43	0.40	0.26	0.03	0.00	0.95	0.12	0.03	0.01									
Churn Creek east of Enterprise	31N/4W-4N1S	2/20/52	......	......	105	7.8	6.4	4.3	8.1	1.6	0	38	9.1	8.5	0.8	0.0	0.06	17		74	33	34	2	
							0.32	0.35	0.35	0.04	0.00	0.62	0.19	0.24	0.01									
Churn Creek north of Anderson	30N/4W-3L1S	2/ 4/55	25	47	157	7.2	12	5.2	11	0.3	0	57	9.2	13	1.4	0.1	0.20	22		102	32	52	5	
							0.60	0.43	0.48	0.01	0.00	0.93	0.19	0.37	0.02									
Stillwater Creek east of Enterprise	31N/4W-11C1S	2/20/52	......	......	71.0	7.8	4.7	2.7	5.5	1.4	0	29	6.1	4.0	0.5	0.1	0.09	16		55	33	23	0	
							0.24	0.22	0.24	0.04	0.00	0.48	0.13	0.11	0.01									
Stillwater Creek northeast of Anderson	30N/4W-1J1S	1/28/55	100	48	106	7.2	10	2.7	7.9	0.3	0	39	7.7	8.5	1.1	0.2	0.02	19		76	32	36	4	
							0.50	0.22	0.34	0.01	0.00	0.64	0.16	0.24	0.02									
Cottonwood Creek at Cottonwood	29N/3W-7A	5/11/55	784	71	150	7.2	13	7.4	7.0	2.7	0	77	9.8	2.8	1.2	0.2	0.16	23		105	19	63	0	P.S.S.P. Sta. #12b[d]
							0.65	0.61	0.30	0.07	0.00	1.26	0.20	0.08	0.02									
		9/14/55	90	66	165	7.0	14	7.4	8.3	1.8	0	92	4.0	3.5	0.5	0.3	0.02	27		112	21	66	0	
							0.70	0.61	0.36	0.05	0.00	1.51	0.08	0.10	0.01									
Sacramento Valley																								
Elder Creek west of Gerber	25N/3W-2	2/ 1/55	......	41	402	8.0	31	25	17	0.6	0	199	21	21	0.4	0.1	0.00	18		232	17	179	16	
							1.55	2.03	0.74	0.02	0.00	3.22	0.44	0.59	0.01									

TABLE 29—Continued

MINERAL ANALYSES OF SURFACE WATER WITHIN THE NORTHEASTERN COUNTIES[a]

Source	Location number MDB&M	Date sampled	Discharge in second-feet	Temp. in °F.	Specific conductance (micromhos at 25°C.)	pH	Mineral constituents in parts per million / equivalents per million: Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Boron (B)	Silica (SiO_2)	Other constituents[c]	Total[b] dissolved solids in ppm	Per cent sodium	Hardness as $CaCO_3$: Total ppm	N.C. ppm	Remarks
CENTRAL VALLEY DRAINAGE BASIN—Continued																								
Sacramento Valley—Continued																								
Mill Creek near Los Molinos	23N/2W-9D	5/11/55	500	62	101	7.6	7.6	2.4	7.3	1.6	0	36	10	6.5	0.2	0.1	0.19	27		81	34	29	0	P.S.S.P. Sta. #88[d]
							0.38	0.20	0.32	0.04	0.00	0.59	0.21	0.18	0.00									
		9/14/55	......	69	252	7.0	18	9.3	16	3.8	0	98	16	19	0.5	0.0	0.46	40		171	28	83	3	
							0.90	0.76	0.70	0.10	0.00	1.61	0.33	0.54	0.01									
Deer Creek near Vina	24N/2W-11	5/11/55	......	68	88.0	7.8	8.5	3.8	4.8	1.3	0	52	1.1	1.2	0.3	0.2	0.01	27		74	21	37	0	P.S.S.P. Sta. #95[d]
							0.42	0.32	0.21	0.03	0.00	0.85	0.02	0.03	0.01									
		9/14/55	6.8	71	326	7.4	34	14	15	3.1	0	203	4.8	6.5	0.1	0.1	0.12	46		224	18	142	0	
							1.70	1.15	0.65	0.08	0.00	3.33	0.10	0.18	0.00									
Sacramento River at Hamilton City	22N/1W-20A	5/12/55	7,290	65	134	7.4	12	5.4	6.9	1.3	0	70	7.3	4.2	0.3	0.0	0.04	25		96	22	52	0	P.S.S.P. Sta. #13[d]
							0.60	0.44	0.30	0.03	0.00	1.15	0.15	0.12	0.01									
		9/15/55	6,980	59	127	7.4	11	5.3	6.0	1.3	0	70	5.2	2.0	0.2	0.2	0.01	27		92	20	49	0	
							0.55	0.44	0.26	0.03	0.00	1.15	0.11	0.06	0.00									
Stony Creek at Hamilton City	22N/2W-36C	1/11/55	103	45	381	8.2	38	15	17	0.7	4	160	..	26	..	..	0.04			......	19	156	18	P.S.S.P. Sta. #13a[d]
							1.90	1.22	0.74	0.02	0.13	2.62		0.73										
		5/12/55	1.4	70	376	7.5	39	14	18	0.9	0	174	21	25	0.6	0.1	0.15	14		219	20	156	13	
							1.95	1.17	0.78	0.02	0.00	2.85	0.44	0.70	0.01									
Colusa Trough near Colusa	16N/2W-34	5/13/55	......	68	453	7.7	23	16	51	2.6	0	174	57	26	1.1	0.2	0.20	17		280	47	122	0	P.S.S.P. Sta. #87[d]
							1.15	1.29	2.22	0.07	0.00	2.85	1.19	0.73	0.02									
		9/19/55	603	66	525	7.4	27	21	51	2.2	0	207	57	29	1.2	0.5	0.20	18		309	42	153	0	
							1.35	1.71	2.22	0.06	0.00	3.39	1.19	0.82	0.02									
Stone Corral Creek near Sites	17N/4W-20	5/15/52	1	......	2,080	8.0	83	63	265	2.7	0	304	204	415	5.6	0.7	0.50	0.0		1,190	55	466	217	
							4.14	5.18	11.52	0.07	0.00	4.98	4.25	11.70	0.09									
Cortina Creek southwest of Williams	11N/3W-16	5/ 6/52	......	......	1,340	8.2	90	49	120	1.5	0	292	178	184	0.9	0.3	0.60	14		782	38	426	186	
							4.49	1.03	5.22	0.04	0.00	4.79	3.71	5.19	0.01									
San Creek southwest of Arbuckle	13N/3W-18C1S	4/30/52	2		351	8.2	20	27	14	1.5	0	192	24	8.0	0.2	0.4	0.07	21		211	16	161	4	
							1.00	2.22	0.61	0.04	0.00	3.15	0.50	0.23	0.00									
	13N/3W-7H1S	4/30/52	2	..	908	8.1	40	35	91	2.4	0	212	47	158	0.2	0.3	0.23	19		497	44	244	70	
							2.00	2.88	3.96	0.06	0.00	3.47	0.98	4.46	0.00									
Sacramento River at Knights Landing	11N/2E-11F	5/16/55	7,330	64	401	7.8	21	14	45	2.7	0	155	49	22	0.9	0.3	0.19	19		250	46	112	0	P.S.S.P. Sta. #14[d]
							1.05	1.19	1.96	0.07	0.00	2.54	1.02	0.62	0.02									
		9/19/55	8,180	65	512	7.4	36	13	51	2.6	0	201	52	32	1.2	0.5	0.25	21		309	43	144	0	
							1.80	1.08	2.22	0.07	0.00	3.29	1.08	0.90	0.02									

TABLE 29—Continued

MINERAL ANALYSES OF SURFACE WATER WITHIN THE NORTHEASTERN COUNTIES [a]

Source	Location number MDB&M	Date sampled	Discharge in second-feet	Temp. in °F.	Specific conductance (micromhos at 25°C.)	pH	Mineral constituents in parts per million / equivalents per million: Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Boron (B)	Silica (SiO_2)	Other constituents [c]	Total[b] dissolved solids in ppm	Per cent sodium	Hardness as $CaCO_3$: Total ppm	N.C. ppm	Remarks
CENTRAL VALLEY DRAINAGE BASIN—Continued																								
Sacramento Valley—Continued																								
Sacramento Slough at Knights Landing	11N/3E-20	5/16/55	0	68	414	8.0	27	20	29	2.1	0	192	14	35	0.9	0.2	0.07	28		251	29	149	0	P.S.S.P. Sta. #14a[d]
							1.35	1.63	1.26	0.05	0.00	3.15	0.29	0.99	0.02									
		9/19/55	823	67	422	7.4	30	21	31	2.3	0	222	7.0	24	0.5	0.3	0.08	32		257	29	162	0	
							1.50	1.74	1.35	0.06	0.00	3.64	0.15	0.68	0.01									
Yuba River at Smartville	16N/6E-14	5/12/55	------	56	61.5	7.3	7.2	2.2	2.8	0.5	0	35	3.0	1.0	0.2	0.2	0.04	12		46	18	27	0	P.S.S.P. Sta. #21a[d]
							0.36	0.18	0.12	0.01	0.00	0.57	0.06	0.03	0.00									
		9/15/55	206	74	126	7.4	18	2.6	3.5	0.9	0	66	8.2	1.5	0.1	0.1	0.00	17		85	12	55	1	
							0.90	0.21	0.15	0.02	0.00	1.08	0.17	0.04	0.00									
Yuba River at Marysville	15N/4E-18	5/13/55	5,120	55	61.7	7.2	8.5	1.9	1.8	0.4	0	34	4.6	0.8	0.2	0.1	0.04	12		47	12	29	1	P.S.S.P. Sta. #21[d]
							0.42	0.16	0.08	0.01	0.00	0.56	0.10	0.02	0.00									
		9/16/55	57	67	150	7.2	18	5.4	3.7	0.9	0	73	14	1.0	0.2	0.1	0.14	20		99	11	67	7	
							0.90	0.44	0.16	0.02	0.00	1.20	0.29	0.03	0.00									
Bear River near Wheatland	13N/5E-3	5/13/55	------	71	106	7.9	11	5.0	3.5	0.7	0	51	8.6	3.8	0.0	0.0	0.00	12		70	13	48	6	P.S.S.P. Sta. #78[d]
							0.55	0.41	0.15	0.02	0.00	0.84	0.18	0.11	0.00									
		9/16/55	5.5	76	305	7.6	37	13	7.1	0.9	0	151	27	7.3	0.1	0.2	0.00	21		188	9	145	21	
							1.85	1.06	0.31	0.02	0.00	2.48	0.56	0.21	0.00									
Feather River at Nicolaus	12N/3E-12	5/13/55	12,400	61	69.9	7.3	7.6	2.7	2.4	0.8	0	39	3.0	0.5	0.3	0.1	0.10	15		52	14	30	0	P.S.S.P. Sta. #20[d]
							0.38	0.22	0.10	0.02	0.00	0.64	0.06	0.01	0.01									
		9/16/55	991	69	151	7.4	15	6.0	6.7	1.5	0	86	4.0	3.0	0.2	0.1	0.04	18		97	19	62	0	
							0.75	0.49	0.29	0.04	0.00	1.41	0.08	0.08	0.00									
Sacramento River at Sacramento	9N/4E-35	5/16/55	29,200	60	167	7.6	13	6.0	12	1.0	0	73	13	9.2	0.5	0.2	0.06	19		110	31	57	0	P.S.S.P. Sta. #15[d]
							0.65	0.49	0.52	0.03	0.00	1.20	0.27	0.26	0.01									
		9/19/55	11,000	64	269	7.5	18	12	21	1.8	0	126	17	16	0.3	0.2	0.19	25		174	32	94	0	
							0.90	0.98	0.91	0.05	0.00	2.06	0.35	0.45	0.01									
Cache Creek near Capay	10N/2W-8	5/16/55	------	76	548	8.2	37	27	39	2.7	0	266	22	40	0.6	0.1	1.5	11		312	29	205	0	P.S.S.P. Sta. #80[d]
							1.85	2.25	1.70	0.07	0.00	4.36	0.46	1.13	0.01									
		9/19/55	125	69	488	7.6	33	23	30	2.9	0	224	17	36	2.4	0.3	1.6	7.7		264	26	178	0	
							1.65	1.91	1.30	0.07	0.00	3.67	0.35	1.02	0.04									
Putah Creek near Winters	8N/2W-28	5/16/55	------	70	467	8.4	24	41	15	1.3	0	280	23	10	0.5	0.1	0.38	27		280	12	230	0	P.S.S.P. Sta. #81[d]
							1.20	3.40	0.65	0.03	0.00	4.59	0.48	0.28	0.01									
		9/19/55	3.8	70	789	8.0	29	64	55	2.6	25	351	54	50	0.2	0.4	1.7	21		476	26	334	4	
							1.45	5.23	2.39	0.07	0.83	5.75	1.12	1.41	0.00									

TABLE 29—Continued

MINERAL ANALYSES OF SURFACE WATER WITHIN THE NORTHEASTERN COUNTIES [a]

Source	Location number MDB&M	Date sampled	Discharge in second-feet	Temp. in °F.	Specific conductance (micromhos at 25°C.)	pH	Mineral constituents in parts per million / equivalents per million: Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Boron (B)	Silica (SiO_2)	Other constituents [c]	Total[b] dissolved solids in ppm	Per cent sodium	Hardness as $CaCO_3$: Total ppm	N.C. ppm	Remarks
LAHONTAN DRAINAGE BASIN																								
Surprise Valley																								
Lower Alkali Lake near Eagleville	40N/17E-20H2S	5/ 5/54	......	83	5,800	9.1	6.9	0.9	1,370	11	192	805	307	1,160	0.4	10	19	63	Fe=1.3 ppm; As=0.09 ppm	3,540	99	20	0	
							0.34	0.07	59.57	0.28	6.40	13.19	6.39	32.72	0.01									
Middle Alkali Lake near Cedarville	42N/16E-3R1S	5/ 5/54	......	75	12,900	9.1	17	8.9	3,180	7.5	363	1,300	576	3,330	3.5	6.0	38	28	Fe=0.08 ppm; As=0.39 ppm	8,160	99	79	0	
							0.85	0.73	138.28	0.19	12.10	21.31	11.99	93.92	0.06									
Upper Alkali Lake near Lake City	44N/16E-33G2S	5/ 5/54	......	79	9,050	9.1	15	0.9	2,120	13	275	970	333	2,150	0.0	7.9	24	67	Fe=0.13 ppm; As=0.18 ppm	5,480	99	41	0	
							0.75	0.07	92.19	0.33	9.17	15.90	6.93	60.64	0.00									
Madeline Plains																								
Bailey Creek west of Termo	34N/12E-10	7/23/52	10	62	172	7.8	17	8.8	5.9	1.1	0	111	0.4	0.5	0.1	0.0	0.14	32		120	14	79	0	
							0.85	0.72	0.26	0.03	0.00	1.82	0.01	0.01	0.00									
Slate Creek west of Termo	35N/11E-20	7/24/52	5	......	102	7.5	8.0	5.1	5.0	2.2	0	62	0.7	1.2	0.0	0.2	0.22	28		81	20	41	0	
							0.40	0.42	0.22	0.06	0.00	1.02	0.02	0.03	0.00									
Red Rock Creek northeast of Ravendale	35N/16E-10	7/24/52	15	......	110	7.2	11	4.5	4.7	2.3	0	67	1.5	1.0	0.6	0.1	0.13	24		83	17	46	0	
							0.55	0.37	0.20	0.06	0.00	1.10	0.03	0.03	0.01									
Said Valley Reservoir west of Termo	36N/11E-31	7/24/52	......	......	128	7.6	10	3.9	7.4	3.4	0	62	0.5	1.8	5.5	0.2	0.18	16		79	26	41	0	
							0.50	0.32	0.32	0.09	0.00	1.02	0.01	0.05	0.09									
Tule Lake Reservoir Runoff south of Madeline	36N/13E-3	7/22/52	25	69	168	7.5	16	6.2	9.5	3.1	0	101	2.1	1.5	0.3	0.0	0.15	31		120	23	65	0	
							0.80	0.51	0.41	0.08	0.00	1.66	0.04	0.04	0.01									
Van Loan Creek southeast of Madeline	36N/14E-8	7/23/52	......	......	165	7.5	17	6.6	7.4	2.4	0	103	1.2	0.4	0.3	0.0	0.15	29		115	18	70	0	
							0.85	0.51	0.32	0.06	0.00	1.69	0.03	0.01	0.01									
Pine Creek																								
Eagle Lake mouth Willow Creek Tunnel	32N/11E-22N1S	6/28/56	......	......	889	8.9	8.8	36	150	35	66	482	3.0	16	0.2	0.2	0.16	4.0	Fe=0.01 ppm	556	60	171	0	
							0.44	2.98	6.52	0.90	2.20	7.90	0.06	0.45	0.00									
Eagle Lake west side of Lake	32N/11E-30	7/11/52	......	......	1,040	9.2	11	39	174	48	81	518	1.0	21	0.1	0.0	0.1	16		661	60	188	0	
							0.55	3.21	7.57	1.23	2.70	8.98	0.02	0.59	0.00									
Eagle Lake north of Susanville	32N/12E-6R1S	5/ 1/51	......	83	1,330	8.8	4.5	49	220	59	55	758	1.6	22	2.2	7.0	0.03	10	Fe=0.03 ppm; As=0.01 ppm	804	62	213	0	
							0.22	4.03	9.57	1.51	1.83	12.12	0.03	0.62	0.04									

TABLE 29—Continued

MINERAL ANALYSES OF SURFACE WATER WITHIN THE NORTHEASTERN COUNTIES [a]

Source	Location number MDB&M	Date sampled	Discharge in second-feet	Temp. in °F.	Specific conductance (micromhos at 25°C.)	pH	Mineral constituents in parts per million / equivalents per million: Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Boron (B)	Silica (SiO_2)	Other constituents [c]	Total[b] dissolved solids in ppm	Per cent sodium	Hardness as $CaCO_3$: Total ppm	N.C. ppm	Remarks
LAHONTAN DRAINAGE BASIN —Continued																								
Willow Creek																								
Willow Creek near Eagle Lake	31N/11E-2	7/25/52	12	63	500	8.2	20	19	61	8.9	0	318	0.7	9.0	0.0	0.0	0.14	36		311	49	128	0	
							1.00	1.56	2.65	0.23	0.00	5.21	0.01	0.25	0.00									
Willow Creek 15 mi. southeast of Eagle Lake	31N/13E-30	7/25/52	20	66	248	7.7	16	9.1	25	3.9	0	156	0.9	2.5	0.6	0.0	0.14	31		166	40	77	0	
							0.80	0.75	1.09	0.10	0.00	2.56	0.02	0.07	0.01									
Susan River																								
Susan River near Susanville	30N/12E-31	5/10/55	108	55	94	7.5	11	3.1	3.8	1.1	0	58	1.6	0.8	0.4	0.2	0.00	23		74	17	40	0	P.S.S.P. Sta. #17b[d]
							0.55	0.25	0.16	0.03	0.00	0.95	0.03	0.02	0.01									
		9/13/55	3.1	62	192	7.6	18	10	5.8	2.7	0	126	0.0	0.0	0.2	0.0	0.00	41		140	12	86	0	
							0.90	0.82	0.25	0.07	0.00	2.06	0.00	0.00	0.00									
Hooey Lake near Buntingville	28N/14E-17K1S	5/ 4/54	......	71	2,310	8.9	9.4	2.9	522	31	59	634	215	242	2.4	2.8	2.8	62	Fe=0.56 ppm; As=0.13 ppm	1,460	94	36	0	
							0.47	0.24	22.70	0.79	1.97	10.39	4.48	6.83	0.01									
Herlong																								
Long Valley Creek near Constantia	24N/17E-13G1S	7/ 8/54	......	......	583	7.0	6.0	8.5	104	3.4	0	101	142	30	0.4	1.3	0.96	53		399	81	50	0	
							0.30	0.70	4.52	0.09	0.00	1.66	2.96	0.85	0.01									

[a] Unless otherwise noted, analyses are by United States Geological Survey, Quality of Water Branch, Sacramento Laboratory.
[b] Unless otherwise noted, calculated from analyzed constituents.
[c] Iron (Fe), Arsenic (As), Aluminum (Al), Copper (Cu), Zinc (Zn), reported here as insignificant or not analyzed for except as shown.
[d] State Department of Water Resources Periodic Stream Sampling Program Station (P.S.S.P. Sta.).
[e] Analysis by State Department of Water Resources, Bryte Laboratory.
[f] Location number referred to Humboldt Base and Meridian.

TABLE 30

MINERAL ANALYSES OF GROUND WATER WITHIN THE NORTHEASTERN COUNTIES [a]

Source	Well number MDB&M	Date sampled	Temp. in °F.	Specific conductance (micromhos at 25°C.)	pH	Mineral constituents in parts per million / equivalents per million: Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Boron (B)	Silica (SiO_2)	Other constituents [c]	Total[b] dissolved solids in ppm	Per cent sodium	Hardness as $CaCO_3$: Total ppm	Hardness as $CaCO_3$: N.C. ppm	Remarks
NORTH COASTAL DRAINAGE BASIN																							
Tule Lake																							
Irrigation well	45N/2W-3H1	10/ 1/53	52	277	7.2	17	13	24	5.2	0	166	3.7	1.8	8.3	0.1	0.05	49		204	34	96	0	270′ Depth; 15′-270′: Perforations
						0.85	1.07	1.04	0.13	0.00	2.72	0.08	0.05	0.13									
Domestic well	46N/5E-3B1	9/23/48	......	680	......	6.0	4.9	108	..	21	488	67	14	..	..	0.08	..		......	87	35	0	
						0.30	0.40	4.70		0.70	8.00	1.40	0.40										
Stock-irrigation well	46N/2E-7E1	7/16/54	53	134	8.0	7.4	6.0	11	2.5	0	74	2.1	6.0	0.4	0.2	0.13	41		113	34	43	0	521′ Depth cased to 20′
						0.37	0.49	0.48	0.06	0.00	1.21	0.04	0.17	0.01									
Irrigation well	46N/1E-8E1	10/ 1/53	54	377	7.5	2.7	19	16	5.3	0	142	12	17	44	0.0	0.00	48		258	19	145	29	200′ Depth
						1.35	1.56	0.70	0.14	0.00	2.33	0.25	0.48	0.71									
Domestic-stock well	46N/1E-31P1	5/13/53	58	153	7.4	9.2	7.5	12	2.1	0	96	1.5	3.2	0.2	0.1	0.03	39		122	32	54	0	172′ Depth
						0.46	0.62	0.52	0.05	0.00	1.57	0.03	0.09	0.00									
Domestic well	45N/1W-2P1	5/13/53	......	546	7.8	33	29	38	7.4	0	241	11	9.0	7.9	0.2	0.00	33		360	28	202	2	
						1.65	2.38	1.65	0.19	0.00	4.00	0.23	0.25	1.27									
Well	46N/1W-22K2	5/13/53	......	233	7.7	18	9.2	17	3.4	0	144	4.6	3.5	0.2	0.1	0.04	32		159	30	83	0	113′ Depth; 65′-105′: Perforations
						0.90	0.76	0.74	0.09	0.00	2.36	0.10	0.10	0.00									
Irrigation well	46N/2W-13B1	5/13/53	51	549	7.5	32	34	37	8.7	0	344	5.1	7.0	13	0.2	0.06	49		356	26	220	0	93′ Depth
						1.60	2.80	1.61	0.22	0.00	5.64	0.11	0.20	0.21									
Irrigation well	46N/2W-15Q1	5/13/53	51	178	7.6	14	9.6	10	2.0	0	117	1.6	0.2	0.1	0.0	0.03	40		135	22	74	0	345′ Depth
						0.70	0.79	0.44	0.05	0.00	1.92	0.03	0.01	0.00									
Well	47N/5E-23M1	5/ 3/47	......	1,120	......	64	57	99	..	18	500	125	28	..	..	0.12	..		......	35	395	0	350′ Depth
						3.20	4.70	4.30		0.60	8.20	2.60	0.80										
Domestic well	47N/4E-7M1	4/13/56	67	988	7.0	52	50	77	14	0	317	126	79	18	0.1	0.26	26	Fe=0.5 ppm	601	32	338	78	90′ Depth
						2.60	4.15	3.33	0.37	0.00	5.19	2.63	2.23	0.29									
Domestic well	47N/2E-20E1	4/20/56	52	395	6.1	14	19	24	3.0	0	145	19	16	29	0.3	0.22	38	Fe=3.0 ppm	237	30	114	0	422′ Depth
						0.70	1.58	1.06	0.08	0.00	2.37	0.40	0.44	0.46									
Flowing stock-irrigation well	47N/1E-10J1	10/ 4/54	66	318	8.3	8.9	6.0	37	9.5	2	146	1.1	9.0	0.4	0.3	0.05	45		191	58	47	0	
						0.44	0.49	1.61	0.24	0.07	2.39	0.03	0.25	0.02									
Domestic well	47N/1W-23G1	7/16/54	62	2,640	8.3	33	39	602	39	10	1310	379	83	3.1	0.4	1.1	52		1,890	82	243	0	107′ Depth
						1.65	3.21	26.18	1.00	0.33	21.47	7.89	2.34	0.05									
Irrigation well	47N/1W-35Q1	7/16/54	52	351	8.1	21	17	34	7.7	0	228	4.3	7.0	5.0	0.2	0.11	40		248	36	122	0	290′ Depth; 90′-290′: Perforations
						1.05	1.40	1.48	0.20	0.00	3.74	0.09	0.20	0.08									
Abandoned well	47N/2W-16P1	5/13/53	45	371	8.0	25	14	34	7.6	0	182	41	0.8	3.2	0.1	0.2	22		237	36	120	0	10′ Depth
						1.25	1.15	1.48	0.19	0.00	2.98	0.85	0.02	0.05									

TABLE 30—Continued

MINERAL ANALYSES OF GROUND WATER WITHIN THE NORTHEASTERN COUNTIES [a]

Source	Well number MDB&M	Date sampled	Temp. in °F.	Specific conductance (micromhos at 25°C.)	pH	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Boron (B)	Silica (SiO_2)	Other constituents [c]	Total[b] dissolved solids in ppm	Per cent sodium	Hardness as $CaCO_3$ Total ppm	Hardness as $CaCO_3$ N.C. ppm	Remarks
						Mineral constituents in parts per million / equivalents per million																	
NORTH COASTAL DRAINAGE BASIN—Continued																							
Tule Lake—Continued																							
Domestic well	48N/5E-27E1	4/19/56	43	2,400	7.2	101	143	273	22	0	1060	480	73	11	0.1	0.10	40	Fe=1.8 ppm	1,670	41	841	0	67′ Cased depth
						5.04	11.77	11.88	0.56	0.00	17.44	10.00	2.07	0.18									
Domestic well	48N/4E-32D1	4/19/56	47	1,160	7.1	45	58	82	14	0	769	1.0	12	0.4	0.3	0.35	40	NH^4=40 ppm; Fe=2.3 ppm	677	27	350	0	190′ Depth
						2.23	4.76	3.55	0.36	0.00	12.60	0.02	0.35	0.01									
Irrigation well	48N/1E-30L1	4/20/56		291	7.2	21	15	17	6.3	0	168	13	1.4	0.2	0.3	0.02	35		193	23	114	0	365′ Depth cased to 210′
						1.07	1.20	0.72	0.16	0.00	2.76	0.27	0.04	0.00									
Municipal well	48N/1E-30N1	5/13/53	56	345	7.5	16	20	24	7.7	0	188	15	8.5	7.3	0.3	0.06	41		232	28	122	0	201′ Depth; 130′-195′: Perforations
						0.80	1.64	1.04	0.20	0.00	3.08	0.31	0.24	0.12									
Domestic well	48N/1W-36R1	10/ 1/53		1,370	7.9	27	67	170	32	0	438	275	80	0.3	0.2	0.28	52		919	49	343	0	80′ Depth
						1.35	5.51	7.39	0.82	0.00	7.18	5.73	2.26	0.00									
Klamath River																							
Domestic well	46N/5W-7G1	5/ 6/53		702	8.4	83	31	26	0.9	10	300	26	20	85	0.1	0.09	21		451	14	334	72	22′ Depth
						4.14	2.55	1.13	0.02	0.33	4.92	0.54	0.56	1.37									
Domestic-stock well	46N/5W-8P2	5/ 6/53		1,390	8.6	33	26	265	2.5	24	524	19	179	0.5	0.3	2.8	18		828	75	190	0	200′+ Depth
						1.65	2.14	11.52	0.06	0.80	8.59	0.40	5.05	0.01									
Irrigation well	46N/5W-21J1	5/ 7/53	56	309	7.9	29	9.1	26	0.7	0	176	12	6.0	3.4	0.3	0.10	28		201	34	110	0	100′ Depth
						1.45	0.75	1.13	0.02	0.00	2.88	0.25	0.17	0.06									
Spring	47N/5W-13Q1	9/25/54	76	15,900	6.7	189	54	3690	102	0	3510	46	4280	--	0.8	--	75		10,200	91	694	0	d
						9.43	4.44	160.46	2.61	0.00	57.52	0.96	120.71										
Shasta Valley																							
Domestic well	41N/5W-4N1	10/ 1/53		559	8.0	8.6	72	6.3	0.8	0	376	4.0	6.5	0.4	0.0	0.14	54		338	4	318	10	20′ Depth
						0.43	5.92	0.27	0.02	0.00	6.16	0.08	0.18	0.01									
Domestic well	41N/5W-9F3	5/11/53		300	8.2	4.2	38	2.4	1.1	0	198	2.8	2.5	2.7	0.0	0.04	32		183	3	167	4	27′ Depth
						0.21	3.12	0.10	0.03	0.00	3.24	0.06	0.07	0.04									
Domestic well	42N/5W-28D1	10/ 1/53		285	7.2	13	11	21	18	0	152	7.2	7.0	2.3	0.3	0.07	56		211	31	78	0	32′ Depth
						0.65	0.90	0.91	0.46	0.00	2.49	0.15	0.20	0.04									
Domestic well	42N/5W-33M3	5/11/53		463	7.6	10	54	8.7	1.5	0	284	7.4	7.8	11	0.0	0.00	55		295	7	247	14	148′ Depth
						0.50	4.44	0.38	0.04	0.00	4.65	0.15	0.22	0.18									
Domestic well	42N/6W-3L1	5/11/53		486	8.0	61	26	8.7	2.4	0	297	19	2.5	10	0.0	0.03	25		301	7	259	16	55′ Depth
						3.04	2.14	0.38	0.06	0.00	4.87	0.40	0.07	0.16									

TABLE 30—Continued

MINERAL ANALYSES OF GROUND WATER WITHIN THE NORTHEASTERN COUNTIES [a]

Source	Well number MDB&M	Date sampled	Temp. in °F.	Specific conductance (micromhos at 25°C.)	pH	Mineral constituents in parts per million / equivalents per million: Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Boron (B)	Silica (SiO_2)	Other constituents [c]	Total [b] dissolved solids in ppm	Per cent sodium	Hardness as $CaCO_3$: Total ppm	N.C. ppm	Remarks
NORTH COASTAL DRAINAGE BASIN—Continued																							
Shasta Valley—Continued																							
Domestic well	42N/6W-10J1	5/11/53	......	508	8.4	10	66	4.1	0.3	10	3.24	4.1	4.5	12	0.0	0.00	50		320	3	296	14	110′ Depth
						0.50	5.43	0.18	0.01	0.33	5.31	0.09	0.13	0.19									
Domestic well	43N/5W-9C1	10/ 1/53	......	765	7.7	36	46	64	4.5	0	416	9.2	48	1.8	0.5	0.64	67		482	33	279	0	16′ Depth
						1.80	3.78	2.78	0.12	0.00	6.82	0.19	1.35	0.03									
Domestic well	43N/5W-2M1	10/ 1/53	......	486	7.5	25	31	36	2.2	0	282	9.9	16	1.4	0.3	0.26	72		333	29	190	0	44′ Depth; 30′-44′: Perforations
						1.25	2.55	1.57	0.06	0.00	4.62	0.21	0.45	0.02									
Domestic well	43N/6W-3K1	5/12/53	52	769	8.2	46	43	63	3.0	0	404	23	48	10	0.3	0.25	55		490	32	292	0	27′ Depth
						2.30	3.54	2.74	0.08	0.00	6.62	0.48	1.35	0.16									
Domestic-irrigation well	43N/6W-29Q3	5/11/53	61	484	8.4	69	23	8.0	0.8	10	308	7.7	1.5	6.0	0.0	0.00	21		299	6	266	0	150′ Depth; 100′-150′: Perforations
						3.44	1.89	0.35	0.02	0.33	5.05	0.16	0.04	0.10									
Irrigation well	44N/5W-1J2	5/ 7/53	53	658	7.6	67	26	41	2.0	0	375	17	26	5.4	0.1	0.81	47		416	24	274	0	59′ Depth
						3.34	2.14	1.78	0.05	0.00	6.15	0.35	0.73	0.09									
Abandoned well	44N/5W-34N1	5/ 8/53	......	472	8.1	23	22	34	23	0	236	8.1	22	17	0.5	0.35	58		324	29	148	0	
						1.15	1.81	1.48	0.59	0.00	3.87	0.17	0.62	0.27									
Domestic well	44N/6W-10R1	5/12/53	......	747	8.0	77	26	58	1.6	0	428	12	31	17	0.0	0.39	36		469	30	299	0	
						3.84	2.14	2.52	0.04	0.00	7.01	0.25	0.87	0.27									
Abandoned well	44N/6W-29D1	5/12/53	53	245	7.5	28	11	7.2	1.1	0	136	6.1	3.5	11	0.0	0.01	25		160	12	115	4	12′ Depth
						1.40	0.90	0.31	0.03	0.00	2.23	0.13	0.10	0.18									
Domestic well	44N/7W-13C2	5/12/53	......	336	8.1	55	6.7	8.0	0.5	0	194	7.9	4.0	11	0.1	0.00	28		217	10	165	6	95′ Depth
						2.74	0.55	0.35	0.01	0.00	3.18	0.16	0.11	0.18									
Domestic well	45N/5W-6E1	5/ 8/53	60	961	8.4	7.5	6.1	242	1.5	14	580	0.4	32	0.1	2.4	5.5	17		614	92	44	0	
						0.37	0.50	10.52	0.04	0.47	9.51	0.01	0.90	0.00									
Irrigation well	45N/5W-28D1	5/ 7/53	......	339	7.9	33	11	34	4.5	0	178	17	10	3.0	0.5	0.17	33		224	28	128	0	175′ Depth; 65′-175′: Perforations
						1.65	0.90	1.04	0.12	0.00	2.92	0.35	0.28	0.05									
Flowing irrigation—stock well	45N/6W-17F1	5/ 8/53	60	302	7.4	17	25	11	1.5	0	171	10	3.2	13	0.1	0.03	45		210	14	145	5	63′ Depth
						0.85	2.06	0.48	0.04	0.00	2.80	0.21	0.09	0.21									
Domestic—stock well	45N/6W-32K1	5/11/53	52	1,230	8.1	116	71	28	1.6	0	364	42	180	47	0.3	0.01	29		694	9	582	286	20′ Depth
						5.79	5.84	1.22	0.04	0.00	5.97	0.87	5.08	0.76									
Irrigation spring	45N/7W-25N2	5/ 8/53	58	724	7.3	54	41	46	1.2	0	204	213	2.0	7.7	0.3	0.05	16		482	25	303	136	
						2.69	3.37	2.00	0.03	0.00	3.34	4.43	0.06	0.12									
Domestic-irrigation well	46N/5W-31F1	5/ 7/53	59	403	8.4	28	18	36	0.6	0	234	18	9.2	10	0.3	0.28	28		263	35	144	0	75′ Depth
						1.40	1.48	1.56	0.02	0.00	3.84	0.38	0.26	0.16									

TABLE 30—Continued

MINERAL ANALYSES OF GROUND WATER WITHIN THE NORTHEASTERN COUNTIES[a]

Source	Well number MDB&M	Date sampled	Temp. in °F.	Specific conductance (micromhos at 25°C.)	pH	Mineral constituents in parts per million / equivalents per million: Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Boron (B)	Silica (SiO_2)	Other constituents[c]	Total[b] dissolved solids in ppm	Per cent sodium	Hardness as $CaCO_3$: Total ppm	Hardness as $CaCO_3$: N.C. ppm	Remarks
NORTH CENTRAL DRAINAGE BASIN—Continued																							
Scott Valley																							
Domestic well	40N/8W-14N1	5/12/53	......	136	7.1	5.8	14	1.0	0.4	0	88	1.7	1.0	1.3	0.1	0.00	18		87	3	72	0	16′ Depth
						0.29	1.15	0.04	0.01	0.00	1.44	0.04	0.03	0.02									
Domestic well	40N/9W-13R1	5/12/53	......	461	7.5	30	39	5.8	1.5	0	3.12	3.2	1.0	0.2	0.0	0.06	15		249	5	236	0	20′ Depth
						1.50	3.21	0.25	0.04	0.00	5.11	0.07	0.03	0.00									
Domestic well	41N/8W-7J1	5/12/53	......	450	7.7	62	20	6.8	0.6	0	260	13	0.5	21	0.0	0.00	19		271	6	236	24	22′ Depth
						3.09	1.64	0.30	0.02	0.00	4.26	0.27	0.01	0.34									
Domestic well	41N/9W-3L1	1/ 6/54	50	652	7.2	96	19	13	3.7	0	314	17	16	62	0.0	0.00	36		417	8	318	60	25′ Depth
						4.79	1.56	0.57	0.09	0.00	5.15	0.35	0.45	1.00									
Domestic well	41N/9W-22M1	10/ 4/53	......	151	6.8	11	4.9	8.0	6.7	0	70	8.0	5.5	1.4	0.2	0.01	35		115	24	48	0	15′ Depth
						0.55	0.40	0.35	0.17	0.00	1.15	0.17	0.16	0.02									
Domestic well	42N/9W-29A1	5/12/53	......	115	7.2	11	6.6	3.8	0.6	0	74	2.6	0.0	0.2	0.0	0.03	25		86	13	55	0	65′ Depth; 30′-65′: Perforations
						0.55	0.54	0.16	0.02	0.00	1.21	0.05	0.00	0.00									
Domestic well	42N/9W-35R1	5/12/53	......	297	7.6	20	25	2.8	0.6	0	186	8.1	1.0	1.4	0.0	0.06	19		170	4	153	0	17′ Depth
						1.00	2.06	0.12	0.02	0.00	3.05	0.17	0.03	0.02									
Stock well	43N/9W-13N2	5/12/53	58	409	7.0	33	29	6.3	2.3	0	189	14	4.8	50	0.0	0.00	24		256	6	202	47	18′ Depth
						1.65	2.38	0.27	0.06	0.00	3.10	0.29	0.14	0.81									
Domestic well	43N/9W-31A1	5/12/53	44	38	6.9	5.1	0.8	1.2	1.4	0	22	1.9	0.0	0.1	0.0	0.04	7.7		29	13	16	0	20′ Depth
						0.25	0.07	0.05	0.04	0.00	0.36	0.04	0.00	0.00									
Stock well	43N/10W-25N1	5/12/53	50	157	6.9	10	10	3.1	1.3	0	38	41	0.8	1.2	0.0	0.00	11		97	9	66	35	
						0.50	0.82	0.14	0.03	0.00	0.62	0.85	0.02	0.02									
Stock well	44N/8W-30N1	5/12/53	52	490	7.9	44	40	5.0	0.4	0	318	14	1.0	4.5	0.0	0.03	25		290	4	274	14	15′ Depth
						2.20	3.29	0.22	0.01	0.00	5.21	0.29	0.03	0.07									
Domestic well	44N/8W-31G1	10/ 4/53	54	538	7.3	42	43	6.0	2.2	0	178	142	1.0	2.5	0.2	0.06	20		347	4	282	136	30′ Depth
						2.10	3.54	0.26	0.06	0.00	2.92	2.96	0.03	0.04									
Irrigation well	44N/9W-29E1	5/12/53	58	162	7.0	15	9.2	3.4	2.0	0	82	6.3	0.8	10	0.0	0.00	15		102	9	75	8	19′ Depth
						0.75	0.75	0.15	0.05	0.00	1.34	0.13	0.02	0.16									
Abandoned well	44N/9W-34R2	5/12/53	51	508	7.5	34	26	11	25	0	132	20	13	120	0.0	0.00	17		331	10	192	84	20′ Depth
						1.70	2.11	0.48	0.64	0.00	2.16	0.42	0.37	1.94									

TABLE 30—Continued

MINERAL ANALYSES OF GROUND WATER WITHIN THE NORTHEASTERN COUNTIES [a]

Source	Well number MDB&M	Date sampled	Temp. in °F.	Specific conductance (micromhos at 25°C.)	pH	Mineral constituents in parts per million / equivalents per million: Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Boron (B)	Silica (SiO_2)	Other constituents [c]	Total [b] dissolved solids in ppm	Per cent sodium	Hardness as $CaCO_3$: Total ppm	N.C. ppm	Remarks
CENTRAL VALLEY DRAINAGE BASIN																							
Goose Lake																							
Irrigation well	45N/14E-18R1	6/ 1/56	55	181	7.1	14	4.4	17	4.5	0	112	3.0	1.7	1.4	0.3	0.06	58	Fe=0.00 ppm	159	39	53	0	
						0.70	0.36	0.74	0.16	0.00	1.84	0.06	0.05	0.02									
Domestic well	46N/14E-32L1	5/23/56	58	253	7.1	19	8.9	16	8.1	0	120	8.2	16	1.6	0.3	0.09	65	Fe=0.07 ppm	202	27	84	0	223′ Depth
						0.95	0.73	0.70	0.21	0.00	1.97	0.17	0.45	0.03									
Industrial and domestic well	47N/14E-28G1	5/23/56	63	385	7.6	27	7.6	46	4.8	0	185	44	5.7	0.3	0.4	0.51	55	Fe=0.00 ppm	282	49	98	0	250′ Depth
						1.35	0.62	2.00	0.12	0.00	3.03	0.92	0.16	0.01									
Alturas																							
Domestic-industrial well	39N/13E-8K1	11/18/55	.....	238	7.9	20	6.6	29	7.9	0	164	7.0	6.0	1.5	0.1	0.00	47		206	42	77	0	
						1.00	0.54	1.26	0.20	0.00	2.69	0.15	0.17	0.02									
Flowing well	40N/12E-11F1	11/21/55	62	162	7.6	8.8	1.7	21	5.7	0	82	7.0	4.0	1.5	0.1	0.09	71		161	56	29	0	800′ Depth
						0.44	0.14	0.91	0.15	0.00	1.34	0.15	0.11	0.02									
Domestic well	40N/12E-25J1	11/18/51	.....	443	8.0	19	8.9	71	9.8	0	283	9.0	5.0	1.5	0.1	0.16	71		334	62	84	0	
						0.95	0.73	3.09	0.25	0.00	4.64	0.19	0.14	0.02									
Domestic-stock well	41N/12E-10J1	11/18/51	......	334	7.5	25	8.2	30	7.2	0	140	2.0	17	12	0.4	0.04	70		259	38	96	0	120′ Depth
						1.25	0.67	1.31	0.18	0.00	2.30	0.01	0.48	0.19									
Irrigation spring	42N/10E-7	3/ 8/55	.....	300	9.0	0.0	0.0	70	..	35	105	0.0	15	..	..	0.14	..		......	100	0	0	
						0.00	0.00	3.04		1.17	1.72	0.00	0.42										
Municipal well	42N/12E-12L1	11/ 9/53	...	.....	8.3	17	3.2	42	..	..	125	14	4.9	0.6	0.2	..	..		237	62	56	0	
						0.85	0.26	1.83			2.05	0.29	0.14	0.01									
Municipal well	42N/12E-13E	11/ 9/53	.....	...	7.9	67	21	44	..	..	200	82	40	1.4	0.2	.	..	Fe=1.5 ppm	506	27	252	..	
						3.34	1.73	1.91			3.28	1.71	1.13	0.02									
Domestic-irrigation well	42N/13E-14G1	6/19/47	.	471	..	28	7.3	64	..	..	177	34	43	..	..	2.85	.		....	58	100	0	148′ Depth
						1.40	0.60	2.78			2.90	0.71	1.21										
Big Valley																							
Domestic well	38N/7E-23	4/16/52	50	1,750	8.0	103	75	155	12	0	90	525	204	14	0.0	0.88	62		1,200	36	580	507	80′ Cased Depth
						5.14	6.17	6.74	0.31	0.00	1.47	10.93	5.75	0.23									
Irrigation well	38N/7E-31J1	5/31/56	48	693	7.3	58	36	45	3.7	0	362	46	29	0.0	0.1	0.10	19	Fe=0.01 ppm	445	25	293	0	606′ Depth
						2.89	2.98	1.96	0.09	0.00	5.93	0.96	0.82	0.00									
Domestic well	38N/8E-17K1	5/31/56	58	214	7.2	14	12	14	2.8	0	130	6.4	2.8	0.1	0.1	0.00	64	Fe=0.01 ppm	180	25	86	0	175′ Depth
						0.70	1.02	0.61	0.07	0.00	2.13	0.13	0.08	0.00									

TABLE 30—Continued

MINERAL ANALYSES OF GROUND WATER IN THE NORTHEASTERN COUNTIES [a]

Source	Well number MDB&M	Date sampled	Temp. in °F.	Specific conductance (micromhos at 25°C.)	pH	Mineral constituents in parts per million / equivalents per million: Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Boron (B)	Silica (SiO_2)	Other constituents [c]	Total [b] dissolved solids in ppm	Per cent sodium	Hardness as $CaCO_3$: Total ppm	N.C. ppm	Remarks
CENTRAL VALLEY DRAINAGE BASIN—Continued																							
Big Valley—Continued																							
Irrigation spring	40N/7E-27G1	10/25/55	56	215	7.4	19	8.9	8.9	2.6	0	80	38	2.2	0.4	0.1	0.01	73		192	18	84	18	
						0.95	0.73	0.39	0.07	0.00	1.31	0.79	0.06	0.01									
Flowing stock-irrigation well	41N/8E-34C1	11/19/55	62	253	7.5	24	5.9	18	6.6	0	154	2.0	1.0	3.3	0.0	0.05	49		186	30	84	0	330′ Depth
						1.20	0.48	0.78	0.17	0.00	2.52	0.04	0.03	0.05									
Montgomery Creek																							
Domestic well	37N/1E-31N1	12/28/55	------	499	7.6	12	3.6	96	1.4	0	201	1.6	57	0.8	1.3	4.0	41		318	82	45	0	487′ Depth Cased to 480′; Perforations: 90′-480′ [e]
						0.60	0.30	4.17	0.04	0.00	3.30	0.03	1.60	0.01									
Clear Creek-Cottonwood Creek																							
Domestic-irrigation well	29N/4W-32	3/ 3/55	66	210	7.2	18	9.0	14	0.9	0	127	2.0	4.0	1.8	0.1	0.03	44		157	27	82	0	578′ Cased depth
						0.90	0.74	0.61	0.02	0.00	2.08	0.04	0.11	0.03									
Irrigatioo well	29N/5W-11C1	10/26/55	66	157	7.4	10	7.3	12	0.7	0	94	2.0	1.8	0.9	0.1	0.03	54		135	32	55	0	460′ Cased depth
						0.50	0.60	0.52	0.02	0.00	1.54	0.04	0.05	0.02									
Mineral spriog	33N/7W-34M1	3/10/54	------	17,700	5.0	1170	1.2	2790	18	0	3	6.8	6160	6.8	0.0	1.5	17		10,200	67	2,920	2,920	
						58.38	0.10	121.32	0.46	0.00	0.05	0.14	173.73	0.11									
Thomes Creek																							
Irrigation well	27N/4W-2J1	3/16/55	57	206	7.0	13	9.6	12	4.7	0	109	--	2.8	--	--	0.00	--		------	25	72	0	150′ Depth
						0.65	0.79	0.52	0.12	0.00	1.79		0.08										
Irrigation well	27N/4W-26L1	3/16/55	68	295	7.5	1.9	25	21	0.9	0	184	--	2.4	--	--	0.01	--		------	29	108	0	175′ Depth
						0.10	2.06	0.91	0.02	0.00	3.02		0.07										
Irrigatioo well	27N/5W-2D1	3/16/55	66	298	7.5	20	15	22	0.8	0	184	--	5.0	--	--	0.03	--		------	30	112	0	150′ Depth cased to 300′
						1.00	1.25	0.96	0.02	0.00	3.02		0.14										
Cache Creek																							
Municipal well	12N/7W-1M2	3/26/52	------	396	7.8	30	26	22	0.8	0	178	62	12	9.4	0.0	0.15	35		285	21	182	36	72′ Depth [f]
						1.50	2.14	0.96	0.02	0.00	2.92	1.29	0.34	0.15									
Domestic well	13N/5W-1	11/24/54	------	------	8.6	67	188	400	3.1	84	469	664	410	0.4	0.2	--	--		2,357	48	938	0	
						3.34	15.46	17.39	0.08	2.80	7.69	13.82	11.56	0.01									
Irrigation well	13N/7W-21H1	2/29/56	65	347	7.5	26	19	18	0.5	0	192	17	7.0	0.4	0.2	0.48	36		220	21	144	0	177′ Depth
						1.30	1.58	0.78	0.01	0.00	3.15	0.35	0.20	0.01									
Domestic well	13N/8W-6Q1	8/24/54	78	705	7.5	37	45	57	8.2	0	424	1.2	38	1.2	0.3	5.3	86		488	30	278	0	
						1.85	3.71	2.48	0.12	0.00	6.95	0.02	1.07	0.02									
Irrigatioo well	13N/9W-2L2	8/24/54	59	531	8.5	29	57	12	1.1	20	308	19	13	3.1	0.0	0.07	43		349	8	305	19	
						1.45	4.65	0.52	0.03	0.67	5.05	0.40	0.37	0.05	--	--	--						

TABLE 30—Continued

MINERAL ANALYSES OF GROUND WATER WITHIN THE NORTHEASTERN COUNTIES [a]

Source	Well number MDB&M	Date sampled	Temp. in °F.	Specific conductance (micromhos at 25°C.)	pH	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Boron (B)	Silica (SiO_2)	Other constituents [c]	Total[b] dissolved solids in ppm	Per cent sodium	Hardness as $CaCO_3$ Total ppm	Hardness as $CaCO_3$ N.C. ppm	Remarks
						Mineral constituents in parts per million / equivalents per million																	
CENTRAL VALLEY DRAINAGE BASIN—Continued																							
Cache Creek—Continued																							
Stock-irrigation well	13N/9W-8N1	8/ 8/52	67	600	7.4	25	48	30	2.7	0	330	0.8	20	34	0.0	1.3	78		402	20	260	0	
						1.25	3.95	1.30	0.07	0.00	5.41	0.02	0.56	0.55									
Irrigation well	13N/9W-22M1	8/24/54	70	421	8.3	18	46	10	1.7	8	264	14	5.8	6.8	0.1	0.04	68		308	8	236	6	110′ Depth
						0.90	3.82	0.44	0.04	0.27	4.33	0.29	0.16	0.11									
Domestic well	14N/8W-13P1	2/29/56	------	71.4	7.1	3.6	4.1	5.0	0.1	0	38	0.0	2.2	2.1	0.1	0.00	10		46	29	26	0	168′ Depth cased to 150′
						0.18	0.34	0.22	0.00	0.00	0.62	0.00	0.06	0.03									
Irrigation well	14N/9W-33P1	7/ 5/53	------	428	7.4	25	37	11	1.1	0	272	4.4	4.0	0.1	0.1	0.10	50		267	10	214	0	
						1.25	3.04	0.48	0.03	0.00	4.46	0.09	0.11	0.00									
Irrigation-industrial well	14N/10W-14E2	8/24/54	59	222	8.1	24	10	8.3	0.7	0	124	9.2	4.3	2.4	0.1	0.13	23		143	15	102	0	104′ Depth
						1.20	0.83	0.36	0.02	0.00	2.03	0.19	0.12	0.04									
Domestic well	15N/9W-31P1	8/24/54	69	150	7.5	5.3	8.9	13	0.3	0	90	1.8	3.1	0.4	0.0	0.01	28		105	36	50	0	110′ Depth
						0.26	0.74	0.56	0.01	0.00	1.48	0.04	0.09	0.01									
Well	15N/10W-3L1	8/ 7/52	60	1,290	7.9	69	95	91	0.6	--	694	147	28	1.6	0.5	0.54	25		800	26	562	0	
						3.44	7.81	3.96	0.02		11.37	3.06	0.79	0.03									
Well	15N/10W-4C1	8/ 7/52	68	455	7.1	31	30	21	0.3	0	233	15	18	12	0.1	0.24	23		265	19	201	10	
						1.55	2.47	0.91	0.01	0.00	3.82	0.31	0.51	0.19									
Irrigation well	16N/9W-31L2	8/24/54	59	330	8.2	27	22	15	0.8	0	206	6.9	9.9	0.6	0.2	0.05	16		199	17	160	0	18′ Depth
						1.35	1.85	0.65	0.02	0.00	3.38	0.14	0.28	0.01									
Putah Creek																							
Domestic well	10N/7W-3A1	2/29/56	------	315	8.2	7.6	36	6.5	1.1	0	207	7.0	3.5	0.9	0.0	0.10	33		198	8	165	0	111′ Depth
						0.38	2.92	0.28	0.03	0.00	3.39	0.15	0.10	0.02									
Domestic well	11N/6W-29F1	2/29/56	48	1,210	8.3	18	171	21	0.3	12	846	52	16	10	0.0	0.15	31		748	6	750	37	40′ Cased depth
						0.90	14.10	0.91	0.01	0.40	13.87	1.08	0.45	0.16									
Battle Creek																							
Domestic dug well	30N/3W-27P1	10/26/55	------	430	------	31	22	14	4.9	0	128	17	30	--	--	0.06	--		------	15	167	62	40′ Depth
						1.55	1.79	0.61	0.12	0.00	2.10	0.35	0.85										
Irrigation well	31N/3W-11J1	10/26/52	62	237	7.2	22	11	11	1.7	0	144	4.0	5.1	0.6	0.2	0.01	78		205	19	102	0	175′ Depth
						1.10	0.94	0.48	0.04	0.00	2.36	0.08	0.14	0.01									
Well	31N/3W-29L1	11/28/55	------	196	8.0	14	12	9.6	2.0	0	118	4.2	3.0	0.5	0.0	0.07	80		183	19	85	0	137′ Cased depth; Perforations: 84′-137′
						0.70	1.00	0.42	0.05	0.00	1.93	0.09	0.08	0.01									

TABLE 30—Continued

MINERAL ANALYSES OF GROUND WATER WITHIN THE NORTHEASTERN COUNTIES [a]

Source	Well number MDB&M	Date sampled	Temp. in °F.	Specific conductance (micromhos at 25°C.)	pH	Mineral constituents in parts per million / equivalents per million: Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Boron (B)	Silica (SiO_2)	Other constituents [c]	Total[b] dissolved solids in ppm	Per cent sodium	Hardness as $CaCO_3$: Total ppm	N.C. ppm	Remarks
CENTRAL VALLEY DRAINAGE BASIN—Continued																							
Battle Creek—Continued																							
Dug well	32N/1W-11C1	5/18/53	58	282	7.1	37	9.6	7.8	2.0	0	178	3.2	0.8	0.0	0.1	0.10	83		231	11	132	0	50′ Cased depth
						1.85	0.79	0.34	0.05	0.00	2.92	0.07	0.02	0.00									
Well	32N/3W-17E2	10/25/55	------	5,740	7.7	73	8.8	1170	6.0	0	162	320	1620	0.0	1.0	13	16		3,310	92	218	85	110′ Cased depth; Perforations: 90′-110′
						3.64	0.72	50.90	0.15	0.00	2.66	6.66	45.68	0.00									
Domestic dug well	32N/3W-17E3	10/25/55	------	121	6.1	5.6	1.5	12	1.0	0	27	5.0	14	1.3	0.1	0.22	20		74	55	20	0	31′ Depth
						0.28	0.12	0.52	0.03	0.00	0.44	0.10	0.40	0.02									
Well	32N/3W-20P1	3/16/56	52	176	6.5	17	4.3	13	1.1	0	72	13	11	5.1	0.0	0.15	27		127	32	60	1	130′ Depth
						0.85	0.35	0.57	0.03	0.00	1.18	0.27	0.31	0.08									
Domestic well	32N/3W-32J1	4/17/56	------	3,530	7.2	106	39	579	6.0	0	120	114	1010	2.3	0.1	4.1	29		1,950	74	424	326	68′ Depth
						5.29	3.20	25.19	0.15	0.00	1.97	2.37	28.48	0.04									
Irrigation well	32N/3W-35C1	10/26/55	66	204	7.3	13	7.7	20	2.5	0	122	4.0	5.2	0.3	0.1	0.04	60		173	39	64	0	100′ Depth
						0.65	0.63	0.87	0.06	0.00	2.00	0.08	0.15	0.01									
Domestic well	33N/2W-25L1	4/17/56	------	103	6.9	12	5.3	2.2	0.2	0	70	1.0	0.0	0.3	0.0	0.00	28		83	8	52	0	200′ Depth
						0.60	0.43	0.10	0.01	0.00	1.15	0.02	0.00	0.01									
Mill Creek																							
Well	24N/2E-14J1	10/—/52	------	52.9	7.5	3.7	2.6	2.8	0.1	--	29	1.6	0.5	0.3	0.0	0.02	26		52	23	20	0	
						0.19	0.21	0.12	0.00		0.48	0.03	0.01	0.01									
Butte Creek																							
Domestic well	20N/4E-32D1	8/20/52	------	154	7.4	13	5.8	10	1.3	0	78	4.4	3.5	4.8	0.1	0.00	76		157	27	56	0	
						0.65	0.48	0.44	0.03	0.00	1.28	0.09	0.10	0.08									
North Fork Feather																							
Domestic well	24N/8E-23E1	5/26/55	------	121	6.9	7.6	5.8	8.0	3.6	0	76	1.4	0.0	0.1	0.0	0.00	57		120	27	43	0	80′ Depth cased to 56′
						0.38	0.48	0.35	0.09	0.00	1.25	0.03	0.00	0.00									
Domestic-irrigation well	24N/9E-13J1	5/26/55	52	89.8	7.0	11	3.5	2.3	0.4	0	52	3.3	0.0	0.4	0.0	0.00	12		59	11	42	0	150′ Depth cased to 148′; Perforations: 82′-92′
						0.55	0.29	0.10	0.01	0.00	0.85	0.07	0.00	0.01									
Domestic-industrial well	24N/9E-24A1	4/27/56	54	109	6.2	12	5.0	3.0	0.4	0	61	3.4	0.0	0.1	0.0	0.04	7		61	12	50	0	100′ Depth
						0.58	0.41	0.13	0.01	0.00	1.00	0.07	0.00	0.00									
Domestic well	24N/10E-18Q1	4/26/56	46	98	6.5	12	4.5	1.6	0.3	0	51	5.3	0.0	0.1	0.0	0.01	8		57	7	48	6	212′ Depth
						0.58	0.37	0.07	0.01	0.00	0.84	0.11	0.00	0.00									
Irrigation well	26N/10E-17N1	5/26/55	53	232	7.5	23	11	10	0.9	0	146	5.1	1.5	0.1	0.0	0.00	29		153	17	103	0	
						1.15	0.91	0.44	0.02	0.00	2.39	0.11	0.04	0.00									

TABLE 30—Continued

MINERAL ANALYSES OF GROUND WATER WITHIN THE NORTHEASTERN COUNTIES[a]

Source	Well number MDB&M	Date sampled	Temp. in °F.	Specific conductance (micromhos at 25°C.)	pH	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Boron (B)	Silica (SiO_2)	Other constituents[c]	Total[b] dissolved solids in ppm	Per cent sodium	Hardness as $CaCO_3$ Total ppm	Hardness as $CaCO_3$ N.C. ppm	Remarks
						Mineral constituents in parts per million / equivalents per million																	
CENTRAL VALLEY DRAINAGE BASIN—Continued																							
North Fork Feather—Continued																							
Domestic-irrigation well	26N/10E-22C1	4/26/56	54	263	7.2	36	5.8	11	0.4	0	158	5.3	0.4	0.2	0.1	0.00	17		155	18	24	0	94′ Depth
						1.80	0.48	0.49	0.01	0.00	2.59	0.11	0.01	0.00									
Industrial well	27N/9E-35P1	4/26/56	54	238	6.8	23	13	8.3	0.3	0	145	2.9	0.7	0.0	0.1	0.00	26		147	14	110	0	120′ Depth
						1.14	1.04	0.36	0.01	0.00	2.37	0.06	0.02	0.00									
Domestic well	28N/7E-5M1	4/26/56	56	102	7.0	9.0	4.3	5.1	1.9	0	59	1.4	1.1	0.2	0.1	0.01	12		65	21	40	0	145′ Depth cased to 127′; Perforations: 80′-117′
						0.45	0.35	0.22	0.05	0.00	0.96	0.03	0.03	0.00									
Domestic well	28N/9E-5F1	4/26/56	50	185	6.2	20	8.6	4.1	0.2	0	105	0.0	2.1	4.3	0.0	0.00	17		109	10	85	0	104′ Depth cased to 24′
						0.99	0.71	0.18	0.01	0.00	1.72	0.00	0.06	0.07									
Middle Fork Feather																							
Domestic well	21N/14E-15J1	5/25/55	55	443	6.9	3.8	11	73	4.6	0	131	1.6	53	13	0.7	0.09	52		278	73	53	0	164′ Depth
						0.19	0.87	3.17	0.12	0.00	2.15	0.03	1.50	0.21									
Domestic well	21N/14E-20A1	5/25/55	......	321	7.3	25	22	11	2.5	0	220	0.3	0.0	0.4	0.0	0.01	52		221	13	154	0	87′ Depth
						1.25	1.83	0.48	0.06	0.00	3.60	0.01	0.00	0.01									
Flowing domestic-stock well	21N/15E-5D1	6/ 1/55	112	1,480	7.1	13	2.1	294	8.5	0	147	153	270	0.3	1.6	5.5	101		921	92	41	0	600′ Depth cased to 20′
						0.65	0.17	12.78	0.22	0.00	2.41	3.19	7.61	0.01									
Flowing developed municipal spring	22N/13E-12J1	5/12/55	48	145	7.1	17	4.8	5.2	2.6	0	91	2.6	0.5	0.4	0.3	0.00	43		121	15	62	0	60′ Horizontal depth
						0.85	0.39	0.23	0.07	0.00	1.49	0.05	0.01	0.01									
Flowing mineral hot springs	22N/14E-13K1	5/11/55	164	2,230	8.2	40	0.5	404	9.2	0	51	317	460	1.2	2.4	5.3	58		1,320	88	102	60	
						2.00	0.04	17.57	0.24	0.00	0.84	6.60	12.97	0.02									
Flowing domestic-stock well	22N/14E-14F1	5/25/55	55	175	7.6	16	8.3	8.3	1.7	0	115	0.5	0.5	0.0	0.0	0.13	47		139	19	74	0	
						0.80	0.68	0.36	0.04	0.00	1.88	0.01	0.01	0.00									
Flowing domestic-stock well	22N/15E-11F1	5/12/55	70	582	7.5	9.3	4.1	114	6.8	0	294	3.9	34	0.6	4.0	1.5	98		421	84	40	0	900′ Depth
						0.46	0.34	4.96	0.17	0.00	4.82	0.08	0.96	0.01									
Flowing well	22N/15E-32F1	6/ 1/55	200	2,450	8.0	40	1.5	467	15	0	48	329	525	0.4	2.8	7.3	58		1,470	89	106	67	900′ Depth Cased to 16′
						2.00	0.12	20.31	0.38	0.00	0.79	6.85	14.81	0.01									
Flowing stock well	22N/15E-35G1	6/ 1/55	66	204	7.9	11	9.6	15	5.8	0	126	3.9	2.0	0.2	0.0	0.01	64		174	30	67	0	600′ Depth
						0.55	0.79	0.65	0.15	0.00	2.06	0.08	0.06	0.00									
Flowing stock well	22N/16E-5N1	5/13/55	70	198	7.4	5.9	3.5	28	3.1	0	104	0.2	2.5	0.1	0.6	0.09	69		164	65	29	0	620′ Depth Cased to 70′
						0.29	0.29	1.22	0.08	0.00	1.70	0.00	0.07	0.00									
Domestic-stock well	22N/16E-20P1	5/13/55	......	197	7.5	15	11	9.9	3.6	0	124	2.2	1.0	0.5	0.0	0.04	58		162	20	82	0	
						0.75	0.89	0.43	0.09	0.00	2.03	0.05	0.03	0.01									

TABLE 30—Continued

MINERAL ANALYSES OF GROUND WATER WITHIN THE NORTHEASTERN COUNTIES [a]

Source	Well number MDB&M	Date sampled	Temp. in °F.	Specific conductance (micromhos at 25°C.)	pH	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Boron (B)	Silica (SiO_2)	Other constituents [c]	Total [b] dissolved solids in ppm	Per cent sodium	Hardness as $CaCO_3$ Total ppm	Hardness as $CaCO_3$ N.C. ppm	Remarks
						Mineral constituents in parts per million / equivalents per million																	
CENTRAL VALLEY DRAINAGE BASIN—Continued																							
Middle Fork Feather—Continued																							
Domestic well	23N/14E-25G1	5/11/55	------	540	7.2	56	19	20	0.8	0	147	20	31	82	0.0	0.00	58		359	17	216	95	
						2.79	1.53	0.87	0.02	0.00	2.41	0.42	0.87	1.32									
Domestic-stock well	23N/14E-35L1	5/25/55	51	737	7.3	22	1.5	130	1.8	0	89	99	114	0.8	0.1	1.5	20		435	82	61	0	400'-500' Depth
						1.10	0.12	5.65	0.05	0.00	1.46	2.06	3.22	0.01									
Flowing well	23N/15E-33A1	5/13/55	55	322	7.7	10	2.0	58	2.3	0	106	23	28	6.4	0.8	1.2	23		207	78	33	0	100' Depth
						0.50	0.16	2.52	0.06	0.00	1.74	0.48	0.79	0.10									
Flowing well	23N/16E-24M1	5/13/55	64	137	7.8	13	0.9	16	1.9	0	77	0.8	1.5	6.4	0.0	0.10	23		102	48	36	0	360' Depth
						0.65	0.07	0.70	0.05	0.00	1.26	0.02	0.04	0.10									
Flowing stock well	23N/16E-28G1	5/15/55	58	183	7.6	20	4.9	13	1.9	0	118	0.7	1.5	0.6	0.6	0.10	47		148	28	70	0	196' Depth
						1.00	0.40	0.56	0.05	0.00	1.93	0.02	0.01	0.01									
Honcut																							
Well	18N/4E-7A1	8/—/52	------	158	7.4	11	8.8	8.0	0.1	0	78	7.7	6.2	3.7	0.0	0.06	27		111	21	64	0	
						0.55	0.72	0.35	0.00	0.00	1.28	0.16	0.18	0.06									
Redding																							
Domestic well	29N/3W-4	1/22/52	58	123	8.1	7.0	6.2	9.4	2.2	--	68	1.9	3.1	4.0	0.1	0.04	78		145	31	43	0	72' Depth
						0.35	0.51	0.41	0.06		1.11	0.04	0.09	0.06									
Irrigation well	29N/4W-7L1	3/ 3/55	64	173	6.8	23	2.3	11	0.8	0	100	5.0	3.8	1.9	0.1	0.00	57		154	26	67	0	240' Cased depth
						1.15	0.19	0.48	0.02	0.00	1.64	0.10	0.11	0.03									
Well	30N/3W-6	2/28/55	66	174	7.3	11	7.9	14	1.4	0	91	3.0	7.2	1.8	0.2	0.07	58		150	33	60	0	
						0.55	0.65	0.61	0.04	0.00	1.49	0.06	0.20	0.03									
Domestic well	30N/4W-2	1/23/52	------	213	7.4	12	11	14	1.2	0	86	11	14	7.2	0.0	0.74	19		132	28	75	5	91' Cased depth
						0.60	0.90	0.61	0.03	0.00	1.41	0.23	0.40	0.12									
Irrigation-industrial well	30N/4W-25N1	10/26/55	63	162	7.7	9.6	7.6	12	0.8	0	87	2.0	4.9	1.5	0.1	0.00	47		128	32	55	0	355' Cased depth
						0.48	0.62	0.52	0.02	0.00	1.43	0.04	0.14	0.02									
Domestic well	31N/4W-6M1	10/11/51	------	464	7.8	49	30	11	1.0	0	314	0.6	4.5	0.2	0.1	0.08	66	Fe=4.4 ppm	322	9	246	0	22' Depth
						2.45	2.47	0.48	0.03	0.00	5.15	0.01	0.13	0.00									
Irrigation well	31N/4W-15B1	2/24/55	62	217	6.9	11	9.9	24	0.6	0	124	2.3	10	0.2	0.2	0.07	48		167	43	68	0	200' Cased depth; Perforations: 105'-200'
						0.55	0.81	1.04	0.02	0.00	2.03	0.05	0.28	0.00									
Flowing stock well	32N/4W-9R1	10/25/55	61	35,100	7.6	244	51	8,470	65	0	254	2.0	13,400	0.1	3.0	11	9.9		22,400	95	818	610	400' Depth
						12.18	4.22	368.44	1.66	0.00	4.16	0.04	377.88	0.00									

TABLE 30—Continued

MINERAL ANALYSES OF GROUND WATER WITHIN THE NORTHEASTERN COUNTIES [a]

Source	Well number MDB&M	Date sampled	Temp. in °F.	Specific conductance (micromhos at 25°C.)	pH	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Boron (B)	Silica (SiO_2)	Other constituents [c]	Total[b] dissolved solids in ppm	Per cent sodium	Hardness as $CaCO_3$ Total ppm	Hardness as $CaCO_3$ N.C. ppm	Remarks
						Mineral constituents in parts per million / equivalents per million																	
CENTRAL VALLEY DRAINAGE BASIN—Continued																							
Redding—Continued																							
Domestic well	32N/4W-14F2	3/16/56	51	63.2	6.9	4.5	0.6	9.4	0.6	0	41	0.6	0.0	0.9	0.4	0.15	17		54	59	14	0	192′ Depth cased to 184′; Perforations: 36′-184′
						0.22	0.05	0.41	0.02	0.00	0.67	0.01	0.00	0.02									
Domestic well	32N/4W-14G1	4/17/56	......	2,300	8.1	8.7	0.6	515	1.0	0	395	109	476	2.1	0.1	31	14		1,350	98	24	0	124′ Depth
						0.43	0.05	22.40	0.03	0.00	6.47	2.27	13.42	0.03									
Domestic well	32N/4W-16B1	12/2/55	57	3,820	7.0	22	5.7	797	8.0	0	244	12	1,120	1.5	0.4	17	34		2,140	95	78	0	100′ Depth
						1.10	0.47	34.67	0.20	0.00	4.00	0.25	31.58	0.02									
Domestic well	32N/4W-20G1	3/16/56	68	235	7.3	7.4	4.1	41	1.2	0	148	7.0	2.1	0.9	0.1	0.20	29		169	72	35	0	162′ Depth cased to 96′; Perforations: 70′-96′
						0.37	0.34	1.91	0.03	0.00	2.43	0.15	0.06	0.02									
Domestic well	32N/4W-20L1	4/17/56	......	2,640	7.6	36	12	500	7.0	0	196	8.8	744	1.2	0.1	4.5	46		1,460	88	139	0	56′ Depth
						1.80	0.98	21.75	0.18	0.00	3.21	0.18	20.90	0.02									
Butte County																							
Domestic well	17N/2E-12A1	8/19/52	......	210	7.7	15	15	6.1	0.9	0	122	6.3	2.6	3.0	0.0	0.02	55		164	12	99	0	
						0.75	1.23	0.26	0.02	0.00	2.00	0.13	0.07	0.05									
Domestic-irrigation well	17N/4E-16E1	8/20/52	......	359	7.3	26	20	13	0.2	0	118	22	22	30	0.0	0.0[illegible]	52		243	16	147	50	
						1.30	1.65	0.57	0.01	0.00	1.93	0.46	0.62	0.48									
Domestic well	18N/2E-16G1	8/19/52	......	188	7.4	12	9.0	13	1.4	0	101	3.4	5.2	2.8	0.2	0.09	69		166	19	67	0	
						0.60	0.74	0.57	0.04	0.00	1.66	0.07	0.15	0.05									
Domestic-irrigation well	18N/3E-8Q1	3/6/56	50	936	6.9	70	74	21	1.2	0	410	62	25	107	0.1	0.03	50		616	9	477	141	150′ Depth [e]
						3.47	6.07	0.92	0.03	0.00	6.72	1.29	0.70	1.72									
Domestic well	19N/1E-28R1	3/6/56	54	376	7.8	27	22	16	1.5	0	178	5.8	25	0.9	0.1	0.08	29		217	19	156	10	130′ Depth [e]
						1.34	1.78	0.70	0.04	0.00	2.91	0.12	0.70	0.02									
Domestic well	19N/2E-16N1	8/19/52	......	586	7.9	56	32	25	1.4	0	284	47	26	1.3	0.0	0.00	61		390	17	271	38	
						2.79	2.63	1.09	0.04	0.00	4.65	0.98	0.73	0.02									
Domestic-irrigation well	19N/3E-16L1	3/6/56	49	207	7.5	14	10	13	1.4	0	122	5.3	3.5	3.2	0.2	0.04	53		166	27	78	0	335′ Depth [e]
						0.70	0.86	0.57	0.04	0.00	1.84	0.11	0.10	0.05									
Domestic well	20N/1W-3D1	8/18/52	......	336	7.4	24	19	17	1.3	0	187	5.2	8.2	1.7	0.1	0.15	18		217	21	138	0	
						1.20	1.56	0.74	0.03	0.00	3.07	0.11	0.23	0.03									
Domestic well	20N/1E-11B1	3/6/56	51	521	7.2	56	25	16	0.9	0	269	14	23	6.1	0.2	0.20	60		336	13	243	22	202′ Depth [e]
						2.81	2.04	0.71	0.02	0.00	4.41	0.28	0.65	0.10									
Domestic-irrigation well	20N/2E-29R1	3/6/56	55	627	7.6	58	31	32	1.2	0	354	12	22	7.6	0.0	0.02	75		384	20	275	0	108′ Depth [e]
						2.91	2.59	1.38	0.03	0.00	5.80	0.25	0.63	0.12									

TABLE 30—Continued

MINERAL ANALYSES OF GROUND WATER WITHIN THE NORTHEASTERN COUNTIES [a]

Source	Well number MDB&M	Date sampled	Temp. in °F.	Specific conductance (micromhos at 25°C.)	pH	Mineral constituents in parts per million / equivalents per million: Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Boron (B)	Silica (SiO_2)	Other constituents [c]	Total[b] dissolved solids in ppm	Per cent sodium	Hardness as $CaCO_3$: Total ppm	N.C. ppm	Remarks
CENTRAL VALLEY DRAINAGE BASIN—Continued																							
Butte County—Continued																							
Domestic well	21N/1W-35B1	3/ 6/56	56	313	7.0	37	24	16	1.7	0	253	7.7	5.9	1.9	0.0	0.05	53		273	15	192	0	64′ Depth [e]
						1.83	2.01	0.70	0.04	0.00	4.14	0.16	0.17	0.03									
Domestic well	21N/1E-10L1	8/18/52	......	314	7.2	24	21	9.6	0.1	0	159	12	5.0	19	0.0	0.03	48		217	12	146	16	
						1.20	1.73	0.42	0.00	0.00	2.61	0.25	0.14	0.31									
Domestic-irrigation well	21N/2E-30C1	3/ 7/56	48	624	7.2	52	42	13	0.4	0	240	68	16	52	0.0	0.11	47		411	9	305	108	151′ Depth cased to 120′ [e]
						2.61	3.49	0.57	0.01	0.00	3.93	1.42	0.45	0.84									
Domestic well	22N/1W-7F1	3/ 6/56	51	276	7.0	17	12	20	1.3	0	112	6.7	24	2.9	0.2	0.17	38		177	32	89	0	137′ Depth [e]
						0.83	0.95	0.85	0.03	0.00	1.83	0.14	0.67	0.05									
Domestic-stock well	22N/1E-9M1	3/ 7/56	52	1,309	8.0	88	104	52	0.6	0	640	39	50	139	0.1	0.10	61		854	15	648	124	230′ Depth cased to 40′ [e]
						4.38	8.58	2.25	0.02	0.00	10.49	0.81	1.41	2.24									
Domestic-stock well	22N/2E-18J1	3/ 7/56	51	545	7.4	45	39	16	1.1	0	336	9.9	5.7	5.6	0.1	0.08	53		343	11	272	0	200′ Depth cased to 120′ [e]
						2.23	3.21	0.70	0.03	0.00	5.50	0.21	0.16	0.09									
Domestic-irrigation well	23N/1W-9L1	3/ 7/56	51	420	7.8	34	29	9.7	1.3	0	234	14	5.1	16	0.2	0.00	58		284	9	206	14	105′ Depth cased to 60′ [e]
						1.69	2.42	0.42	0.03	0.00	3.83	0.29	0.14	0.27									
Stock well	23N/1E-32K1	3/ 7/56	50	188	7.4	17	8.4	7.9	1.1	0	93	2.5	2.3	12	0.1	0.01	57		155	18	76	0	150′ Depth cased to 80′ [e]
						0.83	0.69	0.34	0.03	0.00	1.52	0.05	0.06	0.19									
Colusa County																							
Domestic well	13N/1W-35Q1	3/ 1/56	......	378	8.4	23	16	35	2.3	8	186	8.0	20	3.6	0.1	0.33	55		263	37	125	0	364′ Depth
						1.15	1.35	1.52	0.06	0.27	3.05	0.17	0.56	0.06									
Irrigation well	13N/2W-15H1	7/ 8/52	......	963	7.9	38	42	96	1.8	0	298	21	158	4.1	0.1	1.7	27		536	44	268	24	
						1.90	3.45	4.17	0.05	0.00	4.88	0.44	4.46	0.07									
Stock well	14N/1W-3L1	8/25/52	......	5,060	7.8	181	235	693	1.8	0	312	1,610	695	15	0.3	0.43	43		3,630	51	1,420	1,160	
						9.03	19.33	30.13	0.05	0.00	5.11	33.52	19.60	0.24									
Domestic well	14N/2W-6A1	5/15/52	......	625	8.0	50	18	58	1.3	0	224	80	41	4.1	0.5	0.25	23		386	39	199	16	
						2.50	1.48	2.52	0.03	0.00	3.67	1.67	1.16	0.07									
Stock well	14N/3W-5B1	5/ 6/52	......	1,110	8.3	49	48	131	0.9	0	362	104	128	2.6	1.2	0.35	17		660	47	320	24	
						2.45	3.95	5.70	0.02	0.00	5.93	2.17	3.61	0.04									
Domestic well	14N/3W-22A1	5/ 6/52	......	562	7.7	41	26	27	1.3	0	251	32	26	4.6	0.0	0.34	33		316	22	210	4	100′ Depth
						2.05	2.14	1.17	0.03	0.00	4.11	0.67	0.73	0.07									
Domestic-stock well	15N/2W-32R1	3/ 1/56	56	779	8.5	40	45	66	0.4	13	311	54	45	40	0.3	0.18	26		483	34	283	7	118′ Cased depth
						2.00	3.66	2.87	0.01	0.43	5.10	1.12	1.27	0.65									

TABLE 30—Continued

MINERAL ANALYSES OF GROUND WATER WITHIN THE NORTHEASTERN COUNTIES [a]

Source	Well number MDB&M	Date sampled	Temp. in °F.	Specific conductance (micromhos at 25°C.)	pH	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Boron (B)	Silica (SiO_2)	Other constituents [c]	Total[b] dissolved solids in ppm	Per cent sodium	Hardness as $CaCO_3$ Total ppm	Hardness as $CaCO_3$ N.C. ppm	Remarks
						Mineral constituents in parts per million / equivalents per million																	
CENTRAL VALLEY DRAINAGE BASIN—Continued																							
Colusa County—Continued																							
Irrigation well	15N/3W-28N1	7/ 8/52	------	528	7.7	27	24	62	0.4	0	316	18	8.5	4.7	0.8	0.23	22		323	45	166	0	
						1.35	1.97	2.70	0.01	0.00	5.18	0.37	0.24	0.08									
Domestic well	15N/4W-25P1	5/15/52	------	803	8.0	52	34	67	0.8	0	296	52	62	36	0.9	0.04	29		480	35	270	28	40′ Depth
						2.59	2.80	2.91	0.02	0.00	4.85	1.08	1.75	0.58									
Municipal well	16N/1W-30L1	3/ 1/56	54	502	8.5	10	5.8	99	1.6	10	237	15	32	0.3	0.1	0.77	50		342	81	49	0	423′ Depth
						0.50	0.48	4.31	0.04	0.33	3.88	0.31	0.90	0.01									
Well	16N/2W-26L1	8/25/52	------	541	7.8	19	24	76	1.6	0	260	56	30	0.0	0.2	0.14	46		381	53	146	0	
						0.95	1.97	3.30	0.04	0.00	4.26	1.17	0.85	0.00									
Domestic well	16N/3W-32R1	5/15/52	------	935	8.2	32	32	139	0.9	0	440	92	42	1.0	1.4	0.49	23		580	59	212	0	
						1.60	2.63	6.04	0.02	0.00	7.21	1.92	1.18	0.02									
Domestic well	17N/1W-31K1	3/ 5/56	51	768	7.2	77	44	31	1.5	0	476	27	12	0.2	0.0	0.19	35	Fe=2.1 ppm	466	15	372	0	144′ Depth
						3.83	3.61	1.35	0.01	0.00	7.80	0.57	0.34	0.00									
Domestic well	17N/2W-11K1	8/22/52	------	441	7.7	25	22	43	1.0	0	257	1.0	25	0.0	0.0	0.10	44		288	38	153	0	
						1.25	1.81	1.87	0.03	0.00	4.21	0.02	0.71	0.00									
Domestic well	17N/3W-33R1	7/ 8/52	------	921	7.8	34	30	136	2.6	0	296	105	108	0.1	0.2	0.34	46		608	58	208	0	
						1.70	2.47	5.91	0.07	0.00	4.85	2.19	3.05	0.00									
Glenn County																							
Irrigation well	18N/1W-10N1	8/19/52	------	475	7.8	35	24	32	1.5	0	266	5.6	22	1.5	0.1	0.13	38		291	27	186	0	•
						1.75	1.97	1.39	0.04	0.00	4.36	0.12	0.62	0.02									
Domestic well	18N/2W-11Q1	3/ 5/56	51	232	7.6	17	10	18	1.2	0	136	3.4	2.6	2.8	0.3	0.09	36		158	32	82	0	148′ Depth [e]
						0.83	0.81	0.77	0.03	0.00	2.23	0.07	0.07	0.04									
Domestic well	18N/3W-10G1	3/ 5/56	53	542	7.4	38	20	56	0.9	0	279	32	17	4.2	0.7	0.23	24		332	41	177	0	835′ Depth [e]
						1.92	1.62	2.44	0.02	0.00	4.58	0.67	0.47	0.07									
Domestic well	18N/4W-11B1	8/22/52	------	569	7.6	42	23	47	0.3	0	271	28	19	30	0.7	0.02	28		352	34	200	0	
						2.10	1.89	2.04	0.1	0.01	4.44	0.58	0.54	0.48									
Domestic-irrigation well	19N/1W-1A1	3/ 5/56	56	722	7.4	63	41	35	1.5	0	418	17	25	7.9	0.2	0.02	55	Fe=0.4 ppm	455	19	326	0	260′ Depth [e]
						3.13	3.39	1.53	0.04	0.00	6.86	0.36	0.70	0.13									
Domestic well	19N/2W-36J1	3/ 5/56	50	600	7.6	48	33	39	1.1	0	388	12	5.0	2.2	0.1	0.19	30		366	25	256	0	104′ Depth [e]
						2.40	2.72	1.70	0.04	0.00	6.36	0.26	0.14	0.04									
Industrial well	19N/3W-9J2	3/ 5/56	52	493	7.5	27	25	46	0.7	0	271	27	8.3	5.9	0.5	0.17	26		302	37	170	0	300′ Depth [e]
						1.33	2.07	1.98	0.02	0.00	4.44	0.57	0.23	0.10									

TABLE 30—Continued

MINERAL ANALYSES OF GROUND WATER WITHIN THE NORTHEASTERN COUNTIES [a]

Source	Well number MDB&M	Date sampled	Temp. in °F.	Specific conductance (micromhos at 25°C.)	pH	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Boron (B)	Silica (SiO_2)	Other constituents [c]	Total[b] dissolved solids in ppm	Per cent sodium	Hardness as $CaCO_3$ Total ppm	Hardness as $CaCO_3$ N.C. ppm	Remarks
						Mineral constituents in parts per million / equivalents per million																	
CENTRAL VALLEY DRAINAGE BASIN—Continued																							
Glenn County—Continued																							
Domestic well	20N/1W-31E1	8/21/52	......	927	7.6	54	65	58	0.7	0	504	37	31	33	0.4	0.13	44		571	24	402	0	
						2.67	5.35	2.52	0.02	0.00	8.26	0.77	0.87	0.53									
Domestic well	20N/2W-3H1	3/ 6/56	54	420	6.8	44	20	13	0.6	0	219	18	13	3.7	0.1	0.08	24		247	12	194	14	79′ Depth [e]
						2.21	1.67	0.55	0.02	0.00	3.59	0.37	0.38	0.06									
Municipal well	20N/3W-3D1	3/ 6/56	48	327	7.3	21	20	15	0.9	0	149	13	20	4.3	0.0	0.08	15		184	20	133	11	105′ Depth [e]
						1.04	1.62	0.67	0.02	0.00	2.44	0.27	0.56	0.07									
Domestic-stock well	21N/1W-17F1	8/15/52	......	405	7.4	39	20	16	0.3	0	200	16	20	6.4	0.1	0.08	22		238	16	180	16	27′ Depth
						1.95	1.65	0.70	0.01	0.00	3.28	0.33	0.56	0.10									
Domestic well	21N/2W-23E1	3/ 6/56	54	592	7.0	68	28	18	0.6	0	306	20	28	7.8	0.2	0.20	19		342	12	282	32	125′ Depth [e]
						3.38	2.26	0.78	0.02	0.00	5.01	0.42	0.79	0.13									
Domestic-irrigation well	21N/3W-12C1	8/15/52	----	529	7.2	60	24	19	0.8	0	262	21	29	7.1	0.0	0.11	25		315	14	248	34	
						2.99	1.97	0.83	0.02	0.00	4.29	0.44	0.82	0.11									
Domestic-stock-irrigation well	22N/2W-9D1	2/19/52	65	389	7.8	30	20	18	0.4	0	172	14	27	6.2	0.0	0.50	23		223	20	157	16	80′ Depth; Sampled at 55′
						1.50	1.65	0.78	0.01	0.00	2.82	0.29	0.76	0.10									
Domestic well	22N/3W-30H1	3/ 7/56	48	127	6.7	5.0	5.7	9.9	0.3	0	39	3.3	8.7	11	2.0	0.04	33		99	37	36	4	290′ Depth [e]
						0.25	0.47	0.43	0.01	0.00	0.64	0.07	0.24	0.18									
Domestic well	22N/4W-10H1	3/ 7/56	53	275	7.0	18	17	9.5	2.3	0	110	14	13	18	0.0	0.01	19		166	15	115	24	80′ Depth [e]
						0.92	1.37	0.42	0.06	0.00	1.81	0.29	0.36	0.29									
Sutter County																							
Irrigation well	11N/3E-3C1	8/11/50	......	735	8.9	23	7.1	125	3.0	13	125	5.3	153	1.5	--	0.60	34		427	75	86	0	127′ Depth
						1.15	0.58	5.44	0.08	0.43	2.05	0.11	4.32	0.02									
Domestic-irrigation well	11N/3E-23M2	8/11/50	......	423	8.8	24	33	17	1.8	12	175	60	8.2	0.0	--	0.04	45		287	16	196	32	82′ Cased depth; Perforations: 67′-82′
						1.18	2.71	0.74	0.05	0.40	2.87	1.25	0.23	0.00									
Domestic well	12N/2E-7C1	8/ 5/53	......	183	7.0	17	8.2	8.2	1.4	0	98	--	5.5	--	--	0.01	--		......	19	76	0	
						0.85	0.67	0.36	0.04	0.00	1.61		0.16										
Municipal well	12N/2E-24G1	8/15/50	69	893	9.0	14	8.7	175	7.5	25	218	17	145	0.0	--	0.15	45		544	83	71	0	446′ Depth
						0.70	0.72	7.61	0.19	0.83	3.57	0.35	4.09	0.00									
Irrigation well	12N/3E-34A1	9/18/52	67	3,010	7.3	234	104	194	7.5	0	161	1.3	925	0.3	0.0	0.20	41		1,590	29	1,010	880	110′ Depth
						11.68	8.55	8.44	0.19	0.00	2.64	0.03	26.09	0.01									
Irrigation well	12N/4E-10A1	8/31/51	67	325	8.5	27	21	12	0.0	10	158	7.8	12	4.4	0.2	0.16	81		253	14	154	8	72′ Depth
						1.35	1.73	0.52	0.00	0.33	2.59	0.16	0.34	0.07									

TABLE 30—Continued

MINERAL ANALYSES OF GROUND WATER WITHIN THE NORTHEASTERN COUNTIES [a]

Source	Well number MDB&M	Date sampled	Temp. in °F.	Specific conductance (micromhos at 25°C.)	pH	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Boron (B)	Silica (SiO_2)	Other constituents [c]	Total[b] dissolved solids in ppm	Per cent sodium	Hardness as $CaCO_3$ Total ppm	Hardness as $CaCO_3$ N.C. ppm	Remarks
						Mineral constituents in parts per million / equivalents per million																	
CENTRAL VALLEY DRAINAGE BASIN—Continued																							
Sutter County—Continued																							
Domestic well	13N/2E-6P1	8/ 9/50	61	346	9.2	22	27	15	2.4	28	100	14	20	16	--	0.08	31		224	16	166	37	
						1.10	2.22	0.65	0.06	0.93	1.64	0.29	0.56	0.26									
Domestic-irrigation well	13N/2E-16B1	7/19/51	66	2,230	8.1	76	77	265	4.0	--	266	12	605	2.0	--	1.14	46		1,220	53	506	288	154′ Depth cased to 110′
						3.79	6.33	11.52	0.10		4.36	0.25	17.06	0.03									
Irrigation well	13N/3E-11F1	2/ 7/52	......	2,080	7.5	75	34	288	8.0	0	162	0.7	578	1.5	0.0	1.25	41		1,110	65	327	194	172′ Depth
						3.74	2.80	12.52	0.20	0.00	2.65	0.01	16.30	0.02									
Irrigation well	13N/3E-11G1	4/ 7/53	......	1,060	7.7	81	57	60	4.1	0	404	69	114	0.2	0.0	0.03	32		616	23	436	106	70′ Depth cased to 60′
						4.04	4.69	2.61	0.10	0.00	6.62	1.44	3.22	0.00									
Irrigation well	13N/3E-23L1	6/16/52	......	3,090	7.4	135	59	390	9.0	0	138	0.5	940	2.1	0.0	4.3	37		1,610	59	580	466	
						6.74	4.85	16.96	0.23	0.00	2.26	0.01	26.51	0.03									
Irrigation well	13N/4E-15K1	9/18/51	65	515	7.7	30	23	46	0.7	0	180	74	32	0.3	0.0	0.38	49		344	37	170	22	500′ Depth
						1.50	1.89	2.00	0.02	0.00	2.45	1.54	0.90	0.01									
Irrigation well	13N/5E-19R2	7/27/53	......	208	7.0	15	10	12	0.8	0	96	--	15	--	--	0.00	--		......	25	79	0	
						0.75	0.82	0.52	0.02	0.00	1.57		0.42										
Domestic well	14N/1E-8Q1	6/26/52	60	279	7.8	26	15	11	2.7	0	168	2.9	7.0	0.0	0.1	0.00	41		192	16	127	0	68′ Cased depth
						1.30	1.23	0.48	0.07	0.00	2.75	0.06	0.20	0.00									
Domestic well	14N/2E-30R1	8/14/50	72	682	8.2	27	21	94	4.3	0	307	8.6	71	0.0	--	0.08	49		426	56	154	0	
						1.35	1.73	4.09	0.11	0.00	5.03	0.18	2.00	0.00									
Irrigation well	14N/3E-7P3	8/15/50	67	534	8.6	12	35	37	2.6	30	286	6.3	16	0.0	--	0.02	34		343	24	249	0	100′ Depth
						2.10	2.88	1.61	0.07	1.00	4.69	0.13	0.45	0.00									
Irrigation well	14N/3E-27J1	6/12/52	62	551	7.9	19	13	81	3.0	0	230	4.3	62	0.2	0.4	0.92	39		335	63	101	0	261′ Cased depth
						0.95	1.07	3.52	0.08	0.00	3.77	0.09	1.75	0.00									
Domestic well	15N/1E-14F1	8/20/52	...	512	7.4	37	26	27	3.3	0	128	15	38	104	0.1	0.00	77		390	22	200	94	
						1.85	2.14	1.17	0.08	0.00	2.10	0.31	1.07	1.68									
Domestic well	15N/2E-26D2	6/28/55	71	594	8.2	15	36	28	0.9	0	277	15	42	26	0.0	0.08	50		379	19	262	35	87′ Depth cased to 40′
						2.25	2.99	1.22	0.02	0.00	4.51	0.31	1.18	0.42									
Irrigation well	15N/3E-28A2	7/29/54	69	1,020	7.6	75	72	48	2.6	0	508	46	59	38	0.1	0.01	55		646	18	481	64	157′ Depth
						3.74	5.88	2.09	0.07	0.00	8.33	0.96	1.66	0.61									
Domestic well	16N/1E-5G1	8/19/52	......	402	7.7	28	18	23	2.3	0	176	11	16	18	0.2	0.98	71		274	25	114	0	
						1.40	1.48	1.00	0.06	0.00	2.88	0.23	0.45	0.29									
Irrigation well	16N/3E-5P1	7/28/54	69	330	7.9	20	19	22	3.3	0	200	2.4	8.0	0.8	0.0	0.01	66		240	27	128	0	204′ Depth cased to 64′
						1.00	1.56	0.96	0.08	0.00	3.28	0.05	0.23	0.01									

TABLE 30—Continued

MINERAL ANALYSES OF GROUND WATER WITHIN THE NORTHEASTERN COUNTIES [a]

Source	Well number MDB&M	Date sampled	Temp. in °F.	Specific conductance (micromhos at 25°C.)	pH	Mineral constituents in parts per million / equivalents per million: Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Boron (B)	Silica (SiO_2)	Other constituents [c]	Total[b] dissolved solids in ppm	Per cent sodium	Hardness as $CaCO_3$: Total ppm	Hardness as $CaCO_3$: N.C. ppm	Remarks
CENTRAL VALLEY DRAINAGE BASIN—Continued																							
Tehama County																							
Abandoned irrigation well	23N/2W-30P1	2/28/52	------	2,270	8.2	11	11	56	54	0	1370	3.0	46	1.2	0.1	0.30	6.1	NH_4=325 ppm	1,190	10	72	0	41′ Cased depth; Sampled at 36′
						0.55	0.90	2.44	1.38	0.00	22.45	0.06	1.30	0.02									
Irrigation well	23N/2W-34P1	2/29/52	------	665	7.0	69	32	26	0.6	0	274	25	61	25	0.0	0.36	25		399	16	304	79	194′ Cased depth
						3.44	2.63	1.13	0.02	0.00	4.49	0.52	1.72	0.40									
Domestic-stock well	23N/3W-35B1	3/ 7/56	54	217	7.7	16	9.0	15	0.6	0	93	9.5	13	5.4	0.4	0.02	28		143	29	76	0	250′ Depth [e]
						0.82	0.74	0.63	0.02	0.00	1.52	0.20	0.36	0.09									
Domestic-stock-irrigation well	24N/2W-14B1	3/ 7/56	52	246	8.1	10	8.2	31	2.6	0	141	2.0	8.2	0.3	0.2	0.23	39		172	52	59	0	700′ Cased depth [e]
						0.50	0.67	1.34	0.07	0.00	2.31	0.04	0.23	0.01									
Domestic well	24N/3W-14Q1	8/14/52	------	283	7.5	20	14	21	0.8	0	170	5.0	4.8	4.0	0.1	0.00	31		184	30	107	0	10′ Depth
						1.00	1.15	0.91	0.02	0.00	2.79	0.10	0.14	0.07									
Domestic well	25N/1W-31L1	3/ 8/56	50	392	7.1	32	25	12	3.4	0	240	1.8	6.4	3.7	0.2	0.02	60		265	12	183	0	100′ Depth cased to 30′ [e]
						1.61	2.04	0.52	0.09	0.00	3.93	0.04	0.18	0.06									
Domestic well	25N/2W-4M1	3/ 8/56	50	342	7.0	23	18	14	2.8	0	106	16	22	35	0.1	0.23	59		243	18	132	44	75′ Depth [e]
						1.15	1.49	0.61	0.07	0.00	1.75	0.33	0.62	0.56									
Irrigation well	25N/4W-23N1	3/23/55	67	371	7.4	22	30	12	1.0	0	224	--	10	--	--	0.00	--		------	13	177	0	300′ Depth cased to 250′
						1.10	2.45	0.52	0.03	0.00	3.67		0.28										
Domestic well	26N/2W-15D1	3/ 8/56	51	323	7.3	24	22	9.0	1.5	0	165	10	12	4.3	0.1	0.01	50		215	11	149	13	175′ Cased depth [e]
						1.18	1.79	0.39	0.04	0.00	2.71	0.21	0.34	0.07									
Industrial well	26N/3W-10D1	3/ 8/56	52	220	7.6	18	9.7	12	0.5	0	103	12	4.8	6.7	0.3	0.00	14	Fe=0.5 ppm	130	23	84	0	187′ Depth [e]
						0.89	0.80	0.52	0.01	0.00	1.69	0.25	0.14	0.11									
Irrigation well	26N/3W-30N1	3/23/55	65	149	6.9	4.3	9.1	12	0.7	0	76	--	2.6	--	--	0.00	--		------	35	48	0	255′ Depth
						0.22	0.75	0.52	0.02	0.00	1.25		0.07										
Domestic well	27N/2W-31P1	8/14/52	------	248	7.2	18	14	12	1.9	0	126	8.5	8.8	5.5	0.0	0.04	42		173	20	102	0	34′ Depth
						0.90	1.15	0.52	0.05	0.00	2.07	0.18	0.25	0.09									
Municipal well	27N/3W-19G1	3/ 8/56	50	110	7.1	9.2	4.0	7.4	1.0	0	59	4.5	2.5	0.2	0.0	0.00	30	Fe=6.4 ppm	95	28	39	0	500′ Cased depth [e]
						0.46	0.33	0.32	0.03	0.00	0.97	0.09	0.07	0.00									
Yolo County																							
Domestic well	7N/3E-9J1	7/30/52	70	764	8.0	33	59	52	1.2	0	452	31	22	0.6	0.0	1.5	29		452	26	325	0	267′ Depth
						1.65	4.85	2.26	0.03	0.00	7.41	0.65	0.62	0.01									

TABLE 30—Continued

MINERAL ANALYSES OF GROUND WATER WITHIN THE NORTHEASTERN COUNTIES [a]

Source	Well number MDB&M	Date sampled	Temp. in °F.	Specific conductance (micromhos at 25°C.)	pH	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Boron (B)	Silica (SiO_2)	Other constituents [c]	Total[b] dissolved solids in ppm	Per cent sodium	Hardness as $CaCO_3$ Total ppm	Hardness as $CaCO_3$ N.C. ppm	Remarks
						Mineral constituents in parts per million / equivalents per million																	
CENTRAL VALLEY DRAINAGE BASIN—Continued																							
Yolo County—Continued																							
Domestic well	7N/3E-30Q1	7/30/52	75	1,540	7.9	61	127	94	1.3	0	496	150	193	39	0.0	0.45	31		941	23	674	268	20′ Depth
						3.04	10.44	4.09	0.03	0.00	8.13	3.12	5.44	0.63									
Domestic well	8N/1W-3M2	8/ 5/52	82	658	7.7	66	20	48	0.8	0	326	30	38	6.2	0.4	0.32	22		392	30	246	0	120′ Depth
						3.29	1.64	2.09	0.02	0.00	5.34	0.62	1.07	0.10									
Irrigation well	8N/1W-23D1	8/ 6/52	69	586	7.7	37	40	30	0.9	0	318	23	26	3.2	0.2	0.42	38		355	20	257	0	143′ Depth
						1.85	3.29	1.30	0.02	0.00	5.21	0.48	0.73	0.05									
Domestic-irrigation well	8N/1E-11D2	3/19/51	------	718	7.9	31	52	52	3.4	--	382	36	36	3.2	--	0.40	37		439	28	292	0	172′ Depth
						1.55	4.28	2.26	0.09		6.26	0.75	1.02	0.05									
Stock well	8N/2E-2C2	7/31/52	84	1,850	7.7	27	122	205	1.6	0	682	207	195	1.2	0.5	1.4	27		1,120	44	569	10	47′ Depth
						1.35	10.03	8.91	0.04	0.00	11.18	4.31	5.50	0.02									
Domestic well	8N/2E-15N1	4/ 7/52	75	516	8.4	16	12	90	2.2	0	262	37	22	0.1	0.0	0.64	38		346	68	90	0	1368′ Cased depth; Perforations: 1180′-1350′
						0.80	0.99	3.91	0.06	0.00	4.29	0.77	0.62	0.00									
Irrigation well	8N/3E-8D2	8/ 6/52	66	1,840	7.9	49	128	198	2.7	0	616	314	148	27	0.2	1.4	32		1,200	40	649	144	412′ Depth
						2.45	10.53	8.61	0.07	0.00	10.10	6.54	4.17	0.44									
Irrigation well	8N/3E-19E1	7/30/52	66	1,050	7.9	45	78	74	1.3	0	536	69	42	31	0.3	0.68	39		644	27	433	0	105′ Depth
						2.25	6.41	3.22	0.03	0.00	8.78	1.44	1.18	0.50									
Domestic-stock well	9N/2W-25K1	8/ 7/52	67	2,370	7.6	105	68	318	3.0	0	450	307	400	2.0	0.3	2.3	16		1,440	56	542	173	130′ Depth
						5.24	5.59	13.83	0.08	0.00	7.37	6.39	11.28	0.03									
Irrigation well	9N/1W-9P1	8/20/52	69	851	8.2	69	25	77	0.8	0	316	69	78	5.7	0.4	0.75	26		507	38	275	16	466′ Depth
						3.44	2.06	3.35	0.02	0.00	5.18	1.44	2.20	0.09									
Domestic well	9N/1W-36K1	8/ 7/52	73	625	7.9	50	25	42	0.5	0	234	26	60	21	0.6	0.18	23		363	29	228	36	120′ Depth
						2.50	2.06	1.83	0.01	0.00	3.83	0.54	1.69	0.34									
Well	9N/1E-5R1	8/20/53	66	1,830	7.9	115	90	148	2.1	0	440	162	312	6.3	0.1	3.0	27		1,080	33	657	296	280′ Depth
						5.74	7.40	6.44	0.05	0.00	7.21	3.37	8.80	0.10									
Irrigation well	9N/1E-22K1	8/20/52	68	817	8.3	33	38	86	1.7	0	334	61	70	3.6	0.3	1.1	35		494	44	238	0	516′ Depth
						1.65	3.12	3.74	0.04	0.00	5.47	1.27	1.97	0.06									
Stock well	9N/2E-12J1	8/19/52	73	985	8.6	34	48	102	10	16	332	56	114	4.4	0.2	2.5	29		579	43	282	0	42′ Depth
						1.70	3.95	4.44	0.26	0.53	5.44	1.17	3.22	0.07									
Irrigation well	9N/2E-21D1	8/19/53	72	704	8.0	35	42	47	0.7	0	326	30	54	4.2	0.1	0.68	38		412	28	260	0	410′ Depth
						1.75	3.45	2.04	0.02	0.00	5.34	0.62	1.52	0.07									

TABLE 30—Continued

MINERAL ANALYSES OF GROUND WATER WITHIN THE NORTHEASTERN COUNTIES [a]

Source	Well number MDB&M	Date sampled	Temp in °F.	Specific conductance (micromhos at 25°C.)	pH	Mineral constituents in parts per million / equivalents per million: Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Boron (B)	Silica (SiO_2)	Other constituents [c]	Total[b] dissolved solids in ppm	Per cent sodium	Hardness as $CaCO_3$: Total ppm	Hardness as $CaCO_3$: N.C. ppm	Remarks
CENTRAL VALLEY DRAINAGE BASIN—Continued																							
Yolo County—Continued																							
Stock well	9N/3E-20L1	8/19/52	68	1,850	8.5	47	130	140	1.6	16	286	149	315	1.3	0.1	1.6	30		1,030	32	652	391	60′ Depth
						2.35	10.69	6.09	0.04	0.53	4.69	3.10	10.58	0.02									
Domestic-stock well	10N/2W-18R2	10/11/52	------	1,990	7.9	153	78	150	1.1	--	412	209	332	2.8	0.5	0.72	34		1,160	32	702	364	60′ Depth
						7.63	6.41	6.52	0.03		6.75	4.35	9.36	0.05									
Irrigation well	10N/2W-28J1	8/20/52	72	1,030	8.2	61	70	53	1.9	0	474	10	103	14	0.2	0.30	37		584	21	440	52	275′ Depth
						3.04	5.76	2.30	0.05	0.00	7.77	0.21	2.90	0.23									
Irrigation well	10N/1W-4B1	8/20/53	66	671	8.1	37	37	56	1.2	0	330	16	50	4.4	0.2	0.22	33		397	33	244	0	95′ Depth; Perforations: 28′
						1.85	3.04	2.44	0.03	0.00	5.41	0.03	1.41	0.07									
Irrigation well	10N/1W-23E1	8/26/52	68	672	7.7	47	38	38	2.3	0	312	24	49	4.9	0.1	1.6	20		379	23	274	18	134′ Depth
						2.35	3.12	1.65	0.05	0.00	5.11	0.50	1.38	0.08									
Irrigation well	10N/1E-25D1	8/26/52	65	699	7.7	48	39	42	2.4	0	318	29	54	3.1	0.0	1.4	17		392	24	280	20	252′ Depth
						2.40	3.21	1.83	0.06	0.00	5.21	0.60	1.52	0.05									
Irrigation well	10N/2E-15N1	8/ 8/52	65	733	7.8	50	41	41	2.6	0	328	32	62	5	0.1	0.80	19		414	23	294	24	280′ Depth
						2.50	3.37	1.78	0.07	0.00	5.38	0.67	1.75	0.08									
Irrigation well	10N/2E-16P1	9/ 2/53	64	1,370	7.7	75	90	100	1.9	0	642	74	115	11	0.1	3.0	25		811	28	557	31	96′ Depth
						3.74	7.40	4.35	0.05	0.00	10.52	1.54	3.24	0.18									
Irrigation well	11N/2W-36E1	6/16/39	------	561	------	28	32	53	--	12	309	21	12	4.4	--	0.26	--		------	36	------	------	660′ Depth
						1.43	2.69	2.31		0.40	5.11	0.45	0.35	0.07									
Irrigation well	12N/1W-9D1	7/ 8/52	------	514	7.9	22	35	42	1.6	0	337	6.3	8.0	4.0	0.2	0.25	27		312	31	195	0	
						1.10	2.88	1.83	0.04	0.00	5.52	0.13	0.23	0.06									
Yuba County																							
Irrigation well	13N/4E-12C1	8/27/51	------	380	7.8	20	14	43	0.6	0	173	41	12	0.7	0.0	0.27	71		288	46	107	0	
						1.00	1.15	1.87	0.02	0.00	2.84	0.85	0.34	0.01									
Municipal well	14N/1E-5G2	6/18/52	------	191	8.0	15	8.6	11	1.0	0	96	4.6	10	0.1	0.0	0.06	44		142	24	73	0	268′ Depth cased to 190′
						0.75	0.71	0.48	0.03	0.00	1.57	0.10	0.28	0.00									
Well	14N/5E-16A1	7/20/53	72	205	7.0	15	8.5	13	1.9	0	90	--	10	--	--	0.07	--		------	27	72	0	
						0.75	0.70	0.56	0.05	0.00	1.48		0.28										
Irrigation well	14N/5E-21A1	9/ 5/51	68	4,150	7.9	306	65	440	9.7	0	102	142	1280	1.4	0.1	1.7	67		2,360	48	1,030	948	545′ Depth cased to 490′
						15.27	5.35	19.13	0.25	0.00	1.67	2.96	36.10	0.02									
Irrigation well	15N/4E-17J1	8/28/51	68	816	7.6	87	57	13	0.9	0	290	224	6.0	0.0	0.0	0.12	37		568	6	452	214	90′ Depth cased to 80′
						4.34	4.69	0.57	0.02	0.00	4.75	4.66	0.17	0.00									

TABLE 30—Continued

MINERAL ANALYSES OF GROUND WATER WITHIN THE NORTHEASTERN COUNTIES [a]

Source	Well number MDB&M	Date sampled	Temp. in °F.	Specific conductance (micromhos at 25°C.)	pH	Mineral constituents in parts per million / equivalents per million: Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Boron (B)	Silica (SiO_2)	Other constituents [c]	Total [b] dissolved solids in ppm	Per cent sodium	Hardness as $CaCO_3$: Total ppm	Hardness as $CaCO_3$: N.C. ppm	Remarks
LAHONTAN DRAINAGE BASIN																							
Surprise Valley																							
Flowing stock well	38N/17E-10D1	6/ 2/56	56	216	7.5	2.9	0.7	48	1.7	0	108	4.8	12	0.2	0.9	0.18	59	Fe=0.03 ppm	183	90	10	0	120′ Depth
						0.15	0.06	2.09	0.04	0.00	1.77	0.10	0.34	0.00									
Flowing irrigation well	40N/16E-13J1	6/ 2/56	55	212	7.3	25	6.5	11	3.7	0	136	2.6	0.6	0.5	0.0	0.00	41	Fe=0.00 ppm	158	20	89	0	160′ Depth
						1.25	0.53	0.48	0.10	0.00	2.23	0.05	0.02	0.01									
Flowing stock well	41N/16E-10E2	7/15/54	------	190	7.9	14	5.8	19	2.3	0	115	5.6	1.0	0.8	0.0	0.06	36		142	40	59	0	
						0.70	0.48	0.83	0.06	0.00	1.89	0.12	0.03	0.01									
Flowing stock well	42N/16E-3P1	7/13/54	54	338	8.9	0.9	1.4	83	2.0	22	180	1.3	0.2	0.9	0.0	0.26	59		260	94	8	0	
						0.05	0.12	3.61	0.05	0.73	2.95	0.03	0.01	0.02									
Irrigation well	42N/17E-5D1	6/ 2/56	56	468	7.5	13	3.3	86	7.1	0	210	32	25	0.0	0.6	0.47	57	Fe=0.00 ppm	327	77	46	0	110′ Depth
						0.65	0.27	3.74	0.18	0.00	3.44	0.67	0.71	0.00									
Flowing domestic well	42N/17E-6P1	8/13/54	198	1,410	8.2	17	0.5	284	6.8	0	61	308	191	0.6	0.1	5.8	97	As=0.19 ppm	941	92	45	0	
						0.85	0.04	12.35	0.17	0.00	1.00	6.41	5.39	0.01									
Irrigation well	43N/16E-5M1	6/ 1/56	55	234	7.4	26	8.5	13	0.9	0	148	0.4	1.0	4.3	0.0	0.00	38	Fe=0.00 ppm	165	22	100	0	236′ Depth
						1.30	0.70	0.57	0.02	0.00	2.43	0.01	0.03	0.07									
Abandoned flowing hot springs	43N/16E-13B1	7/13/54	100+	1,780	7.8	10	6.7	374	7.0	0	174	393	218	0.1	2.2	5.7	71		1,170	93	52	0	
						0.50	0.55	16.26	0.18	0.00	2.85	8.18	6.15	0.00									
Domestic well	43N/17E-32M1	6/24/46	------	483	------	14	8.5	76	--	12	177	34	25	--	--	0.45	--		------	72	70	0	24′ Depth
						0.70	0.70	3.30		0.40	2.90	0.71	0.70										
Well	43N/17E-32N1	6/24/46	------	1,390	------	4.0	--	336	--	81	647	4.8	11	--	--	1.20	--		------	98	------	------	25′ Depth
						0.20		14.61		2.70	10.60	0.10	0.31										
Light irrigation well	46N/16E-21B1	6/ 2/56	56	220	7.4	8.7	4.0	33	4.5	0	118	11	4.3	1.5	0.8	0.10	56	Fe=0.00 ppm	182	62	38	0	95′ Depth
						0.43	0.33	1.44	0.16	0.00	1.93	0.23	0.12	0.02									
Domestic well	47N/17E-19C1	7/14/54	60	144	6.4	15	4.5	9.9	1.4	0	84	2.5	3.0	4.4	0.1	0.00	31		113	27	56	0	25′ Depth
						0.75	0.37	0.43	0.04	0.00	1.38	0.05	0.08	0.07									
Madeline Plains																							
Domestic well	34N/14E-15E1	7/23/52	------	542	7.5	34	26	37	6.7	0	242	64	16	2.6	0.1	0.03	42		348	29	192	0	120′ Depth
						1.70	2.14	1.61	0.17	0.00	3.97	1.33	0.45	0.04									
Domestic-industrial well	34N/14E-22K1	7/22/52	60	271	7.6	19	12	21	2.9	0	160	4.0	5.5	2.0	0.1	0.61	39		184	31	97	0	
						0.95	0.99	0.91	0.07	0.00	2.62	0.08	0.16	0.03									
Domestic well	34N/15E-19F1	7/23/52	------	701	7.7	62	22	47	4.7	0	245	40	65	22	0.1	0.50	40		421	29	245	44	36′ Cased depth
						3.09	1.81	2.04	0.12	0.00	4.02	0.83	1.83	0.35									

TABLE 30—Continued

MINERAL ANALYSES OF GROUND WATER WITHIN THE NORTHEASTERN COUNTIES [a]

Source	Well number MDB&M	Date sampled	Temp. in °F.	Specific conductance (micromhos at 25°C.)	pH	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Boron (B)	Silica (SiO_2)	Other constituents [c]	Total[b] dissolved solids in ppm	Per cent sodium	Hardness as $CaCO_3$ Total ppm	Hardness as $CaCO_3$ N.C. ppm	Remarks
						Mineral constituents in parts per million / equivalents per million																	
LAHONTAN DRAINAGE BASIN —Continued																							
Madeline Plains—Continued																							
Domestic well	34N/15E-22K1	7/23/52	......	451	7.5	40	20	25	4.0	0	206	25	21	14	0.2	0.03	28		279	23	182	13	100′ Cased depth
						2.00	1.64	1.09	0.10	0.00	3.38	0.52	0.59	0.23									
Domestic well	35N/13E-25M1	7/23/52	......	1,020	7.9	82	65	38	8.0	0	538	29	40	25	0.1	0.10	44		596	15	472	31	
						4.09	5.35	1.65	0.20	0.00	8.82	0.60	1.13	0.40									
Stock well	35N/13E-26H1	7/23/52	52	690	8.4	30	37	65	9.1	8	352	19	22	29	0.1	0.00	44		436	37	227	0	
						1.50	3.04	2.83	0.23	0.27	5.77	0.40	0.62	0.47									
Domestic well	35N/16E-7N1	7/24/52	......	235	7.6	22	9.2	15	3.8	0	136	5.6	6.0	1.6	0.1	0.61	34		164	25	93	0	18′ Depth
						1.10	0.76	0.65	0.10	0.00	2.23	0.12	0.17	0.03									
Domestic well	35N/16E-20Q1	7/23/52	......	293	7.6	4.8	2.9	56	7.8	0	160	8.6	9.0	0.9	0.3	0.10	63		232	78	24	0	280′ Depth cased to 90′
						0.24	0.24	2.44	0.20	0.00	2.62	0.18	0.25	0.02									
Domestic well	36N/12E-2M1	7/22/52	......	892	7.9	58	59	32	6.9	0	302	20	64	128	0.1	0.03	41		558	15	387	140	60′ Cased depth
						2.89	4.85	1.39	0.18	0.00	4.95	0.42	1.81	2.06									
Domestic well	36N/12E-29C1	7/22/52	......	445	8.1	19	17	50	10	0	257	7.8	16	0.5	0.1	0.13	37		284	46	117	0	198′ Cased depth
						0.95	1.40	2.17	0.26	0.00	4.21	0.16	0.45	0.01									
Stock well	36N/13E-7E1	7/22/52	......	682	7.9	24	26	87	14	0	416	24	8.5	0.2	0.1	0.15	50		439	51	167	0	350′ Depth cased to 120′
						1.20	2.14	3.78	0.36	0.00	6.82	0.50	0.24	0.00									
Domestic well	36N/13E-17F1	7/23/52	......	288	7.4	16	9.5	31	6.8	0	156	12	8.0	0.5	0.2	0.64	42		203	43	79	0	
						0.80	2.56	1.35	0.17	0.00	2.56	0.25	0.23	0.01									
Spring	37N/12E-11	7/22/52	......	157	7.5	13	6.8	7.9	2.7	0	96	0.8	1.5	0.8	0.0	0.19	42		123	21	60	0	
						0.65	0.56	0.34	0.07	0.00	1.57	0.02	0.04	0.01									
Domestic well	37N/13E-10R1	7/ 8/52	60	470	7.9	46	23	20	3.9	0	250	9.1	15	21	0.1	0.00	43		304	17	210	4	
						2.30	1.89	0.87	0.10	0.00	4.10	0.19	0.42	0.34									
Domestic well	37N/13E-29D1	7/22/52	55	899	7.9	46	41	79	11	0	333	92	73	4.1	0.1	0.14	53		563	36	284	10	105′ Cased depth
						2.30	3.37	3.44	0.28	0.00	5.46	1.92	2.06	0.07									
Willow Creek																							
Well	31N/12E-13	7/ 9/54	......	198	7.2	9.4	9.8	17	4.1	0	125	1.2	2.4	0.7	0.1	0.01	35		142	35	64	0	
						0.47	0.81	0.74	0.10	0.00	2.05	0.02	0.07	0.01									
Spring	32N/11E-26J1	9/10/52	......	191	7.7	12	8.4	20	3.7	0	118	2.6	4.5	0.7	0.0	0.09	38		148	39	64	0	
						0.60	0.69	0.87	0.10	0.00	1.93	0.05	0.13	0.01									

TABLE 30—Continued

MINERAL ANALYSES OF GROUND WATER WITHIN THE NORTHEASTERN COUNTIES [a]

Source	Well number MDB&M	Date sampled	Temp. in °F.	Specific conductance (micromhos at 25°C.)	pH	Mineral constituents in parts per million / equivalents per million: Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Boron (B)	Silica (SiO_2)	Other constituents [c]	Total[b] dissolved solids in ppm	Per cent sodium	Hardness as $CaCO_3$: Total ppm	N.C. ppm	Remarks
LAHONTAN DRAINAGE BASIN —Continued																							
Secret Valley																							
Well	30N/15E-15	7/ 8/54	------	467	8.4	23	23	45	6.0	5	207	60	5.9	9.1	0.0	0.01	21		300	38	153	0	
						1.15	1.92	1.96	0.15	0.17	3.39	1.25	0.17	0.15									
Stock well	31N/14E-24	6/23/54	------	524	7.5	40	21	39	8.4	0	236	46	26	4.4	0.1	0.07	68		367	30	188	0	53′ Depth
						2.00	1.76	1.70	0.21	0.00	3.87	0.96	0.73	0.07									
Susan River																							
Irrigation well	28N/14E-2Q	11/22/55	56	2,070	7.2	88	40	256	14	0	282	32	515	1.3	0.1	0.35	50		1,140	58	382	151	500′ Depth
						4.39	3.25	11.14	0.36	0.00	4.62	0.67	14.52	0.02									
Irrigation well	29N/12E-3R1	5/28/56	53	421	7.2	42	14	26	2.6	0	171	45	19	5.5	0.4	0.16	46		285	25	164	24	
						2.10	1.19	1.13	0.07	0.00	2.80	0.94	0.54	0.09									
Abandoned dug well	29N/14E-16N1	7/ 8/54	------	696	8.8	24	16	119	11	15	294	65	29	14	0.5	0.49	54		492	65	125	0	
						1.20	1.30	5.17	0.28	0.50	4.82	1.35	0.82	0.23									
Irrigation well	29N/15E-21N1	11/22/55	52	1,060	8.5	6.4	1.9	266	4.0	18	604	35	20	3.4	1.4	0.93	44		699	95	24	0	525′ Depth
						0.32	0.16	11.57	0.10	0.60	9.90	0.73	0.56	0.05									
Well	30N/12E-32	----------	------	------	7.3	28	15	48	--	0	158	63	25	--	0.3	--	--		339	44	129	2	
						1.40	1.23	2.09		0.00	2.59	1.31	0.70										
Hot springs	29N/15E-25	—/—/56	------	1,510	8.7	21	0.6	304	7.8	0.3	113	348	192	--	4.5	5.4	--		957	92	54	0	
						1.03	0.05	13.20	0.20	0.01	1.85	7.25	5.42										
Herlong																							
Industrial well	22N/17E-8K1	5/29/56	63	219	7.3	18	4.6	22	2.6	0	116	2.4	4.6	14	0.1	0.00	33	Fe=0.00 ppm	158	42	64	0	220′ Depth
						0.90	0.38	0.96	0.07	0.00	1.90	0.50	0.13	0.23									
	25N/17E-21P1	7/ 8/54	------	337	7.5	28	11	30	1.7	0	175	13	8.2	13	0.1	0.17	46		237	36	114	0	
						1.40	0.88	1.30	0.04	0.00	2.87	0.27	0.23	0.21									
Irrigation well	26N/16E-15D1	5/30/56	57	559	7.2	41	11	66	4.1	0	208	82	18	6.3	0.6	0.34	37	Fe=0.00 ppm	368	48	149	0	700′ Depth
						2.05	0.93	2.87	0.10	0.00	3.41	1.71	0.51	0.10									
Well U. S. Army Ordnance	27N/16E-36Q3	10/ 9/52	60	1,160	7.2	90	33	123	--	--	184	391	48	0.1	0.4	--	41	Fe=0.02 ppm	817	42	360	209	540′ Depth
						4.49	2.71	5.35			3.02	8.14	1.35	0.00									
Irrigation and stock dug well	27N/17E-3H1	5/30/56	57	1,870	8.4	7.4	9.6	119	12	20	576	69	261	5.1	1.4	1.2	48	Fe=0.02 ppm	1,140	93	58	0	
						0.37	0.79	18.23	0.31	0.67	9.44	1.44	7.36	0.08									
Municipal well U. S. Army Ordnance	27N/17E-31K1	5/30/56	65	927	7.4	76	23	94	6.3	0	206	237	47	0.0	1.4	0.33	48	Fe=0.00 ppm	634	41	283	114	
						3.79	1.84	4.09	0.16	0.00	3.38	4.93	1.33	0.00									

TABLE 30—Continued

MINERAL ANALYSES OF GROUND WATER WITHIN THE NORTHEASTERN COUNTIES[a]

Source	Well number MDB&M	Date sampled	Temp. in °F.	Specific conductance (micromhos at 25°C.)	pH	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Boron (B)	Silica (SiO_2)	Other constituents[c]	Total[b] dissolved solids in ppm	Per cent sodium	Hardness as $CaCO_3$ Total ppm	Hardness as $CaCO_3$ N.C. ppm	Remarks
						Mineral constituents in parts per million / equivalents per million																	
LAHONTAN DRAINAGE BASIN—Continued																							
Herlong—Continued																							
Flowing well	28N/17E-19	6/25/54	------	281	7.6	5.5	0.7	57	3.2	0	124	23	14	0.3	0.2	0.07	29		194	86	17	0	
						0.27	0.06	2.48	0.08	0.00	2.03	0.48	0.40	0.01									
Irrigation well	28N/17E-20J1	5/30/56	81	224	7.2	6.0	2.0	41	4.6	0	108	15	8.8	0.0	0.1	0.10	39	Fe=0.01 ppm	170	76	23	0	550′ Depth
						0.30	0.16	1.78	0.12	0.00	1.77	0.31	0.25	0.00									

[a] Unless otherwise noted, analyses are by United States Geological Survey, quality of water branch, Sacramento Laboratory.
[b] Unless otherwise noted, calculated from analyzed constituents.
[c] Iron (Fe), Ammonium (NH_4), Arsenic (As), reported here as insignificant or not analyzed for except as shown.
[d] Analysis by United States Geological Survey, Radio Chemical Laboratory.
[e] Analysis by State Department of Water Resources, Bryte Laboratory.
[f] Analysis by State Department of Public Health, Bureau of Sanitary Engineering, Berkeley Laboratory.

The most serious water quality problem in the area, especially in the Klamath and Trinity River Drainage Basins, now that mining operations have nearly ceased, is posed by the lumbering industry. Drainage and discharges from logging mill ponds can cause a toxic condition in the receiving waters due to tannic acid dissolved from ponded logs. In order to control these conditions, restrictions on waste discharges from the mining and lumbering industries have been imposed by the State Fish and Game Code, as well as the Regional Water Pollution Control Board. Waste discharges are generally permitted only during periods of high stream flow.

Additional sources of quality impairment include sewage and industrial waste discharges. Percolation to ground water from private septic tanks constitutes the principal method of sewage disposal. The larger communities, including the cities of Yreka and Weed, have sewage treatment plants which discharge to percolation beds in the immediate vicinity of surface streams. Control of waste discharges is administered by the Regional Water Pollution Control Board.

Improper construction and abandonment of wells constitutes a threat to ground-water quality in the various ground water basins. Such wells permit mixing of poor quality water with usable ground water. Shasta Valley is almost entirely underlain with lava flows containing waters with excessive concentrations of boron, magnesium, fluoride, sulfate, and other dissolved minerals. Wells penetrating this aquifer should be sealed off to prevent commingling of this poor quality water with overlying usable water. Portions of the Upper Klamath River near Ager are believed to have a similar source of poor quality ground water.

Considerable impairment of ground waters in Butte, Shasta, and Scott Valleys, as evidenced by high concentrations of nitrates, may be due to organic materials which enter the ground waters through wells with inadequate surface sanitary seals.

Central Valley Drainage Basin. Surface waters originating in the northeastern tributary streams of the portion of the Central Valley Drainage Basin lying in northeastern counties hydrographic units 12 and 14, are generally of a calcium-sodium-bicarbonate type, soft to moderately hard, low in total dissolved solids, and suitable for all beneficial uses. An exception to this is found in the waters of Goose Lake. These waters are of a sodium bicarbonate type and contain excessive percent sodium, making them generally unsuitable for irrigation uses. They also contain more than 2 parts per million of boron and are of Class III quality for irrigation. During periods of low flows, streams draining this basin become more highly mineralized, but nevertheless do not normally exceed 100 parts per million in total dissolved solids with low concentrations of boron and fluoride.

The concentrations of mineral constituents in surface streams within the Sacramento River Basin vary widely with the source and seasonal period. There is a gradual increase in total dissolved solids in the streams from the foothills across the valley floor to the trough of the Sacramento Valley with a further general increase from north to south.

East side streams originating in the Sierra Nevada and the Cascade Mountains are ordinarily of excellent quality and calcium bicarbonate in type. These waters are characterized by low total dissolved solids, chlorides, boron, and fluoride, and are generally soft to moderately hard.

Water from the west side of the Sacramento Valley can be divided into two classifications: those waters originating on the lower slopes of an extension of the Klamath Mountains, and those flowing from the Coastal Range. The latter classification includes waters of Cache Creek. Waters in the first classification are of similar quality to east side waters. Waters in the second classification have higher mineral content, but they are generally of excellent quality.

A notable exception to the general good quality of surface waters in the Sacramento River Basin is found in Cache Creek. Water from Clear Lake, a tributary of Cache Creek, is generally of the same type as its tributaries, that is, calcium-magnesium-bicarbonate in type, soft to moderately hard, and low in total dissolved solids. Boron concentrations of 0.5-2.0 parts per million place it in Class II irrigation water. Waters of the North Fork of Cache Creek are calcium bicarbonate in type, but generally more highly mineralized than streams tributary to Clear Lake. In low flow periods, boron concentrations up to 4.6 parts per million have been observed in this stream. Use of this water for domestic purposes would generally require some softening. Bear Creek, a major tributary to Cache Creek, is highly mineralized. Waters of this stream are very hard, sodium bicarbonate in nature, and contain extremely high concentrations of boron and total dissolved solids, particularly during periods of low flow. However, these waters are extensively used for irrigation.

Another west side stream of poor quality is Spring Creek, flowing into the Sacramento River above Keswick Dam. The creek receives mine waste run-off, and contains high concentrations of heavy metals during periods of low flows. Aluminum, copper, iron, and zinc, are the principal metals present in significant amounts; and the waters are high in total dissolved solids and hardness. The waters of Spring Creek are of a calcium-magnesium sulfate type, and are highly acid, with a pH on the order of 3.0. These waters are obviously unfit for beneficial purposes during periods of low flow.

Quality of Sacramento River water generally reflects that of east side streams, due to the much larger quantity of inflow from those sources. During periods of low flows, reaches of the Sacramento River near Knights Landing contain increased total dissolved solids, because of irrigation water return flows from reclamation and drainage district drains. The Sacramento River is generally a calcium bicarbonate type water but, from Knights Landing south, reflects return flows during the irrigation season by a change to sodium bicarbonate water, increased total dissolved solids, chlorides, and per cent sodium. Total hardness in the river ranges from soft to moderately hard.

Ground waters occurring in the upper watersheds of the Central Valley Drainage Basin are ordinarily of good to excellent quality, soft to moderately hard, and are calcium or sodium bicarbonate in nature. However, in the Bieber area in Big Valley, a more highly mineralized sodium sulfate water, with considerable hardness, high total dissolved solids, and a significant boron content was indicated by one analysis. Highly mineralized springs frequently occur in the foothills of these upper valleys, and contain sodium chloride water of high total dissolved solids content and significant boron concentrations.

Like most of the ground water supplies in the upper Feather River area, those in Sierra Valley are good to excellent calcium bicarbonate waters suitable for most beneficial uses. However, several wells in the valley yield highly mineralized ground water. Most of these wells appear to be in the vicinity of Marble Hot Springs and yield hot, highly mineralized ground waters. These waters are characterized by a fluoride content exceeding the 1.5 parts per million maximum recommended by the United States Public Health Service for drinking water, and values of boron greatly exceed Class II irrigation water standards. High sodium percentage and chloride concentration make this an undesirable supply for most irrigation, industrial, or domestic purposes.

Ground waters in the valleys contiguous to Clear Lake are generally of exellent mineral quality. However, scattered wells in Big Valley and the Upper Lake areas yield very hard waters with signficant concentrations of boron. Although the wells containing boron in Big Valley seem to be located predominantly along the lower edges of the valley, their interspersion with wells yielding waters of excellent mineral quality prevents the delimitation of any specfic area of poor quality ground water. A limited number of wells scattered throughout the Upper Lake area yield water containing boron in quantities toxic to the more sensitive crops. Wells in Big Valley and the Upper Lake area contain typically magnesium bicarbonate water, with an occasional well showing predominant sodium or calcium cations.

Sacramento Valley ground waters generally reflect the quality of sources of recharge. East side ground water basins, recharged by streams originating in the Cascade Range and Sierra Nevada, usually contain calcium bicarbonate waters of excellent quality with low concentrations of dissolved solids. Similarly west side ground waters, replenished by streams from the Coast Range, reflect the quality of tributary surface waters. These waters, although of a more mineralized character than east side waters, are nevertheless of good quality suitable for most beneficial uses.

Dominant cations in east side and west side ground waters are calcium and magnesium. Toward the trough of the valley, sodium replaces the calcium and/or magnesium as the predominant cation, particularly in the lower reaches of the Sacramento Valley.

Total hardness of ground waters in the Sacramento Valley trough appears generally to range from slightly hard to very hard, with the majority of the observed wells containing relatively hard water. Excessive nitrates have been noted in a number of wells throughout the valley.

Variance from good quality is noted in ground waters in the Cache and Putah Creek drainage basins. Class III irrigation water exists in the following areas: lower Yolo By-Pass in Yolo County; an area to the east of Woodland and extending between vicinity of Woodland and the Davis-Sacramento Highway; North Fork of Willow Slough to the west of the Plainfield Ridge; upper Chickahominy Creek; and lower Capay Valley. Boron concentrations toxic to the more sensitive crops are found in these poor quality ground waters. Aside from boron content, the mineral quality of the water is usually good. Ground waters in these basins are generally very hard and, for domestic use, would require softening to some degree.

A water quality problem area exists in portions of Sutter and Yuba Counties, located in the trough of the Sacramento Valley. In the areas enclosed by the Sacramento River and Sutter By-Pass, that bounded by the Feather River and Sutter By-Pass to the south of Yuba City, and two small areas in the vicinity of Wheatland, appreciable chlorides have been encountered in the ground water. Many wells in these areas have yielded ground water of such poor mineral quality as to make its use for irrigation undesirable, particularly upon such crops as sensitive as peaches and apricots, extremely important products of the area. Chloride concentrations as high as 3500 parts per million have been found in water from wells in the vicinity of Robbins. Boron concentrations considerably in excess of the 0.5 part per million limit, for Class I irrigation water, were noted also in many wells. A geochemical study of the area has indicated that deep-seated brines are responsible for the high chloride content. These brines are usually encountered in the deeper wells. However, in these four general areas they have been found at shallow depths. This is, in most instances, due to rising of the brines where the water table has been lowered excessively.

Around the fringes of the northern portion of the Redding ground water basin, wells yield waters of a predominantly sodium chloride type, and occasionally moderate to high fluoride concentrations are found. Boron is often found in excess of Class II irrigation water standards. These waters are not recommended as a domestic supply due to their high chloride content.

Water quality problems in the Central Valley Drainage Basin have been investigated in detail in only specific local areas. Municipal and domestic sewage, treated and untreated, is discharged into many stream systems throughout the area, but waste discharge requirements set by the Regional Water Pollution Control Board provide adequate protection of water quality. Numerous lumbering and food-processing industries contribute substantial quantities of mineral and organic wastes to both surface and ground waters. Most lumbering activities are carried on in the mountain valleys, and in the Redding area of the Anderson-Cottonwood Valley.

Waste drainage from mines and associated industry is especially prevalent in the mountain counties. The principal mines in the area include chromite, copper, gold, iron, manganese, silver, and tungsten. Many of these mines are presently inactive.

A number of natural gas fields are located in the Sacramento Valley including portions of Butte, Colusa, Glenn, Sutter, Tehama, and Yolo Counties. Wastes from gas wells ordinarily contain high concentrations of dissolved mineral constituents. With the present small production of gas in these fields, resulting waste waters are at a minimum. A substantial industrial increase in the Sacramento Valley will increase the demand for natural gas by industries and will no doubt create an increased production of waste waters. These waste discharges could pollute receiving waters unless stringent controls exercised.

Highly mineralized hot springs widely scattered throughout the mountains and foothills impair the quality of some streams and, in many cases, percolate and impair ground water.

Deep-seated saline connate brines are believed to underlie the entire Sacramento Valley. Heavy ground water pumping in certain areas, notably that of Sutter County to the south of Yuba City and in the vicinity of Redding in Shasta County, have created an overdraft, causing the connate brines to rise upward or laterally and commingle with usable water in the overlying aquifers.

A major source of surface and ground water impairment in the Sacramento Valley and, to a much lesser extent, in the mountain valleys is irrigation return water which includes minerals leached from the soils and the various applied fertilizers.

As the Sacramento Valley becomes more highly industrialized, increased use of ground and surface water for industrial and domestic uses will occur. Increased use of these waters for cooling purposes in air conditioning and refrigeration installations may create localized temperature increases in receiving waters.

Lahontan Drainage Basin. Surface waters originating on the eastern slopes of the Sierra Nevada, and draining into the highly mineralized lakes of the Lahontan Drainage Basin, are generally of excellent mineral quality. All are calcium bicarbonate type waters, soft to slightly hard, and are satisfactory for all ordinary beneficial uses.

In Surprise Valley, the Alkali Lakes contain sodium chloride type water, with excessive concentrations of fluoride, boron, total dissolved solids, and arsenic, which preclude their use for domestic, irrigation, or most industrial purposes.

Water in Honey Lake contains high concentrations of sodium, bicarbonates, chlorides, and sulfates; and significant quantities of fluoride, boron, iron, and arsenic. This water is unsuitable for domestic use or as a source of irrigation water supply. Long Valley Creek, tributary to Honey Lake, contains water less highly mineralized than the lake. However, it is unsuitable for such crops as deciduous fruit, most vegetables, and grasses, due to its boron content, which runs as high as 0.95 parts per million and its per cent sodium which is as high as 80.

Eagle Lake is a sodium bicarbonate type water of doubtful quality for unrestricted irrigation use. The lake waters are moderately hard to very hard, requiring softening to some degree for domestic use.

Ground water in Surprise Valley generally varies from a soft to slightly hard sodium bicarbonate to sodium sulfate in type. The sulfate waters appear to be concentrated in the area near Middle Alkali Lake. They also contain excessive amounts of boron, high total dissolved solids, and per cent sodium which place them in Class III irrigation water. A toxic amount of arsenic was found in the analysis of water from one well. These waters originate from mineralized hot springs prevalent in the area with temperatures ranging up to 200 degrees Fahrenheit. The sodium bicarbonate type ground waters appear to be principally found in the vicinity of Upper and Lower Alkali Lakes. An excessive per cent sodium in these waters restrict its use for irrigation.

Ground waters in the Madeline Plains area are predominantly calcium or sodium bicarbonate in character. The majority of the wells sampled yielded moderately hard to very hard water. The mineral quality of these ground waters is generally excellent to good and falls in Class I within respect to irrigation use. Waters high in nitrates were found in several areas.

Ground waters in Honey Lake Valley are generally classified as fair to good but variable as to mineral composition. Waters to the north of Honey Lake are ordinarily sodium bicarbonate in nature, soft to moderately hard, and contain total dissolved solids ranging from 200 to 700 parts per million. However, water from a deep well in the Janesville area, in the immediate vicinity of Honey Lake, contains a very hard, sodium chloride water, with total dissolved solids exceeding 1,000 parts per million, and per cent sodium on the order of 60. Hot springs located near Wendel contain a sodium sulfate type water with high concentrations of chlorides and total dissolved solids, and a per cent sodium of about 90.

Ground water in the vicinity of Janesville and Wendel to the north of Honey Lake is Class III irrigation water, and generally usable for only the more salt-tolerant crops. Ground waters to the south of Honey Lake are generally of a sodium bicarbonate nature, soft to moderately hard, and contain total dissolved solids ranging from 200 to 400 parts per million, with the exception of ground waters found in the vicinity of the Sierra Ordnance Depot near Herlong. This latter area contains sodium sulfate type water, very hard, with total solids ranging from 400 to 800 parts per million.

Impairment of ground and surface water resources in the Lahontan Drainage Basin is caused primarily by discharges of domestic and industrial wastes. Domestic wastes in the principal ground water basins are ordinarily discharged to the ground water by means of individual septic tanks or cesspools.

Industrial development in Madeline Plains, and in Surprise and Willow Creek Valleys, is presently at a minimum. In Honey Lake Valley, the lumbering industry is of considerable importance, especially in the Susanville area adjacent to the Susan River. Mining operations are of minor importance.

Natural causes of ground water quality impairment include highly mineralized hot springs, and the inability of the closed basins of Madeline Plains and Surprise and Honey Lake Valleys to maintain a satisfactory salt balance. Salt balance refers to the condition wherein the quantity of soluble salts entering the water supply of a basin are balanced by an equal quantity of soluble salts being removed from the basin by surface or subsurface outflow.

Water Quality Planning Considerations. In developing plans for the utilization of water resources, both surface and underground, thorough consideration must be given to the maintenance of quality levels suitable for the intended beneficial uses. Planning toward this objective involves the evaluation of the native quality of waters, the effects on this water quality of future developments, and a determination of protective measures required to maintain suitable water quality.

In order to determine whether water quality requirements for all intended beneficial uses will be met under conditions of future development, it is necessary to consider and evaluate the various causes of water quality impairment. The more common causes of impairment in quality of waters in the Northeastern Counties are as follows:

1. Domestic and municipal sewage
2. Industrial wastes
   a. Organic wastes
   b. Mineral wastes
3. Irrigation return water
4. Interchange of poor quality water between aquifers due to improperly constructed, defective, or abandoned wells
5. Adverse salt balance
6. Upward or lateral diffusion of connate brines and juvenile waters
7. Poor quality waters originating from highly mineralized springs and surface runoff.

The use of water resources for waste disposal must be considered along with the water requirements for other planned beneficial uses. Many organic wastes can be successfully treated by ordinary sewage treatment processes, including self purification in streams and ground water bodies. In surface streams adequate quantities of water must be provided to permit natural purification of these wastes in order to preserve the quality of the receiving waters for downstream beneficial purposes. Ordinary treatment processes do not, however, materially reduce the mineral content of these wastes, which may be many times greater than that of the original water supply. In cases of highly mineralized wastes, therefore, the importation of water of high quality specifically for dilution, or removal of wastes through a separate waste conveyance channel, may be required.

Irrigation return waters present a problem similar to that of mineralized sewage or industrial wastes. These return flows are usually of a higher mineral content than the original supply due to leaching of soils and applied agricultural chemicals. Further, since plants use only minute quantities of dissolved minerals, the concentration of mineral constituents is greatly increased in irrigation return waters. In many cases these return waters could seriously impair the quality of ground or surface water resources of the area. Plans for water development should include provisions either for adequate dilution water, or a separate waste conveyance channel in order to maintain water of a suitable quality for other beneficial uses.

In many areas, water of poor mineral quality either overlies or underlies water of usable quality. The interchange of these poor quality waters between aquifers, due to improperly constructed, defective, or abandoned wells could seriously impair the quality of usable ground water supplies. The enforcement of proper well construction and sealing standards can control quality impairment from this cause.

Overpumping in ground water basins often results in quality impairment of usable water supplies. It may reduce outflow from the basin to the point that adverse salt balance conditions exist. Continued adverse salt balance would eventually increase the concentration of soluble salts in the basin to the point where the soil and ground water would be rendered unfit for beneficial use.

Excessive concentration of pumping can also cause upward or lateral diffusion of poor quality waters, such as connate brines or highly mineralized juvenile waters, into usable water supplies. In planning water development projects, it may be necessary to consider the need for control of the pumping draft and pattern in order to avoid creation of quality problems from adverse salt balance or diffusion of poorer quality waters.

The existence of highly mineralized springs and streams within the area of water resources development projects may adversely affect the quality of water for intended beneficial purposes. Isolation or dilution of these poor quality waters should be considered in planning water development projects.

From the foregoing, it can be seen that plans for water development must include consideration of all causes of quality impairment, and an evaluation of their effect on proposed beneficial uses.

LAND RESOURCES

Agriculture, and the utilization of forest products, will continue to constitute the major factors in the economy of the Northeastern Counties. Further, the development of these resources will continue to provide the greatest demand for water service. By far the largest use of water in the Northeastern Counties is for agriculture, a condition that will continue to prevail even under conditions of ultimate development.

Detailed and extensive surveys to determine the nature and extent of present land use, as well as the probable nature and extent of the ultimate land use pattern, were conducted by the Department of Water Resources during this investigation. The United States Forest Service provided data and estimates of the sustained yield of the forest lands and the estimated future production of forest products.

These land surveys and estimates of sustained yield were the basis for the evaluation of the greater part of the water requirements of the Northeastern Counties. The methods of collecting and compiling the basic data, as well as the data itself, are presented in the following sections: "Presently Irrigated Lands," "Irrigable Lands," "Urban Lands," and "Forest Lands."

Presently Irrigated Lands

Data as to the nature, location, and areal extent of lands in the Northeastern Counties, to which water is presently applied in addition to precipitation, were obtained wherever available, from federal, state, and local agencies. These data generally were based on results of field surveys, segregated in accordance with various classes and types of land use, and are regularly determined by many water service agencies as a part of their operational procedures. The Bureau of Reclamation of the United States Department of the Interior, in planning for and operating the Central Valley Project, has made land use surveys of much of the irrigated area on the floor of the Sacramento Valley. The former Division of Water Resources, now the State Department of Water Resources, in connection with recent and current water resources investigations, has examined and classified water-using lands in many areas of northern California, including areas where water rights determinations have been made and which are now administered under watermaster service.

Surveys of present water service areas, conducted during this investigation, were accomplished generally by field inspection, using aerial photographs to delineate the boundaries of the various classifications. Areas so delineated were then measured and the data compiled with that from other sources.

Within the scope of the present investigation, it was impractical to survey during any single season all areas receiving water service in the Northeastern Counties. Tabulations of present water service areas included herein represent a composite of survey data covering the period from 1954 through 1956, which is the period referred to in this report in discussing present conditions of development.

Irrigated lands include all agricultural lands depending upon application of surface or ground water, as well as those utilizing water directly from a high water table. The irrigated land was categorized into the following individual crop types: alfalfa, improved and meadow pasture, grain and grain hay, truck crops, field crops, deciduous orchard, subtropical orchard, rice, and vineyard. Irrigated pasture crops were grouped in accordance with differences in water use. Improved pasture is that with improved irrigation facilities, and is generally cropped to select grasses and legumes. Meadow pasture consists of that with little or no improvements, normally growing forage of native grasses including rush and wire grass, and utilizing more water than improved pasture because of high water table condi-

TABLE 31

PRESENT WATER SERVICE AREAS (1954 TO 1956) WITHIN HYDROGRAPHIC UNITS, NORTHEASTERN COUNTIES

(In acres)

Hydrographic uoit		Type of laod use													
		Irrigated lands											Urban lands	Swamp and marsh lands	Principal reservoirs
		Alfalfa	Pasture		Grain and grain hay	Truck	Field	Deciduous orchard	Subtropical orchard	Rice	Vineyard	Total irrigated			
Reference number	Name		Improved	Meadow											
	North Coastal Drainage Basin														
1	Tule Lake	5,400	11,780	8,440	43,840	12,960	0	0	0	0	0	82,420	260	2,580	36,550
2	Butte Valley	1,820	4,120	2,780	3,490	2,610	0	10	0	0	0	14,830	720	110	2,850
3	Klamath River	910	3,830	370	910	0	0	20	0	0	0	6,040	250	0	800
4	Shasta Valley	11,210	22,700	3,930	1,330	20	0	10	0	0	0	39,200	1,450	1,310	1,640
5	Scott Valley	4,370	12,130	8,630	7,320	10	0	10	0	0	0	32,470	160	120	0
6	Salmon River	0	100	0	0	0	0	0	0	0	0	100	0	0	0
7	Upper Trinity River	0	1,890	0	0	0	0	0	0	0	0	1,890	0	0	13,120
8	Lower Trinity River	80	300	0	0	0	0	0	0	0	0	380	0	0	0
9	South Fork Trinity River	70	990	0	20	0	0	0	0	0	0	1,080	460	0	0
10	Southern Trinity Couoty	0	70	50	0	0	0	0	0	0	0	120	0	0	0
11	Lake Pillsbury	0	0	0	0	0	0	0	0	0	0	0	0	0	1,600
	SUBTOTALS	23,860	57,910	24,200	56,910	15,600	0	50	0	0	0	178,530	3,300	4,120	56,560
	Central Valley Drainage Basin														
12	Goose Lake	940	1,900	8,270	260	0	0	0	0	0	0	11,370	90	0	150
13	Jess Valley	0	40	4,950	0	0	0	0	0	0	0	4,990	0	0	2,870
14	Alturas	5,200	2,530	27,550	7,110	90	0	0	0	0	0	42,480	1,910	50	11,090
15	Big Valley	3,060	6,950	17,900	1,900	0	0	0	0	0	0	29,810	320	1,240	1,360
16	McArthur	1,710	5,940	17,890	30	0	0	0	0	0	0	25,570	440	700	1,120
17	Hat Creek	970	3,140	6,550	590	0	60	10	0	0	0	11,320	390	600	1,170
18	Montgomery	0	1,340	50	60	40	0	70	0	0	0	1,560	10	40	60
19	McCloud River	0	1,650	560	10	0	0	0	0	0	0	2,220	670	0	0
20	Dunsmuir	0	1,810	930	10	10	0	10	0	0	0	2,770	1,300	0	0
21	Shasta Lake	0	0	0	0	50	0	0	0	0	0	50	0	0	27,500
22	Clear Creek	0	60	0	0	0	10	0	0	0	0	70	50	0	2,600
23	Keswick	0	0	0	0	0	0	0	0	0	0	0	0	0	600
24	Cottonwood Creek	120	1,240	0	0	80	0	10	410	0	0	1,860	20	0	60
25	Olinda	10	650	0	0	30	0	0	470	0	0	1,160	470	0	20
26	Redbank Creek	10	220	0	0	0	0	0	0	0	0	230	100	0	0
27	Elder Creek	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	Thomes Creek	0	620	0	0	0	0	0	0	0	0	620	100	0	0
29	Stony Creek	210	760	80	0	0	0	0	0	0	0	1,050	110	80	2,480
30	Clear Lake	2,350	3,560	1,610	90	380	340	6,180	0	0	750	15,260	1,650	980	40,540
31	Middletown	110	1,480	0	0	0	0	20	0	0	0	1,610	150	0	100
32	Stillwater Plains	80	350	40	0	30	0	30	0	0	0	530	1,810	0	30
33	Cow Creek	260	7,010	110	0	30	0	50	0	0	0	7,460	0	20	0
34	Bear Creek	80	2,040	70	0	0	0	120	0	0	0	2,310	30	0	10
35	Battle Creek	10	830	1,670	0	0	0	230	0	0	0	2,740	180	20	90
36	Paynes Creek	90	270	0	0	0	0	0	0	0	0	360	10	0	0
37	Antelope Creek	0	0	170	0	0	0	0	0	0	0	170	10	0	0
38	Mill Creek	0	0	860	0	0	0	0	0	0	0	860	0	0	0
39	Deer Creek	0	0	1,580	0	0	0	0	0	0	0	1,580	0	0	0
40	Chico Creek	0	80	200	0	0	0	0	0	0	0	280	0	0	0
41	Paradise	0	220	0	0	0	0	1,220	480	120	50	2,090	190	20	230
42	North Fork Feather River	0	1,530	10,390	0	0	0	0	0	0	0	11,920	530	0	30,910
43	East Branch Feather River	490	4,650	11,650	990	0	0	80	0	0	0	17,860	280	0	140
44	Sierra Valley	1,210	11,300	26,310	1,370	0	0	0	0	0	0	40,190	100	0	10
45	Middle Fork Feather River	0	2,660	3,580	0	0	0	20	0	0	0	6,260	250	0	230
46	South Fork Feather River	0	80	30	0	0	0	10	0	0	0	120	0	0	90
47	North Yuba River	0	210	870	0	0	0	10	0	0	0	1,090	130	0	400
48	Challenge	0	1,070	120	0	0	0	30	180	0	0	1,400	0	0	260
49	Wyandotte	30	1,000	0	0	20	10	390	4,170	710	10	6,340	0	30	90
50	Anderson	830	21,200	0	850	140	160	380	0	40	10	23,610	3,320	60	0
51	Corning	3,970	24,560	10	470	500	1,490	2,060	4,780	0	0	37,840	1,170	10	30
52	Los Molinos	4,700	9,430	50	560	4,710	6,210	10,340	40	150	0	36,190	3,250	10	0
53	Fruto	100	660	0	20	0	0	10	0	50	0	840	0	0	0
54	Orlaod	6,070	31,330	50	1,020	70	1,970	3,990	1,360	1,420	30	47,310	2,660	50	0
55	Durham	1,660	5,940	40	0	2,470	3,400	12,200	40	19,260	0	45,010	1,970	1,420	0
56	Colusa	12,820	53,330	300	5,650	32,440	26,660	11,590	120	199,980	0	342,890	2,420	6,000	0
57	Gridley	4,940	18,640	2,120	1,520	8,710	4,150	21,690	1,490	85,540	0	148,800	1,410	9,570	50
58	Browns Valley	0	2,430	20	0	0	0	0	330	0	0	2,780	20	0	290
59	Cortina	250	290	0	0	10	50	1,460	0	40	0	2,100	0	0	0
60	Arbuckle	2,850	3,930	0	200	2,750	2,210	7,840	20	6,310	40	26,150	510	0	0
61	Sutter	2,340	5,270	370	70	13,130	4,680	22,140	50	19,920	60	68,030	2,370	70	0
62	Marysville	4,910	23,260	570	270	5,090	4,150	13,280	410	25,510	0	77,450	3,560	650	10
63	Pleasant Grove	460	2,350	0	0	0	70	50	20	5,610	0	8,560	0	0	0
64	West Yolo	0	60	0	0	0	0	200	0	0	0	260	0	0	480
65	Capay	610	400	0	0	0	70	970	0	0	0	2,050	0	0	0
66	Woodland	23,770	12,010	0	0	11,450	10,000	7,380	220	17,870	280	82,980	2,810	0	0
67	East Yolo	13,750	14,840	20	6,410	15,850	24,510	650	0	25,900	0	101,930	2,520	50	0
	SUBTOTALS	100,970	297,120	147,540	29,460	98,080	90,200	124,720	14,590	408,430	1,230	1,312,340	39,290	24,250	125,070

TABLE 31—Continued

PRESENT WATER SERVICE AREAS (1954 TO 1956) WITHIN HYDROGRAPHIC UNITS, NORTHEASTERN COUNTIES

(In acres)

Hydrographic unit		Type of land use													
		Irrigated lands													
			Pasture												
Reference number	Name	Alfalfa	Improved	Meadow	Grain and grain hay	Truck	Field	Deciduous orchard	Subtropical orchard	Rice	Vineyard	Total irrigated	Urban lands	Swamp and marsh lands	Principal reservoirs
	Lahontan Drainage Basin														
68	Surprise Valley	16,540	1,490	11,960	3,890	0	0	0	0	0	0	33,880	310	460	300
69	Madeline Plains	20	1,010	5,030	1,960	0	0	0	0	0	0	8,020	0	0	1,540
70	Eagle Lake	0	60	3,580	0	0	0	0	0	0	0	3,640	0	180	0
71	Willow Creek	0	850	3,940	120	60	0	0	0	0	0	4,970	0	380	60
72	Secret Valley	0	160	2,760	0	0	0	0	0	0	0	2,920	0	40	600
73	Susan River	5,070	3,150	10,250	2,840	160	0	0	0	0	0	21,470	1,430	980	4,500
74	Herlong	1,000	2,980	920	420	0	0	0	0	0	0	5,320	520	20	0
75	Little Truckee River	0	440	2,420	0	0	0	0	0	0	0	2,860	0	140	0
	SUBTOTALS	22,630	10,140	40,950	9,230	220	0	0	0	0	0	83,080	2,260	2,200	7,060
	TOTALS, NORTHEASTERN COUNTIES	147,460	365,170	212,600	95,600	113,900	90,200	124,770	14,590	408,430	1,230	1,573,950	44,850	27,990	188,690

tions. This high water table condition may be either natural or induced, depending upon the method of irrigation practiced.

Deciduous orchard includes all kinds of deciduous fruits and nuts such as peaches, pears, walnuts, almonds, prunes, and apples. Subtropical orchard is made up of oranges, lemons, limes, and olives. Principal crops in the truck category are tomatoes, melons, strawberries, carrots, cabbage, onions, celery, green beans, and potatoes. Field crops consist mainly of corn, sugar beets, grain sorghums, safflower, field peas, and beans. In the field survey, no separation was made between pasture or alfalfa used for forage or cut for hay. Similarly, since determination of water requirements was the primary objective, no distinction was made between small grains threshed and those cut for hay. The acreage of presently irrigated lands by hydrographic units and counties is presented in Tables 31 and 32. The tabulated values are for gross areas without reduction for roads, farmsteads, and other non-water-using areas.

Urban lands, swamp and marsh lands, and principal reservoirs are also included in Tables 31 and 32 as present water services areas. Urban lands were taken to include the developed areas of cities and towns delineated during the field surveys without regard to municipal boundaries. Swamp and marsh lands comprise those areas that are, for most of the year, too wet for agricultural purposes. As swamp lands often make heavy demands on available water supplies, the effect of these lands on present and future water supplies were considered. Similarly principal reservoirs were included in the present water service area because of the depletion of available water supplies caused by evaporation. The average water surface areas, obtained from operating records or estimated as 80 per cent of the normal pool area, are shown in Tables 31 and 32.

These lands are depicted on Plate 4, entitled "Classification of Lands for Water Service." The area delineated as presently irrigated lands includes agricultural lands irrigated by man-made and natural methods, and swamp and marsh lands.

Irrigable Lands

The extent and location of the irrigable lands in the Northeastern Counties were determined by field surveys which grouped all lands into their appropriate classifications of irrigability and crop adaptability. Considerable emphasis was placed upon this classification procedure and projection of the probable ultimate crop pattern, since the water requirement to meet the consumptive use of irrigated agriculture is the most significant as to quantities involved. The magnitude of water requirements for other purposes are relatively small in comparison.

New developments in irrigation practice in recent years, and new irrigated crops have modified former concepts of the types of land suitable for irrigated agriculture. Lands formerly considered nonirrigable because of excessive slope or roughness of topography are now being irrigated satisfactorily by sprinklers. The successful irrigation of ladino clover, and certain other irrigated forage crops, has resulted in a rapid expansion of the acreage devoted to irrigated pasture, and has justified the development of shallow soil lands formerly considered nonirrigable. These recent tech-

TABLE 32

PRESENT WATER SERVICE AREAS (1954 TO 1956) WITHIN THE NORTHEASTERN COUNTIES

(In acres)

County and hydrographic unit		Type of land use														
		Irrigated lands												Urban lands	Swamp and marsh lands	Principal reservoirs
			Pasture													
Reference number	Name	Alfalfa	Improved	Meadow	Grain and grain hay	Truck	Field	Deciduous orchard	Subtropical orchard	Rice	Vineyard	Total irrigated				
	Butte County															
40	Chico Creek	0	80	200	0	0	0	0	0	0	0	280	0	0	0
41	Paradise	0	220	0	0	0	0	1,220	480	120	50	2,090	190	20	230
42	North Fork Feather River	0	320	140	0	0	0	0	0	0	0	460	0	0	530
45	Middle Fork Feather River	0	60	0	0	0	0	20	0	0	0	80	0	0	0
46	South Fork Feather River	0	60	30	0	0	0	10	0	0	0	100	0	0	90
48	Challenge	0	0	0	0	0	0	0	0	0	0	0	0	0	0
49	Wyandotte	30	1,000	0	0	20	10	390	4,170	710	10	6,340	0	30	90
52	Los Molinos	2,550	3,410	0	260	3,720	4,640	5,280	0	150	0	20,010	2,650	10	0
55	Durham	1,660	5,940	40	0	2,470	3,400	12,200	40	19,260	0	45,010	1,970	1,420	0
57	Gridley	3,120	13,630	1,230	1,490	3,440	2,430	9,870	1,490	64,520	0	101,220	1,100	4,110	50
	COUNTY TOTALS	7,360	24,720	1,640	1,750	9,650	10,480	28,990	6,180	84,760	60	175,590	5,910	5,590	990
	Colusa County															
29	Stony Creek	100	310	0	0	0	0	0	0	0	0	410	0	0	1,460
30	Clear Lake	0	80	570	0	0	0	0	0	0	0	650	0	0	20
53	Fruto	0	0	0	0	0	0	0	0	0	0	0	0	0	0
56	Colusa	7,240	23,280	120	610	4,890	10,890	5,880	50	102,650	0	155,610	1,640	2,630	0
57	Gridley	0	180	260	0	0	0	0	0	0	0	440	0	60	0
59	Cortina	130	50	0	0	0	0	930	0	10	0	1,120	0	0	0
60	Arbuckle	1,750	2,830	0	40	0	640	6,800	20	4,060	40	16,180	390	0	0
	COUNTY TOTALS	9,220	26,730	950	650	4,890	11,530	13,610	70	106,720	40	174,410	2,030	2,690	1,480
	Glenn County															
11	Lake Pillsbury	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	Stony Creek	110	330	80	0	0	0	0	0	0	0	520	110	80	1,020
53	Fruto	100	640	0	20	0	0	10	0	50	0	820	0	0	0
54	Orland	6,070	31,180	10	1,020	70	1,970	3,990	1,360	1,420	30	47,120	2,660	50	0
56	Colusa	4,260	24,990	0	500	2,220	4,240	4,080	70	50,140	0	90,500	490	2,880	0
57	Gridley	0	700	180	0	0	0	0	0	10,700	0	11,580	0	1,390	0
59	Cortina	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	COUNTY TOTALS	10,540	57,840	270	1,540	2,290	6,210	8,080	1,430	62,310	30	150,540	3,260	4,400	1,020
	Lake County															
11	Lake Pillsbury	0	0	0	0	0	0	0	0	0	0	0	0	0	1,600
29	Stony Creek	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	Clear Lake	2,350	3,480	1,040	90	380	340	6,180	0	0	750	14,610	1,650	980	40,520
31	Middletown	110	1,480	0	0	0	0	20	0	0	0	1,610	150	0	100
	COUNTY TOTALS	2,460	4,960	1,040	90	380	340	6,200	0	0	750	16,220	1,800	980	42,220
	Lassen County															
13	Jess Valley	0	20	1,020	0	0	0	0	0	0	0	1,040	0	0	2,120
14	Alturas	0	0	0	0	0	0	0	0	0	0	0	0	0	120
15	Big Valley	1,480	4,420	10,680	420	0	0	0	0	0	0	17,000	150	170	750
16	McArthur	250	330	4,220	0	0	0	0	0	0	0	4,800	30	330	890
17	Hat Creek	0	0	580	0	0	0	0	0	0	0	580	0	0	0
42	North Fork Feather River	0	60	5,210	0	0	0	0	0	0	0	5,270	400	0	4,750
68	Surprise Valley	0	240	1,030	50	0	0	0	0	0	0	1,320	0	0	0
69	Madeline Plains	20	1,010	5,030	1,960	0	0	0	0	0	0	8,020	0	0	1,540
70	Eagle Lake	0	60	3,580	0	0	0	0	0	0	0	3,640	0	180	0
71	Willow Creek	0	850	3,940	120	60	0	0	0	0	0	4,970	0	380	60
72	Secret Valley	0	160	2,760	0	0	0	0	0	0	0	2,920	0	40	600
73	Susan River	5,070	3,150	10,250	2,840	160	0	0	0	0	0	21,470	1,430	980	4,560
74	Herlong	1,000	1,350	920	420	0	0	0	0	0	0	3,690	520	20	0
	COUNTY TOTALS	7,820	11,650	49,220	5,810	220	0	0	0	0	0	74,720	2,530	2,100	15,390
	Modoc County															
1	Tulelake	3,510	4,360	7,120	21,430	9,080	0	0	0	0	0	45,500	0	70	22,220
12	Goose Lake	040	1,900	8,270	260	0	0	0	0	0	0	11,370	90	0	150
13	Jess Valley	0	20	3,930	0	0	0	0	0	0	0	3,950	0	0	750
14	Alturas	5,200	2,530	27,550	7,110	90	0	0	0	0	0	42,480	1,910	50	10,970
15	Big Valley	1,580	2,530	7,220	1,480	0	0	0	0	0	0	12,810	170	1,070	610
16	McArthur	0	0	2,650	0	0	0	0	0	0	0	2,650	20	20	0
68	Surprise Valley	16,540	1,250	10,930	3,840	0	0	0	0	0	0	32,560	310	460	300
	COUNTY TOTALS	27,770	12,590	67,670	34,120	9,170	0	0	0	0	0	151,320	2,500	1,670	35,000

TABLE 32—Continued

PRESENT WATER SERVICE AREAS (1954 TO 1956) WITHIN THE NORTHEASTERN COUNTIES

(In acres)

County and hydrographic unit		Type of land use													
		Irrigated lands											Urban lands	Swamp and marsh lands	Principal reservoirs
Reference number	Name	Alfalfa	Pasture		Grain and grain hay	Truck	Field	Deciduous orchard	Subtropical orchard	Rice	Vineyard	Total irrigated			
			Improved	Meadow											
	Plumas County														
40	Chico Creek	0	0	0	0	0	0	0	0	0	0	0	0	0	0
42	North Fork Feather River	0	1,150	5,030	0	0	0	0	0	0	0	6,180	130	0	25,630
43	East Branch Feather River	490	4,650	11,650	990	0	0	80	0	0	0	17,860	280	0	140
44	Sierra Valley	540	8,750	11,640	1,150	0	0	0	0	0	0	22,080	0	0	0
45	Middle Fork Feather River	0	2,600	3,580	0	0	0	0	0	0	0	6,180	250	0	230
46	South Fork Feather River	0	0	0	0	0	0	0	0	0	0	0	0	0	0
47	North Yuba River	0	0	0	0	0	0	0	0	0	0	0	0	0	0
73	Susan River	0	0	0	0	0	0	0	0	0	0	0	0	0	0
74	Herlong	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	COUNTY TOTALS	1,030	17,150	31,900	2,140	0	0	80	0	0	0	52,300	660	0	26,000
	Shasta County														
16	McArthur	1,460	5,610	8,540	30	0	0	0	0	0	0	15,640	250	350	230
17	Hat Creek	970	3,140	5,970	590	0	60	10	0	0	0	10,740	390	600	1,170
18	Montgomery Creek	0	1,340	50	60	40	0	70	0	0	0	1,560	10	40	60
19	McCloud River	0	610	60	0	0	0	0	0	0	0	670	0	0	0
20	Dunsmuir	0	140	0	10	10	0	10	0	0	0	170	40	0	0
21	Shasta Lake	0	0	0	0	50	0	0	0	0	0	50	0	0	27,500
22	Clear Creek	0	60	0	0	0	10	0	0	0	0	70	50	0	2,600
23	Keswick	0	0	0	0	0	0	0	0	0	0	0	0	0	600
24	Cottonwood Creek	60	1,050	0	0	80	0	10	410	0	0	1,610	10	0	60
25	Olinda	10	650	0	0	30	0	0	470	0	0	1,160	470	0	20
32	Stillwater Plains	80	350	40	0	30	0	30	0	0	0	530	1,810	0	30
33	Cow Creek	260	7,010	110	0	30	0	50	0	0	0	7,460	0	20	0
34	Bear Creek	80	2,040	70	0	0	0	120	0	0	0	2,310	30	0	10
35	Battle Creek	0	350	630	0	0	0	40	0	0	0	1,020	140	20	90
38	Mill Creek	0	0	0	0	0	0	0	0	0	0	0	0	0	0
42	North Fork Feather River	0	0	10	0	0	0	0	0	0	0	10	0	0	0
50	Anderson	650	17,440	0	560	100	150	140	0	0	10	19,050	3,320	30	0
	COUNTY TOTALS	3,570	39,790	15,480	1,250	370	220	480	880	0	10	62,050	6,520	1,060	32,370
	Sierra County														
44	Sierra Valley	670	2,550	14,670	220	0	0	0	0	0	0	18,110	100	0	10
45	Middle Fork Feather River	0	0	0	0	0	0	0	0	0	0	0	0	0	0
47	North Yuba River	0	170	860	0	0	0	10	0	0	0	1,040	50	0	150
74	Herlong	0	1,630	0	0	0	0	0	0	0	0	1,630	0	0	0
75	Little Truckee River	0	440	2,420	0	0	0	0	0	0	0	2,860	0	140	0
	COUNTY TOTALS	670	4 790	17,950	220	0	0	10	0	0	0	23,640	150	140	160
	Siskiyou County														
1	Tulelake	1,890	7,420	1,320	22,410	3,880	0	0	0	0	0	36,920	260	2,510	14,330
2	Butte Valley	1,820	4,120	2,780	3,490	2,610	0	10	0	0	0	14,830	720	110	2,850
3	Klamath River	910	3,830	370	910	0	0	20	0	0	0	6,040	250	0	800
4	Shasta Valley	11,210	22,700	3,930	1,330	20	0	10	0	0	0	39,200	1,450	1,310	1,640
5	Scott Valley	4,370	12,130	8,630	7,320	10	0	10	0	0	0	32,470	160	120	0
6	Salmon River	0	100	0	0	0	0	0	0	0	0	100	0	0	0
15	Big Valley	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	McArthur	0	0	2,480	0	0	0	0	0	0	0	2,480	140	0	0
19	McCloud River	0	1,040	500	10	0	0	0	0	0	0	1,550	670	0	0
20	Dunsmuir	0	1,670	930	0	0	0	0	0	0	0	2,600	1,260	0	0
	COUNTY TOTALS	20,200	53,010	20,940	35,470	6,520	0	50	0	0	0	136,190	4,910	4,050	19,620
	Sutter County														
56	Colusa	800	4,240	180	3,630	24,420	9,790	1,350	0	29,630	0	74,010	180	490	0
57	Gridley	1,820	4,130	450	30	5,270	1,720	11,820	0	10,320	0	35,560	310	4,010	0
61	Sutter	2,340	5,270	370	70	13,130	4,680	22,140	50	19,920	60	68,030	2,370	70	0
62	Marysville	660	2,420	10	0	440	530	4,170	0	6,060	0	14,290	200	0	0
63	Pleasant Grove	460	2,350	0	0	0	70	50	20	5,610	0	8,560	0	0	0
67	East Yolo	2,310	3,440	20	0	3,310	2,720	60	0	12,110	0	23,970	40	40	0
	COUNTY TOTALS	8,390	21,850	1,030	3,730	46,570	19,510	39,590	70	83,650	60	224,450	3,100	4,610	0

TABLE 32—Continued

PRESENT WATER SERVICE AREAS (1954 TO 1956) WITHIN THE NORTHEASTERN COUNTIES

(In acres)

Reference number	Name (County and hydrographic unit)	Irrigated lands: Alfalfa	Pasture: Improved	Pasture: Meadow	Grain and grain hay	Truck	Field	Deciduous orchard	Subtropical orchard	Rice	Vineyard	Total irrigated	Urban lands	Swamp and marsh lands	Principal reservoirs
	Tehama County														
24	Cottonwood	60	190	0	0	0	0	0	0	0	0	250	10	0	0
26	Red Bank Creek	10	220	0	0	0	0	0	0	0	0	230	100	0	0
27	Elder Creek	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	Thomes Creek	0	620	0	0	0	0	0	0	0	0	620	100	0	0
29	Stony Creek	0	120	0	0	0	0	0	0	0	0	120	0	0	0
35	Battle Creek	10	480	1,040	0	0	0	190	0	0	0	1,720	40	0	0
36	Paynes Creek	90	270	0	0	0	0	0	0	0	0	360	10	0	0
37	Antelope Creek	0	0	170	0	0	0	0	0	0	0	170	10	0	0
38	Mill Creek	0	0	860	0	0	0	0	0	0	0	860	0	0	0
39	Deer Creek	0	0	1,580	0	0	0	0	0	0	0	1,580	0	0	0
40	Chico Creek	0	0	0	0	0	0	0	0	0	0	0	0	0	0
50	Anderson	180	3,760	0	290	40	10	240	0	40	0	4,560	0	30	0
51	Corning	3,970	24,560	10	470	500	1,490	2,060	4,780	0	0	37,840	1,170	10	30
52	Los Molinos	2,150	6,020	50	300	990	1,570	5,060	40	0	0	16,180	600	0	0
53	Fruto	0	20	0	0	0	0	0	0	0	0	20	0	0	0
54	Orland	0	150	40	0	0	0	0	0	0	0	190	0	0	0
	COUNTY TOTALS	6,470	36,410	3,750	1,060	1,530	3,070	7,550	4,820	40	0	64,700	2,040	40	30
	Trinity County														
7	Upper Trinity River	0	1,890	0	0	0	0	0	0	0	0	1,890	0	0	13,120
8	Lower Trinity River	80	300	0	0	0	0	0	0	0	0	380	0	0	0
9	South Fork Trinity River	70	990	0	20	0	0	0	0	0	0	1,080	460	0	0
10	Southern Trinity County	0	70	50	0	0	0	0	0	0	0	120	0	0	0
	COUNTY TOTALS	150	3,250	50	20	0	0	0	0	0	0	3,470	460	0	13,120
	Yolo County														
30	Clear Lake	0	0	0	0	0	0	0	0	0	0	0	0	0	0
56	Colusa	520	820	0	910	910	1,740	280	0	17,560	0	22,740	110	0	0
59	Cortina	120	240	0	0	10	50	530	0	30	0	980	0	0	0
60	Arbuckle	1,100	1,100	0	160	2,750	1,570	1,040	0	2,250	0	9,970	120	0	0
64	West Yolo	0	60	0	0	0	0	200	0	0	0	260	0	0	480
65	Capay	610	400	0	0	0	70	970	0	0	0	2,050	0	0	0
66	Woodland	23,770	12,010	0	0	11,450	10,000	7,380	220	17,870	280	82,980	2,810	0	0
67	East Yolo	11,440	11,440	0	6,410	12,540	21,790	590	0	13,790	0	77,960	2,480	10	0
	COUNTY TOTALS	37,560	26,030	0	7,480	27,660	35,220	10,990	220	51,500	280	196,940	5,520	10	480
	Yuba County														
46	South Fork Feather River	0	20	0	0	0	0	0	0	0	0	20	0	0	0
47	North Yuba River	0	40	10	0	0	0	0	0	0	0	50	80	0	250
48	Challenge	0	1,070	120	0	0	0	30	180	0	0	1,400	0	0	260
58	Browns Valley	0	2,430	20	0	0	0	0	330	0	0	2,780	20	0	290
62	Marysville	4,250	20,840	560	270	4,650	3,620	9,110	410	19,450	0	63,160	3,360	650	10
	COUNTY TOTALS	4,250	24,400	710	270	4,650	3,620	9,140	920	19,450	0	67,410	3,460	650	810
	TOTALS, NORTHEASTERN COUNTIES	147,460	365,170	212,600	95,600	113,900	90,200	124,770	14,590	408,430	1,230	1,573,950	44,850	27,990	188,690

nological developments made it necessary to review and revise some of the land classification standards established for prior investigations.

Standards for Determining Suitability of Lands for Irrigation. The suitability of land for irrigation development is influenced by many factors. Some of the indirect factors are those related to the production and marketing of climatically adapted crops, location of land with respect to a water supply, and climatic conditions. The physical characteristics of the land, and the inherent conditions of the soil itself, directly affect the adaptability of the land for irrigation development. Further, the location of the land with respect to the available water supply affects the degree of possible development through irrigation. For this investigation all pertinent factors, direct and indirect, were considered in evaluating the reasonable ultimate requirements for water.

Land classification surveys determined the amount and location of irrigable lands, and divided the lands into various crop adaptability classes. Lands classified as suitable for irrigation development were segregated into three broad topographic groups: smooth lying valley lands, slightly sloping and undulating lands, and steeper and more rolling lands. Where other conditions limited the suitability of the lands to produce climatically adapted crops, the three broad classes were further subdivided in accordance with the nature of the limitations. Such limiting conditions included shallow soil depths, rockiness, high water tables, coarse textures with low moisture-holding capacities, very fine textures limiting the effective depth, and the presence of saline and alkaline salts.

In certain of the mountainous and foothill areas in the Northeastern Counties, lands are found with soils and physical characteristics which make them suitable for irrigation development. However, due to climatic and other factors associated with their present utilization, they were classified as best suited to remain under some type of forest management. In general these areas lie at elevations where length of growing season and frost hazards greatly limit crop adaptabilities. The soils are usually of the residual type normally associated with conifer production. Such soils were formed in place through the action of soil forming processes upon the underlying bedrock. They exhibit chemical and physical characteristics which make them well suited for timber production where rainfall is adequate. In other areas, where the economy is influenced by the production of livestock with the accompanying demand for range land, particularly in the national forests, it appears reasonable that the marginal land classes would remain as grazing lands under general forest management practices. Other areas, adjacent to high mountain lakes and streams, have a value for recreational activities and were not considered as potential agricultural lands, but were assumed to remain under forest management.

Table 33 comprises a description of the land classes used in the survey as they affect irrigability and crop adaptability.

TABLE 33

LAND CLASSIFICATION STANDARDS

Land class	Characteristics
	Irrigable Valley Lands
V	Smooth lying valley lands with slopes up to 6 per cent in general gradient, in reasonably large-sized bodies sloping in the same plane; or slightly undulating lands which are less than 4 per cent in general gradient. The soils have medium to deep effective root zones, are permeable throughout, and free of salinity, alkalinity, rock or other conditions limiting crop adaptability of the land. These lands are suitable for all climatically adapted crops.
Vw	Similar in all respects to Class V, except for the present condition of a high water table, which in effect limits the crop adaptability of these lands to pasture crops. Drainage and a change in irrigation practice would be required to affect the crop adaptability. For the purpose of this investigation, it was assumed that there would be no future change in use of these lands.
Vs	Similar in all respects to Class V, except for the presence of saline and alkaline salts, which limits the present adaptability of these lands to crops tolerant to such conditions. The presence of salts within the soil generally indicates poor drainage and a medium to high water table. Reclamation of these lands will involve drainage and the application of additional water over and above crop requirements in order to leach out the harmful salts.
Vh	Similar in all respects to Class V, except for having very heavy textures, which makes these lands best suited for the production of shallow-rooted crops such as rice and pasture.

TABLE 33—Continued

LAND CLASSIFICATION STANDARDS

Land class	Characteristics
Vl	Similar in all respects to Class V, except for having fairly coarse textures and low moisture-holding capacities, which in general make these lands unsuited for the production of shallow-rooted crops because of the frequency of irrigations required to supply the water needs of such crops.
Vp	Similar in all respects to Class V, except for depth of the effective root zone, which limits use of these lands to shallow-rooted crops, such as irrigated grain and pasture.
Vr	Similar in all respects to Class V, except for the presence of rock on the surface or within the plow zone in sufficient quantity to prevent use of the land for cultivated crops. These lands are suitable for irrigated pasture crops.
Vhs	Similar in all respects to Class V, except for the limitations set forth for Classes Vh and Vs, which makes these lands best suited for the production of shallow-rooted, salt-tolerant crops.
Vls	Similar in all respects to Class V, except for the limitations set forth for Classes Vl and Vs, which makes these lands best suited for the production of deep-rooted, salt-tolerant crops.
Vps	Similar in all respects to Class V, except for the limitations set forth for Classes Vp and Vs, which restrict the crop adaptability of these lands to shallow-rooted, salt-tolerant crops.
Vpr	Similar in all respects to Class V, except for the limitations set forth for Classes Vp and Vr, which restrict the crop adaptability of these lands to irrigated pasture.
	Irrigable Hill Lands
H	Rolling and undulating lands with slopes up to a maximum of 20 per cent for rolling large-sized bodies sloping in the same plane; and grading down to a maximum slope of less than 12 per cent for undulating lands. The soils are permeable, with medium to deep effective root zones, and are suitable for the production of all climatically adapted crops. The only limitation is that imposed by topographic conditions, which affect the ease of irrigation and the amount of these lands that may ultimately be developed for irrigation.
Hl	Similar in all respects to Class H, except for having fairly coarse textures and low moisture-holding capacities, which in general makes these lands unsuited for the production of shallow-rooted crops because of the frequency of irrigations required to supply the water needs of such crops.
Hp	Similar in all respects to Class H, except for depth of the effective root zone, which limits use of these lands to shallow-rooted crops.
Hr	Similar in all respects to Class H, except for the presence of rock on the surface or within the plow zone in sufficient quantity to restrict use of the land to noncultivated crops.
Hpr	Similar in all respects to Class H, except for depth of the effective root zone and the presence of rock on the surface or within the root zone in sufficient quantity to restrict use of these lands to noncultivated crops.
Ht	Similar in all respects to Class H, except for topographic limitations. These lands have smooth slopes up to 30 per cent in general gradient for large-sized bodies sloping in the same plane, and slopes up to 12 per cent for rougher and more undulating topography. These lands will probably never become as highly developed as other "H" classes of land, and are best suited only for irrigated pasture.
Htl	Similar in all respects to Class Ht, except for having fairly coarse textures and low moisture-holding capacities which in general makes these lands unsuited for the production of shallow-rooted crops and presents a great erosion hazard.
Htp	Similar in all respects to Class Ht, except for depth of the effective root zone, which limits use of these lands to shallow-rooted crops.
Htr	Similar in all respects to Class Ht, except for the presence of rock on the surface or within the plow zone in sufficient quantity to restrict use of these lands to noncultivated crops.
Htpr	Similar in all respects to Class Ht, except for depth of the effective root zone and the presence of rock on the surface or within the root zone, which limits use of these lands to noncultivated shallow-rooted crops.
	Other Lands
F	Presently forested lands, or lands subject to forest management, which meet the requirements for irrigable land but which, because of climatic conditions and physiographic position, are better suited for timber production or some type of forest management program rather than for irrigated agriculture.
U	Urban lands presently used for residential, commercial, resort, and industrial purposes.
N	Includes all lands which fail to meet the requirements of the above classes.

Example of Land Classification Delineated on Aerial Photograph

Land Classification Survey Procedure. The land classification procedure employed during the investigation consisted basically of an examination of the soil characteristics and the physiography of the landscape. Field mapping was done on aerial photographs having a scale of approximately 1 to 20,000. Stereoscopes were used in the field to assist the soil technologists in making delineations in accordance with observed conditions. The character of the soils was established by examination of materials from test holes, road cuts, and ditch banks, together with observation of the type and quality of natural vegetation and crops. The presence of rock, high water tables, alkalinity and salinity were observed. Representative slopes throughout the area were measured with a clinometer to determine their degree of slope. Considering all these factors, the appropriate crop adaptability class for each parcel of land was determined and delineated on the aerial photograph.

In certain areas covered by this investigation, work done by other agencies was of value in the land classification procedure. The Soil Conservation Service of the United States Department of Agriculture has made detailed land capability surveys for a number of soil conservation districts throughout the Northeastern Counties, and the Bureau of Reclamation of the United States Department of the Interior has made land classification studies in connection with Federal reclamation projects. The surveys of both these agencies were used to supplement the work of the Department of Water Resources. In addition, the cooperative soil surveys of the University of California and the United States Department of Agriculture aided in the classification procedure.

After irrigable areas were delineated in the field on aerial photographs, the areas were projected to either United States Geological Survey topographic maps or United States Forest Service planimetric maps at scales of approximately 1:24,000 or 1:31,680, respectively. The areas of each of the land classes were determined by cutting the delineated areas on the base maps and weighing with an analytical balance. The areas by land classes were then computed and tabulated by hydrographic unit and county.

Results of the land classification survey indicate that approximately 4,575,000 acres of land within the Northeastern Counties, out of a total of about 23,500,000 acres, are susceptible of agricultural development under irrigation.

Approximately 3,470,000 acres, or some 76 per cent of the lands classed as irrigable, are valley lands. Practically all of these irrigable valley lands are composed of recent alluvial and lacustrine soils, and the greater part is of excellent agricultural quality and will produce all climatically adapted crops. Some of the irrigable hill lands are found on recent alluvial soils, but for the most part they are comprised of residual soils or old valley terrace soils. The best of the irrigable hill lands, those which have adequate soil depth and reasonably smooth topography, comprise about 325,000 acres, or approximately 7 per cent of the total irrigable area. The remainder of the irrigable hill lands, totaling some 780,000 acres, or about 17 per cent of the irrigable area, are quite limited in crop adaptability by inadequate soil depths, presence of rock, or excessive slopes.

Results of the classification of irrigable lands in the Northeastern Counties are presented in Table 34, segregated by hydrographic units. Table 35 presents the results summarized by counties. The irrigable valley lands, irrigable hill lands, and other irrigable lands best suited to forest management are delineated on Plate 4.

Determination of the Amount of Land That Will Ultimately Be Irrigated. Even in the most intensively developed areas of irrigated agriculture, not all of the irrigable lands receive water every year. Since the results of the land classification survey were in terms of gross areas, it was necessary to determine the net acreage that might ultimately be irrigated in any one season. This probably will depend on one or more of the following factors:

(1) *Quality of the Land and Crop Rotation.* It is anticipated that in the future the higher quality irrigable lands will be intensively developed for irrigation and will remain in relatively continuous operation, whereas lands of poorer quality and of limited crop adaptability will be in production only as favorable economic conditions permit. Also, even though it is assumed that all irrigable lands will receive water service, the effect of crop rotation is acknowledged. Even in areas of intensive irrigation development certain lands lie fallow each year, thus reducing the water requirements.

(2) *Irrigable Areas Utilized for Purposes other than Agriculture.* It is anticipated that there will always be a portion of the irrigable lands that will be occupied by urban types of development, farm lots, highways, railroads, canals, industrial establishments, etc. The nature of the agricultural development will, to some extent, determine the amount of certain of these nonagricultural land uses. For example, orchard and truck farming areas ordinarily include more land used for roads and farmsteads than areas where field crops are dominant.

(3) *Inclusions of Nonirrigable Land.* Due to the scale of the photographs on which the irrigable lands were mapped, it was not possible to delineate all of the small areas of nonirrigable land which occurred within the lands classed as irrigable. The occurrence of these small plots of nonirrigable land, which are included within the areas classed as irrigable, varies generally with the detail of the survey and classes of lands being surveyed, being greatest in the marginal classes.

Livestock Pastured on Cut Hay Land

Department of Water Resources Photograph

Milo in the Sacramento Valley

United States Bureau of Reclamation Photograph

(4) *Size, Shape, and Location of the Irrigable Land.* It is apparent that small irregularly shaped plots of land, particularly those isolated from other irrigable lands, cannot be irrigated as readily or completely as large, regularly shaped, compact units. Ownership boundaries also exert an influence, since small, isolated, ownerships probably will never be developed.

(5) *Ease of Development of the Irrigable Lands.* The inherent difficulties encountered in developing and serving water to lands with more adverse topographic conditions will tend to prevent them from being utilized completely. This is particularly true of those lands with hilly topography which could not be served completely by a gravity irrigation system and would require numerous pump lifts.

(6) *Economic Conditions.* Influential factors in limiting the annual irrigated acreage and resultant water requirements are crop production costs and net farm income. It is probable that there will always be a tendency to withdraw land from production in years of economic adversity. Inasmuch as the concept of ultimate development adopted for purposes of the present studies presupposes maximum land use within physical limitations and water supply availability, the factors of production costs and net farm income were not given consideration in determining the probable ultimate irrigated area. This assumption is conservative in relation to water requirements, in that the estimated requirements have thus been maximized in this stage of planning for future water resources development.

(7) *Availability of Water Supply.* It is recognized that one of the limiting factors of irrigation development is the availability of an adequate and economic water supply. In the final evaluation of determining the land that will ultimately be irrigated, consideration must be given to the relative reasonableness of the physical possibilities and costs of developing and conveying the available water supplies to the places of demand. While the current investigation does not include specific project plans for the entire area, past reports of project development were considered in evaluating the availability of water for each hydrographic unit.

The area that will actually be irrigated in any one year under probable conditions of ultimate development, was estimated by the application of appropriate percentage factors for each of the above-mentioned items, except for economic conditions and availability of water supply. The factors were largely based upon measurements previously made in intensively developed irrigated areas of the State, and upon knowledge of the characteristics of the lands. The method of reducing gross irrigable land to that potentially irrigable from the available water supply is discussed in Chapter III, "Water Utilization and Requirements."

Probable Ultimate Crop Pattern. The projection of a probable ultimate crop pattern that could be sustained on the net irrigable lands in the Northeastern Counties was an important step in evaluating the ultimate water requirements.

The present irrigated agricultural development in the area, and trends in such development throughout California, were considered in projecting this ultimate crop pattern. Other factors affecting the ultimate crop pattern are climate, and limitations on crop adaptability due to various undesirable land and soil characteristics revealed by the land classification surveys. The county farm advisors and leaders in agriculture throughout the region furnished additional information to aid in the forecast of future agricultural development.

In many of the areas in the Northeastern Counties that lie at the higher elevations, and which are adjacent to large tracts of public lands, the raising of livestock will probably continue as a dominant segment of the agricultural industry. The availability of summer grazing land, coupled with the production of forage crops for winter feeding has largely been responsible for this development. It appears reasonable that such an economy will continue, and, therefore, the crop projection for those areas was weighted heavily toward the forage type crops.

In the Sacramento Valley the diversity of products raised in recent years would indicate that many climatically adaptable crops may be grown in the area. It was anticipated that there would be a considerable increase in the acreage devoted to the production of deciduous fruits and nuts, particularly on the better lands bordering the Sacramento and Feather Rivers. This will be partly due to the increasing demand for homesites in and around the San Francisco Bay region. This demand is, even at this time, causing a significant decrease in the acreage devoted to deciduous orchard in that area. Similarly, a fairly large increase in truck crops in the Sacramento Valley is expected as the population growth of the State brings about greater demands and some of the present truck crop acreage is taken up by urban development.

At the present time there is a considerable acreage of swamps and marshes in the region, particularly on the heavy, basin soils of the Sacramento Valley, and in the low-lying, poorly drained parts of the mountainous areas. In the valley, most of these areas are used as gun clubs for migratory waterfowl hunting. Since there is a great demand for this type of recreation, it was assumed there would be no change in the use of these lands under conditions of ultimate development. Similarly, it was expected that the marsh lands of the higher areas would remain as at present, since, due to the land's physiographic position, drainage and reclamation are generally difficult.

TABLE 34

CLASSIFICATION OF IRRIGABLE LANDS WITHIN HYDROGRAPHIC UNITS, NORTHEASTERN COUNTIES

(In acres)

Hydrographic unit		Irrigable valley land classes											Irrigable hill land classes										Gross irrigable area	Irrigable lands best suited to forest management
Reference number	Name	V	Vw	Vs	Vh	Vl	Vp	Vr	Vhs	Vls	Vps	Vpr	H	Hl	Hp	Hr	Hpr	Ht	Htl	Htp	Htr	Htpr		
	North Coastal Drainage Basin																							
1	Tule Lake	108,540	13,330	9,230	0	0	900	410	0	0	0	500	14,460	0	1,450	740	100	1,110	0	0	0	0	150,770	0
2	Butte Valley	71,160	6,410	6,250	0	0	2,840	3,550	0	0	0	100	4,380	0	450	500	1,210	1,330	0	0	0	0	98,180	18,070
3	Klamath River	6,990	180	0	0	0	100	420	0	0	0	0	8,180	0	5,730	220	460	1,830	0	3,370	60	160	27,700	410
4	Shasta Valley	62,110	11,690	7,870	0	0	2,140	20,600	0	0	0	2,290	16,720	0	8,440	5,720	1,120	1,160	0	760	0	0	140,620	3,080
5	Scott Valley	35,750	7,880	0	0	0	0	4,970	0	0	0	0	11,480	0	1,060	70	20	1,800	0	1,660	0	0	64,690	7,390
6	Salmon River	0	0	0	0	0	0	0	0	0	0	0	400	0	0	0	0	150	0	0	0	0	550	0
7	Upper Trinity River	80	0	0	0	0	0	130	0	0	0	0	150	0	0	0	0	0	0	0	0	0	360	660
8	Lower Trinity River	80	0	0	0	0	0	10	0	0	0	0	2,390	0	0	40	0	460	0	0	0	0	2,980	0
9	South Fork Trinity River	2,260	0	0	0	0	0	370	0	0	0	0	4,490	0	100	0	0	330	0	0	0	0	7,550	2,600
10	Southern Trinity County	2,220	50	0	0	610	450	300	0	0	0	0	680	0	70	10	0	30	0	0	0	0	4,420	5,310
11	Lake Pillsbury	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,310
	SUBTOTALS	289,190	39,540	23,350	0	610	6,430	30,760	0	0	0	2,890	63,330	0	17,300	7,300	2,910	8,200	0	5,790	60	160	479,820	38,830
	Central Valley Drainage Basin																							
12	Goose Lake	11,830	4,550	4,790	0	0	1,700	90	0	0	0	820	5,060	0	6,530	750	4,350	750	0	350	440	0	42,010	0
13	Jess Valley	320	4,820	0	0	0	430	20	0	0	0	430	100	0	130	200	1,620	0	0	60	70	310	8,510	24,240
14	Alturas	16,950	24,810	17,000	0	0	12,320	10	0	0	280	3,840	2,540	0	52,660	220	9,830	220	0	7,450	0	4,030	152,160	12,280
15	Big Valley	41,950	18,730	4,710	60	0	26,680	290	0	0	80	530	6,840	0	21,530	1,180	3,790	630	0	3,870	200	490	131,560	92,860
16	McArthur	25,320	16,940	0	0	50	12,790	610	0	0	20	570	8,130	0	730	1,460	2,500	2,520	0	750	180	80	72,650	188,540
17	Hat Creek	9,060	6,300	0	0	180	30	1,330	0	0	0	150	2,280	0	1,340	440	530	600	0	590	20	40	22,890	195,180
18	Montgomery Creek	830	70	0	0	0	0	100	0	0	0	0	2,190	0	0	510	0	2,730	0	0	520	0	6,950	35,680
19	McCloud River	2,430	390	0	0	0	0	30	0	0	0	0	230	0	0	0	0	30	0	0	0	0	3,110	92,800
20	Dunsmuir	1,610	860	0	0	0	240	360	0	0	0	0	3,630	0	2,530	170	0	1,010	0	920	0	0	11,330	4,890
21	Shasta Lake	90	0	0	0	0	0	10	0	0	0	0	800	0	560	10	0	700	0	10	0	0	2,180	0
22	Clear Creek	10	0	0	0	0	0	10	0	0	0	0	50	0	20	110	0	50	0	90	30	0	370	0
23	Keswick	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	Cottonwood Creek	13,140	0	0	0	920	3,840	70	0	0	0	40	8,140	0	16,100	170	920	2,520	0	8,670	0	0	54,530	0
25	Olinda	6,140	0	0	0	0	700	0	0	0	0	20	620	0	1,480	0	450	0	0	830	0	0	10,240	0
26	Redbank Creek	7,300	0	0	0	110	1,140	30	0	0	0	0	4,630	0	5,670	0	20	1,600	0	2,650	0	0	23,150	0
27	Elder Creek	1,590	0	0	0	0	450	0	0	0	0	0	880	0	1,610	0	0	350	0	1,720	0	0	6,600	0
28	Thomes Creek	7,820	0	0	0	0	2,820	140	0	0	0	0	3,580	0	5,430	30	0	1,420	0	6,020	0	0	27,260	110
29	Stony Creek	17,360	20	0	0	0	3,770	600	0	0	0	0	13,110	0	12,780	300	20	2,350	0	5,520	80	0	55,910	0
30	Clear Lake	36,610	1,000	120	20	1,710	5,630	130	0	0	0	0	16,710	0	5,460	60	390	10,670	0	5,940	450	720	85,620	0
31	Middletown	7,850	0	0	0	0	780	20	0	0	0	20	4,450	0	600	30	110	710	0	130	0	0	14,700	0
32	Stillwater Plains	7,100	40	0	0	0	12,720	100	0	0	0	0	3,840	0	11,080	260	0	210	0	2,100	0	0	37,450	0
33	Cow Creek	10,380	160	0	0	0	950	1,210	0	0	0	60	14,310	0	2,550	9,120	840	4,830	0	790	4,550	130	49,880	17,370
34	Bear Creek	3,820	30	0	0	0	1,940	1,520	0	0	0	210	5,300	0	1,690	4,490	1,480	950	0	0	220	0	21,650	16,930
35	Battle Creek	2,370	1,910	0	0	0	0	1,050	0	0	0	180	8,030	0	0	2,680	4,380	1,170	0	0	2,530	150	25,450	55,640
36	Paynes Creek	1,040	0	0	0	0	0	580	0	0	0	530	590	0	160	600	400	50	0	0	10	20	3,980	4,220
37	Antelope Creek	320	160	0	0	0	0	260	0	0	0	980	60	0	0	190	360	0	0	0	0	0	2,330	18,950
38	Mill Creek	750	0	0	0	0	0	300	0	0	0	10	0	0	0	40	70	0	0	0	0	0	1,170	6,810
39	Deer Creek	1,580	0	0	0	0	0	0	0	0	0	90	60	0	0	20	0	0	0	0	0	0	1,750	19,360
40	Chico Creek	40	150	0	0	0	0	90	0	0	0	90	760	0	130	300	360	490	0	290	0	70	2,770	22,180
41	Paradise	560	0	0	0	0	490	0	0	0	0	0	13,760	0	3,560	3,250	1,550	1,950	0	580	1,130	460	27,290	2,950
42	North Fork Feather River	220	7,540	0	0	0	270	1,690	0	0	0	260	6,740	0	0	2,280	0	3,720	0	50	1,490	0	24,260	97,610
43	East Branch Feather River	12,200	9,390	0	0	100	800	1,090	0	0	0	160	6,240	0	250	4,680	530	190	0	0	290	0	35,920	8,450
44	Sierra Valley	29,030	25,740	3,600	0	10,700	17,340	1,750	0	1,230	4,520	280	8,930	900	2,180	5,600	620	1,450	0	40	4,250	0	118,160	6,650
45	Middle Fork Feather River	1,130	3,100	0	0	0	0	400	0	0	0	0	6,440	0	410	1,760	270	2,040	0	40	370	100	16,060	22,350
46	South Fork Feather River	10	0	0	0	0	0	0	0	0	0	0	190	0	0	240	0	410	0	0	350	0	1,200	11,550
47	North Yuba River	10	910	0	0	0	0	20	0	0	0	0	780	0	0	140	0	1,010	0	0	10	0	2,880	32,030
48	Challenge	650	0	0	0	0	20	110	0	0	0	0	3,820	0	890	3,250	1,450	2,480	0	3,360	1,970	1,680	19,680	11,800

TABLE 34—Continued

CLASSIFICATION OF IRRIGABLE LANDS WITHIN HYDROGRAPHIC UNITS, NORTHEASTERN COUNTIES

(In acres)

Hydrographic unit		Irrigable valley land classes											Irrigable hill land classes												Irrigable lands best suited to forest management
Reference number	Name	V	Vw	Vs	Vb	Vl	Vp	Vr	Vhs	Vls	Vps	Vpr	H	Hl	Hp	Hr	Hpr	Ht	Htl	Htp	Htr	Htpr	Gross irrigable area	
	Central Valley Drainage Basin —Continued																							
49	Wyandotte	880	0	0	0	0	3,220	0	0	0	0	0	1,350	0	17,980	560	5,300	10	0	11,030	10	5,730	46,070	0
50	Anderson	20,890	0	0	0	640	5,700	970	0	0	0	660	3,720	0	3,850	210	330	0	0	150	0	0	37,120	0
51	Corning	65,770	30	0	0	20	58,700	2,460	0	0	0	0	1,980	0	41,900	100	0	270	0	6,100	0	1,190	178,520	0
52	Los Molinos	74,550	80	0	0	340	15,500	5,880	0	0	0	18,070	1,490	0	1,350	50	570	0	0	30	0	10	117,920	0
53	Fruto	12,640	0	0	190	0	9,550	170	0	0	0	0	9,630	0	16,440	50	120	5,880	0	10,170	80	0	64,920	0
54	Orland	73,350	180	0	9,290	9,160	35,670	30	0	0	10	0	1,390	10	190	0	0	460	0	110	0	0	129,850	0
55	Durham	47,710	10	0	40,070	480	4,990	10	0	0	0	100	2,530	90	470	450	60	0	0	0	0	0	96,970	0
56	Colusa	207,610	400	5,000	167,840	560	60,170	0	107,800	0	5,920	0	1,670	0	510	0	0	450	0	60	0	0	557,990	0
57	Gridley	71,620	10	50	69,930	660	91,140	400	0	0	4,190	690	1,100	80	20,380	210	1,780	0	0	1,850	0	0	264,090	0
58	Browns Valley	540	90	0	0	0	460	0	0	0	0	0	90	0	9,310	0	1,730	140	0	8,250	0	1,320	21,930	0
59	Cortina	19,710	0	0	1,120	180	10,420	0	0	0	860	0	22,950	0	13,750	0	0	10,570	0	10,030	0	160	89,750	0
60	Arbuckle	76,220	0	10	20,190	380	16,870	10	3,720	0	1,110	0	5,290	0	1,980	0	0	410	0	240	0	0	126,430	0
61	Sutter	46,240	180	0	730	1,030	28,400	0	0	0	0	0	0	0	20	0	0	0	0	0	0	0	76,600	0
62	Marysville	51,720	50	0	0	2,320	99,620	0	0	0	0	20	180	10	30,820	40	3,150	0	0	7,260	0	3,990	199,180	0
63	Pleasant Grove	4,300	0	0	2,870	0	11,140	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18,310	0
64	West Yolo	3,850	0	0	0	0	60	0	0	0	0	0	1,790	0	420	0	0	2,310	0	1,730	40	0	10,200	0
65	Capay	8,610	0	0	0	0	0	20	0	0	0	0	2,850	0	0	20	0	1,180	0	0	0	0	12,680	0
66	Woodland	136,060	0	3,490	31,440	0	710	0	8,140	0	0	0	4,250	0	7,790	0	0	1,460	0	1,160	0	0	194,500	0
67	East Yolo	64,200	0	490	69,820	0	22,800	0	10,350	0	0	0	0	0	0	0	0	0	0	0	0	0	167,660	0
	SUBTOTALS	1,265,890	128,650	39,260	413,570	29,540	582,970	23,970	130,010	1,230	16,990	28,810	226,080	1,030	325,220	47,230	49,880	72,950	0	110,990	19,290	20,680	3,534,300	1,003,430
	Lahontan Drainage Basin																							
68	Surprise Valley	34,430	12,430	38,820	0	60	0	190	0	0	0	0	16,910	370	2,250	1,180	530	4,960	0	2,150	660	0	114,940	2,030
69	Madeline Plains	7,600	5,750	1,010	99,360	5,580	13,090	250	17,900	0	640	30	2,540	3,690	4,970	580	5,670	140	260	290	10	0	169,360	15,540
70	Eagle Lake	430	3,820	70	0	320	0	0	0	50	0	0	260	130	0	10	80	0	0	0	0	0	5,170	96,550
71	Willow Creek	810	3,550	500	790	0	4,750	0	0	0	80	60	310	0	1,670	0	80	10	0	120	0	0	12,760	3,250
72	Secret Valley	340	2,770	4,500	1,800	0	2,030	20	5,130	40	660	10	180	0	4,030	50	160	0	0	280	0	0	22,060	5,780
73	Susan River	16,500	10,390	34,010	0	6,280	280	100	0	1,040	1,090	140	6,840	5,940	2,010	480	590	320	1,470	1,610	40	150	89,280	50,650
74	Herlong	6,610	950	31,420	0	19,590	260	100	0	9,790	0	0	7,810	16,500	2,950	2,970	0	2,470	4,460	5,390	3,530	220	118,050	60
75	Little Truckee River	490	2,490	0	0	0	0	260	0	0	0	0	170	0	1,500	2,900	0	0	0	0	3,730	0	11,545	4,520
	SUBTOTALS	67,240	42,150	113,330	101,950	31,830	20,410	920	23,030	10,920	2,470	240	35,050	26,630	19,410	8,170	7,110	7,900	6,190	9,840	7,970	370	542,980	178,380
	TOTALS	1,622,320	210,340	175,940	515,520	61,980	603,810	55,650	153,040	12,150	19,460	31,940	324,460	27,720	361,960	62,700	59,900	89,050	6,190	126,620	27,320	21,210	4,575,280	1,220,660

TABLE 35

CLASSIFICATION OF IRRIGABLE LANDS WITHIN THE NORTHEASTERN COUNTIES

(In acres)

County and hydrographic unit		Irrigable valley land classes											Irrigable hill land classes										Gross irrigable area	Irrigable lands best suited to forest management
Reference number	Name	V	Vw	Vs	Vh	Vl	Vp	Vr	Vhs	Vls	Vps	Vpr	H	Hl	Hp	Hr	Hpr	Ht	Htl	Htp	Htr	Htpr		
	Butte County																							
40	Chico Creek	40	140	--	--	--	--	10	--	--	--	--	760	--	130	270	320	490	--	290	--	70	2,520	15,570
41	Paradise Creek	560	--	--	--	--	490	--	--	--	--	--	13,760	--	3,560	3,250	1,550	1,950	--	580	1,130	460	27,290	4,950
42	North Fork Feather River	30	70	--	--	--	--	--	--	--	--	--	980	--	--	910	--	3,630	--	50	620	--	6,290	5,190
45	Middle Fork Feather River	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	140	980	--	40	--	100	1,260	3,340
46	South Fork Feather River	10	--	--	--	--	--	--	--	--	--	--	110	--	--	100	--	410	--	--	350	--	980	8,650
48	Challenge	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	940
49	Wyandotte	880	--	--	--	--	3,220	--	--	--	--	--	1,350	--	17,980	560	5,300	10	--	11,030	10	5,730	46,070	--
52	Los Molinos	43,330	70	--	--	200	12,370	380	--	--	--	3,350	1,350	--	1,290	40	30	--	--	30	--	--	62,440	--
55	Durham	47,710	10	--	40,070	480	4,990	10	--	--	--	100	2,530	90	470	450	60	--	--	--	--	--	96,970	--
57	Gridley	33,760	10	--	53,100	540	72,440	400	--	--	2,750	690	660	80	19,500	210	1,780	--	--	1,850	--	--	187,770	--
	COUNTY TOTALS	126,320	320	--	93,170	1,220	93,510	800	--	--	2,750	4,140	21,500	170	42,930	5,790	9,180	7,470	--	13,870	2,110	6,360	431,590	38,640
	Colusa County																							
29	Stony Creek	5,250	20	--	--	--	1,180	150	--	--	--	--	3,320	--	4,050	50	--	230	--	1,330	10	--	15,590	--
30	Clear Lake	2,010	550	--	--	30	3,760	30	--	--	--	--	2,900	--	380	--	--	500	--	40	10	20	10,230	--
53	Fruto	--	--	--	--	--	--	--	--	--	--	--	20	--	40	--	--	--	--	--	--	--	60	--
56	Colusa	79,050	30	4,760	62,450	40	17,180	--	93,990	--	5,720	--	1,180	--	510	--	--	440	--	60	--	--	265,410	--
57	Gridley	--	--	--	1,870	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1,870	--
59	Cortina	14,430	--	--	1,120	180	6,820	--	--	--	860	--	15,960	--	8,710	--	--	7,840	--	4,610	--	160	60,690	--
60	Arbuckle	52,990	--	10	9,670	380	12,930	10	3,270	--	1,030	--	4,710	--	1,700	--	--	370	--	200	--	--	87,270	--
	COUNTY TOTALS	153,730	600	4,770	75,110	630	41,870	190	97,260	--	7,610	--	28,090	--	15,390	50	--	9,380	--	6,240	20	180	441,120	--
	Glenn County																							
11	Lake Pillsbury	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
29	Stony Creek	10,180	--	--	--	--	2,590	400	--	--	--	--	8,900	--	7,630	250	20	2,020	--	2,810	70	--	34,870	--
53	Fruto	12,620	--	--	190	--	9,550	170	--	--	--	--	9,610	--	16,260	50	120	5,880	--	10,000	80	--	64,530	--
54	Orland	72,470	180	--	9,290	9,160	34,990	30	--	--	10	--	1,390	10	100	--	--	460	--	70	--	--	128,160	--
56	Colusa	71,980	370	20	39,700	520	19,930	--	13,630	--	200	--	470	--	--	--	--	10	--	--	--	--	146,830	--
57	Gridley	210	--	--	14,960	--	230	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	15,400	--
59	Cortina	40	--	--	--	--	630	--	--	--	--	--	10	--	460	--	--	--	--	50	--	--	1,190	--
	COUNTY TOTALS	167,500	550	20	64,140	9,680	67,920	600	13,630	--	210	--	20,380	10	24,450	300	140	8,370	--	12,930	150	--	390,980	--
	Lake County																							
11	Lake Pillsbury	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1,310
29	Stony Creek	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
30	Clear Lake	34,530	450	120	20	1,680	1,870	100	--	--	--	--	13,640	--	5,080	60	390	10,170	--	5,900	440	700	75,150	--
31	Middletown	7,850	--	--	--	--	780	20	--	--	--	20	4,450	--	600	30	110	710	--	130	--	--	14,700	--
	COUNTY TOTALS	42,380	450	120	20	1,680	2,650	120	--	--	--	20	18,090	--	5,680	90	500	10,880	--	6,030	440	700	89,850	1,310
	Lassen County																							
13	Jess Valley	100	1,260	--	--	--	430	--	--	--	--	60	--	20	180	40	--	--	--	--	20	--	2,110	16,620
14	Alturas	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3,680
15	Big Valley	22,360	12,880	4,400	60	--	16,940	190	--	--	80	230	3,760	--	13,210	170	1,220	630	--	3,230	--	160	79,520	7,990
16	McArthur	6,420	4,280	--	--	50	470	290	--	--	20	470	5,120	--	40	1,440	2,460	1,070	--	360	100	--	22,590	56,070
17	Hat Creek	--	570	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	570	66,120
42	North Fork Feather River	50	5,220	--	--	--	--	210	--	--	--	--	4,600	--	--	550	--	70	--	--	--	--	10,700	30,670
68	Surprise Valley	420	1,050	1,020	--	60	--	40	--	--	--	--	860	370	--	370	--	20	--	--	--	--	4,210	2,030
69	Madeline Plains	7,600	5,750	1,010	99,360	5,580	13,090	250	17,900	--	640	30	2,540	3,690	4,970	580	5,670	140	260	290	10	--	169,360	15,540

TABLE 35—Continued

CLASSIFICATION OF IRRIGABLE LANDS WITHIN THE NORTHEASTERN COUNTIES

(In acres)

County and hydrographic unit		Irrigable valley land classes											Irrigable hill land classes										Gross irrigable area	Irrigable lands best suited to forest management
Reference number	Name	V	Vw	Vs	Vh	Vl	Vp	Vr	Vhs	Vls	Vps	Vpr	H	Hl	Hp	Hr	Hpr	Ht	Htl	Htp	Htr	Htpr		
	Lassen County—Continued																							
70	Eagle Lake	430	3,820	70	--	320	--	--	--	50	--	--	260	130	--	10	80	--	--	--	--	--	5,170	96,550
71	Willow Creek	810	3,550	500	790	--	4,750	--	--	--	80	60	340	--	1,670	--	80	10	--	120	--	--	12,760	3,250
72	Secret Valley	340	2,770	4,500	1,800	--	2,030	20	5,130	40	660	10	180	--	4,090	50	160	--	--	280	--	--	22,060	5,780
73	Susan River	16,500	10,390	34,010	--	6,280	280	100	--	1,040	1,090	140	6,840	5,940	2,010	480	590	320	1,470	1,610	40	150	89,280	50,550
74	Herlong	5,470	950	34,420	--	19,590	260	100	--	9,790	--	--	7,430	16,500	2,220	1,800	--	2,330	4,460	3,390	2,390	220	111,320	--
	COUNTY TOTALS	60,500	52,490	79,930	102,010	31,880	38,250	1,200	23,030	10,920	2,570	1,000	31,930	26,630	28,230	5,630	10,300	4,590	6,190	9,280	2,560	530	529,650	354,850
	Modoc County																							
1	Tulelake	49,570	7,230	320	--	--	--	110	--	--	-	460	5,140	--	350	490	--		--	--	--	--	63,670	--
12	Goose Lake	11,830	4,550	4,790	--	--	1,700	90	--	--	--	820	5,160	--	6,530	750	4,350	750	--	350	440	-	42,010	--
13	Jess Valley	220	3,560	--	--	--	--	20	--	--	--	370	100	--	110	20	1,580	--	--	60	50	310	6,400	7,620
14	Alturas	16,950	24,810	17,000	--	--	12,320	10	--	--	280	3,840	2,540	--	52,660	220	9,830	220	--	7,450	--	4,030	152,160	8,600
15	Big Valley	19,590	5,850	310	--	--	9,740	100	--	--	--	300	3,080	--	8,320	1,010	2,570		--	640	200	330	52,040	84,870
16	McArthur	1,270	2,670	--	--	--	--	-	--	--	--	100	50	--	--	20	10	--	-	--	--	80	4,200	10,830
68	Surprise Valley	34,010	11,380	37,800	--	--	--	150	--	-	--	--	16,050	--	2,250	810	530	4,940	-	2,150	660	--	110,730	--
	COUNTY TOTALS	133,440	60,050	60,220	--	--	23,760	480	--	--	280	5,890	32,020	--	70,220	3,320	18,870	5,910	--	10,550	1,350	4,750	431,210	111,920
	Plumas County																							
40	Chico Creek	-		--	-	--	--	--	--	--	--	--	--	-	--		--	-	--	-	--	--	--	--
42	North Fork Feather River	140	2,210	--	--		270	1,480	--	-	--	260	1,160	--	--	820	--	20	--	--	870	--	7,230	61,700
43	East Branch Feather River	12,200	9,390	--	--	100	800	1,090	--	--		160	6,240	--	250	4,680	530	190	--	--	290	-	35,920	8,450
44	Sierra Valley	18,360	11,300	2,130	--	10,700	11,270	20	-	1,230	4,090	--	6,500	900	2,030	3,260	210	1,030	--	40	2,070	--	75,140	3,150
45	Middle Fork Feather River	1,130	3,100		--	--	--	370	--	--	--	--	6,140	--	400	1,760	130	1,060		--	370	-	14,760	18,690
46	South Fork Feather River	--	--	-		--	--	--		--	--	--	40	-	--	140	--	--	-	-	--	--	180	2,600
47	North Yuba River	--	--	--	-	--	--	--	--	--	--	--	--	--	--	--	--	--	--	-	--	--	--	740
73	Susan River	--	--	--	--		--	--	--	--	--	-	--	--		--		--	--	--	--	-	--	100
74	Herlong	--	-	--	-	--	--	--	--	--	--	--	-	--	30	--	--		--	--	--		30	60
	COUNTY TOTALS	31,830	26,000	2,130	--	10,800	12,340	2,960	--	1,230	4,090	420	20,380	900	2,710	10,660	870	2,300	--	40	3,600	.	133,260	95,510
	Shasta County																							
16	McArthur	17,400	8,380	--	--	-	12,320	320	--	--	--	-	2,960	--	690	--	30	1,450	--	390	80	-	44,020	32,770
17	Hat Creek	9,060	5,730	--	--	180	30	1,330	--	--	-	150	2,280	--	1,340	440	530	600	--	590	20	40	22,320	129,060
18	Montgomery Creek	830	70	-	--	--	--	100	--	--	-	--	2,190		--	510	--	2,730	--	--	520	--	6,950	35,680
19	McCloud River	780	50	--	-	--	--	--	--	--	--	--	100	--	-	--	--	30	--		--	--	960	960
20	Dunsmuir	390	--	--	--	-		270	--	--	--	--	540	--	20	50	--	430	-	40	-	--	1,740	20
21	Shasta Lake	90		--	--	--	-	10	--	--	--	--	800	--	560	10	-	700	--	10	--	--	2,180	--
22	Clear Creek	10	--	--	--	--	--	10	--	--	--	--	50	--	20	110	--	50	-	90	30	--	370	--
23	Keswick	--	-	--	--	--	-	--	--	--	--	--	--	-		-	-	--	--	--	--	--		--
24	Cottonwood Creek	5,410	--	--		210	2,270	60	--	--	--	40	1,020	--	7,000	170	850	1,730	-	5,940	--	--	21,730	--
25	Olinda	6,140		--	--	--	700	.	--	--	--	20	620	--	1,480	.	450	--	--	830	.	--	10,210	
32	Stillwater Plains	7,100	40	--	--	-	12,720	100	--	-	--		3,840	--	11,080	260		210	--	2,100		-	37,450	--
33	Cow Creek	10,380	160	-	-	--	950	1,210	-	--	--	60	14,310	--	2,550	9,120	840	4,830		790	4,550	130	49,880	17,370
34	Bear Creek	3,820	30	-	--	-	1,940	1,520	-	--	--	210	5,300	--	1,690	4,490	1,480	950	-		220	--	21,650	16,930
35	Battle Creek	1,840	670	--	-	--	--	910	--	-	--	--	1,820	-	-	3,100	150	650	--	.	1,470	80	10,990	44,190
38	Mill Creek		-	--	-		--	--	--	-	--	--	--	--	--	-	--	--	--	--	--	--	--	
42	North Fork Feather River		40	--	-	-	-	-	--	--	-	--	-	--	--	-	-	--	--	-	--	--	40	50
50	Anderson	13,650	--	--	--	450	5,060	70	--	--	-	250	2,860	--	3,070	10	80	--	--	30	--	-	25,530	--
	COUNTY TOTALS	76,930	15,170	--	--	840	35,990	5,910	-	--	--	730	38,690	--	29,500	18,570	4,410	14,360	--	10,810	6,890	250	259,050	277,030

TABLE 35—Continued

CLASSIFICATION OF IRRIGABLE LANDS WITHIN THE NORTHEASTERN COUNTIES

(In acres)

County and hydrographic unit		Irrigable valley land classes											Irrigable hill land classes											Gross irrigable area	Irrigable lands best suited to forest management
Reference number	Name	V	Vw	Vs	Vh	Vl	Vp	Vr	Vhs	Vls	Vps	Vpr	H	Hl	Hp	Hr	Hpr	Ht	Htl	Htp	Htr	Htpr		
	Sierra County																							
44	Sierra Valley	10,670	14,440	1,470	--	--	6,070	1,730	--	--	430	280	2,430	--	150	2,340	410	420	--	--	2,180	--	43,020	3,500
45	Middle Fork Feather River	--	--	--	--	--	--	30	--	--	--	--	--	--	10	--	--	--	--	--	--	--	40	320
47	North Yuba River	--	910	--	--	--	--	20	--	--	--	--	500	--	--	140	--	290	--	--	10	--	1,870	20,060
74	Herlong	1,170	--	--	--	--	--	--	--	--	--	--	380	--	700	1,170	--	140	--	2,000	1,140	--	6,700	--
75	Little Truckee River	490	2,490	--	--	--	--	260	--	--	--	--	170	--	1,500	2,900	--	--	--	--	3,730	--	11,540	4,520
	COUNTY TOTALS	12,330	17,840	1,470	--	--	6,070	2,040	--	--	430	280	3,480	--	2,360	6,550	410	850	--	2,000	7,060	--	63,170	28,400
	Siskiyou County																							
1	Tulelake	58,970	6,100	8,910	--	--	900	300	40	--	--	40	9,320	--	1,100	250	100	1,110	--	--	--	--	87,100	--
2	Butte Valley	71,160	6,410	6,250	--	--	2,840	3,550	--	--	--	100	4,380	--	450	500	1,120	1,330	--	--	--	--	98,180	18,070
3	Klamath River	6,990	180	--	--	--	100	420	--	--	--	--	8,180	--	5,730	220	460	1,830	--	3,370	60	160	27,700	410
4	Shasta Valley	62,110	11,690	7,870	--	--	2,140	20,600	--	--	--	2,290	16,720	--	8,440	5,720	1,120	1,160	--	760	--	--	140,620	3,080
5	Scott Valley	35,750	7,880	--	--	--	--	4,970	--	--	--	--	11,480	--	1,060	70	20	1,800	--	1,660	--	--	64,690	7,390
6	Salmon River	--	--	--	--	--	--	--	--	--	--	--	400	--	--	--	--	150	--	--	--	--	550	--
15	Big Valley	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
16	McArthur	230	1,610	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1,840	88,870
19	McCloud River	1,650	340	--	--	--	--	30	--	--	--	--	130	--	--	--	--	--	--	--	--	--	2,150	91,840
20	Dunsmuir	1,220	860	--	--	--	240	90	--	--	--	--	3,090	--	2,510	120	--	580	--	880	--	--	9,590	4,870
	COUNTY TOTALS	238,080	35,070	23,030	--	--	6,220	29,960	--	--	--	2,430	53,700	--	19,290	6,880	2,910	7,690	--	6,670	60	160	432,420	214,530
	Sutter County																							
56	Colusa	48,680	--	210	36,450	--	23,060	--	--	--	--	--	20	--	--	--	--	--	--	--	--	--	108,420	--
57	Gridley	37,650	--	50	--	120	18,470	--	--	--	1,440	--	440	--	880	--	--	--	--	--	--	--	59,050	--
61	Sutter	46,240	180	--	730	1,030	28,400	--	--	--	--	--	--	--	20	--	--	--	--	--	--	--	76,600	--
62	Marysville	9,790	--	--	--	460	16,460	--	--	--	--	--	--	--	50	--	--	--	--	--	--	--	26,760	--
63	Pleasant Grove	4,300	--	--	2,870	--	11,140	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	18,310	--
67	East Yolo	18,550	--	--	3,330	--	22,190	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	44,070	--
	COUNTY TOTALS	165,210	180	260	43,380	1,610	119,720	--	--	--	1,440	--	460	--	950	--	--	--	--	--	--	--	333,210	--
	Tehama County																							
24	Cottonwood	7,700	--	--	--	710	1,570	10	--	--	--	--	7,120	--	9,100	--	70	790	--	2,730	--	--	29,800	--
26	Red Bank Creek	7,300	--	--	--	110	1,140	30	--	--	--	--	4,630	--	5,670	--	20	1,600	--	2,650	--	--	23,150	--
27	Elder Creek	1,590	--	--	--	--	450	--	--	--	--	--	880	--	1,610	--	--	350	--	1,720	--	--	6,600	--
28	Thomes Creek	7,820	--	--	--	--	2,820	140	--	--	--	--	3,580	--	5,430	30	--	1,420	--	6,020	--	--	27,260	110
29	Stony Creek	1,930	--	--	--	--	--	50	--	--	--	--	890	--	1,100	--	--	100	--	1,380	--	--	5,450	--
35	Battle Creek	530	1,240	--	--	--	--	140	--	--	--	180	6,210	--	--	280	4,230	520	--	--	1,060	70	14,460	11,450
36	Paynes Creek	1,040	--	--	--	--	--	580	--	--	--	530	590	--	160	600	400	50	--	--	10	20	3,980	4,220
37	Antelope Creek	320	160	--	--	--	--	260	--	--	--	980	60	--	--	190	360	--	--	--	--	--	2,330	18,950
38	Mill Creek	750	--	--	--	--	--	300	--	--	--	10	--	--	--	40	70	--	--	--	--	--	1,170	6,810
39	Deer Creek	1,580	--	--	--	--	--	--	--	--	--	90	60	--	--	20	--	--	--	--	--	--	1,750	19,360
40	Chico Creek	--	10	--	--	--	--	80	--	--	--	90	--	--	--	30	40	--	--	--	--	--	250	6,610
50	Anderson	7,240	--	--	--	190	640	900	--	--	--	410	860	--	780	200	250	--	--	120	--	--	11,590	--
51	Corning	65,770	30	--	--	20	58,700	2,460	--	--	--	--	1,980	--	41,900	100	--	270	--	6,100	--	1,190	178,520	--
52	Los Molinos	31,220	10	--	--	140	3,130	5,500	--	--	--	14,720	140	--	60	10	540	--	--	--	--	10	55,480	--
53	Fruto	20	--	--	--	--	--	--	--	--	--	--	--	--	140	--	--	--	--	170	--	--	330	--
54	Orland	880	--	--	--	--	680	--	--	--	--	--	--	--	90	--	--	--	--	40	--	--	1,690	--
	COUNTY TOTALS	135,690	1,450	--	--	1,170	69,130	10,450	--	--	--	17,010	27,000	--	66,040	1,500	5,980	5,100	--	20,930	1,070	1,290	363,810	67,510

TABLE 35—Continued

CLASSIFICATION OF IRRIGABLE LANDS WITHIN THE NORTHEASTERN COUNTIES

(In acres)

County and hydrographic unit		Irrigable valley land classes											Irrigable hill land classes										Gross irrigable area	Irrigable lands best suited to forest management
Reference number	Name	V	Vw	Vs	Vh	Vl	Vp	Vr	Vhs	Vls	Vps	Vpr	H	Hl	Hp	Hr	Hpr	Ht	Htl	Htp	Htr	Htpr		
	Trinity County																							
7	Upper Trinity River	80	--	--	--	--	--	130	--	--	--	--	150	--	--	--	--	--	--	--	--	--	360	660
8	Lower Trinity River	80	--	--	--	--	--	10	--	--	--	--	2,390	--	--	40	--	460	--	--	--	--	2,980	--
9	South Fork Trinity River	2,260	--	--	--	--	--	370	--	--	--	--	4,490	--	100	--	--	330	--	--	--	--	7,550	2,600
10	South Trinity County	2,220	50	--	--	610	450	300	--	--	--	--	680	--	70	10	--	30	--	--	--	--	4,420	5,310
	COUNTY TOTALS	4,640	50	--	--	610	450	810	--	--	--	--	7,710	--	170	50	--	820	--	--	--	--	15,310	8,570
	Yolo County																							
30	Clear Lake	70	--	--	--	--	--	--	--	--	--	--	170	--	--	--	--	--	--	--	--	--	240	--
56	Colusa	7,900	--	10	29,240	--	--	--	180	--	--	--	--	--	--	--	--	--	--	--	--	--	37,330	--
59	Cortina	5,240	--	--	--	--	2,970	--	--	--	--	--	6,980	--	4,580	--	--	2,730	--	5,370	--	--	27,870	--
60	Arbuckle	23,230	--	--	10,520	--	3,940	--	450	--	80	--	580	--	280	--	--	40	--	40	--	--	39,160	--
64	West Yolo	3,850	--	--	--	--	60	--	--	--	--	--	1,790	--	420	--	--	2,310	--	1,730	40	--	10,200	--
65	Capay	8,610	--	--	--	--	--	20	--	--	--	--	2,850	--	--	20	--	1,180	--	--	--	--	12,680	--
66	Woodland	136,060	--	3,490	31,440	--	710	--	8,140	--	--	--	4,250	--	7,790	--	--	1,460	--	1,160	--	--	194,500	--
67	East Yolo	45,650	--	490	66,490	--	610	--	10,350	--	--	--	--	--	--	--	--	--	--	--	--	--	123,590	--
	COUNTY TOTALS	230,610	--	3,990	137,690	--	8,290	20	19,120	--	80	--	16,620	--	13,070	20	--	7,720	--	8,300	40	--	445,570	--
	Yuba County																							
46	South Fork Feather River	--	--	--	--	--	--	--	--	--	--	--	40	--	--	--	--	--	--	--	--	--	40	300
47	North Yuba River	10	--	--	--	--	--	--	--	--	--	--	280	--	--	--	--	720	--	--	--	--	1,010	11,230
48	Challenge	650	--	--	--	--	20	110	--	--	--	--	3,820	--	890	3,250	1,450	2,480	--	3,360	1,970	1,680	19,680	10,860
58	Browns Valley	540	90	--	--	--	460	--	--	--	--	--	90	--	9,310	--	1,730	140	--	8,250	--	1,320	21,930	--
62	Marysville	41,930	50	--	--	1,860	83,160	--	--	--	--	20	180	10	30,770	40	3,150	--	--	7,260	--	3,990	172,420	--
	COUNTY TOTALS	43,130	140	--	--	1,860	83,640	110	--	--	--	20	4,410	10	40,970	3,290	6,330	3,340	--	18,870	1,970	6,990	215,080	22,390
	AREA TOTALS	1,622,320	210,340	175,940	515,520	61,980	609,810	55,650	153,040	12,150	19,460	31,940	324,460	27,720	361,960	62,700	59,900	89,050	6,190	126,620	27,320	21,210	4,575,280	1,220,660

Young Walnut Orchard
in Tehama County

United States Bureau of Reclamation Photograph

Meadow Hay in Modoc County

Department of Water Resources Photograph

TABLE 36

PROBABLE ULTIMATE PATTERN OF IRRIGATED LAND USE WITHIN HYDROGRAPHIC UNITS, NORTHEASTERN COUNTIES

(In acres)

Hydrographic unit		Irrigated lands									
Reference number	Name	Alfalfa	Pasture: Improved	Pasture: Meadow	Grain and grain hay	Truck	Field Crops	Deciduous orchard	Subtropical orchard	Rice	Total irrigated
	North Coastal Drainage Basin										
1	Tule Lake	14,600	12,000	11,600	56,300	22,500	6,500	0	0	0	123,500
2	Butte Valley	23,400	7,000	3,900	18,600	12,400	15,300	0	0	0	80,600
3	Klamath River	5,500	10,100	200	2,700	200	500	100	0	0	19,300
4	Shasta Valley	43,900	29,100	10,200	15,100	2,100	4,900	0	0	0	105,300
5	Scott Valley	17,500	15,000	6,900	12,400	400	600	0	0	0	52,800
6	Salmon River	0	400	0	0	0	0	0	0	0	400
7	Upper Trinity River	100	200	0	0	0	0	0	0	0	300
8	Lower Trinity River	500	1,300	0	200	100	0	100	0	0	2,200
9	South Fork Trinity River	1,800	2,800	0	900	100	200	100	0	0	5,900
10	Southern Trinity County	900	2,000	0	800	0	0	0	0	0	3,700
11	Lake Pillsbury	0	0	0	0	0	0	0	0	0	0
	SUBTOTALS	108,200	79,900	32,800	107,000	37,800	28,000	300	0	0	394,000
	Central Valley Drainage Basin										
12	Goose Lake	6,400	19,800	4,000	2,800	1,200	1,000	0	0	0	35,200
13	Jess Valley	0	2,700	4,300	0	0	0	0	0	0	7,000
14	Alturas	16,500	77,400	15,000	5,700	400	2,200	0	0	0	117,200
15	Big Valley	23,000	39,700	6,700	19,300	3,000	18,000	0	0	0	109,700
16	McArthur	16,200	20,500	15,200	5,600	600	2,800	0	0	0	60,900
17	Hat Creek	5,300	6,500	4,000	2,900	0	500	0	0	0	19,200
18	Montgomery Creek	800	2,600	100	400	100	0	1,300	0	0	5,300
19	McCloud River	700	1,700	300	0	0	0	0	0	0	2,700
20	Dunsmuir	600	6,700	800	200	100	100	400	0	0	8,900
21	Shasta Lake	200	900	0	0	400	0	200	0	0	1,700
22	Clear Creek	0	200	0	0	0	0	0	0	0	200
23	Keswick	0	0	0	0	0	0	0	0	0	0
24	Cottonwood Creek	8,700	23,100	0	3,500	700	2,600	3,900	0	0	42,500
25	Olinda	700	5,000	0	700	100	400	1,500	0	0	8,400
26	Redbank Creek	5,400	8,600	0	1,800	400	1,200	900	0	0	18,300
27	Elder Creek	1,000	2,400	0	600	200	500	300	0	0	5,000
28	Thomes Creek	4,700	9,300	0	2,500	800	2,900	600	300	0	21,100
29	Stony Creek	10,000	17,200	0	5,300	600	6,500	4,000	300	0	43,900
30	Clear Lake	13,000	20,000	900	3,000	600	3,000	28,700	0	0	69,200
31	Middletown	1,600	4,100	0	1,800	1,200	1,400	1,900	0	0	12,000
32	Stillwater Plains	2,300	19,700	0	2,900	500	1,500	2,800	0	0	29,700
33	Cow Creek	8,000	18,900	100	2,000	400	1,600	7,500	0	0	38,500
34	Bear Creek	2,100	10,500	0	1,300	200	900	1,900	0	0	16,900
35	Battle Creek	2,100	11,300	1,700	400	100	500	3,500	0	0	19,600
36	Paynes Creek	1,000	1,800	200	0	0	0	200	0	0	3,200
37	Antelope Creek	200	1,300	100	0	0	0	100	0	0	1,700
38	Mill Creek	0	300	700	0	0	0	0	0	0	1,000
39	Deer Creek	0	100	1,600	0	0	0	0	0	0	1,700
40	Chico Creek	0	1,700	100	0	0	0	300	0	0	2,100
41	Paradise	400	8,000	0	300	200	0	8,100	3,600	0	20,600
42	North Fork Feather River	900	9,000	6,600	600	0	0	800	600	0	18,500
43	East Branch Feather River	2,200	12,400	8,500	2,000	2,200	0	1,800	0	0	29,100
44	Sierra Valley	14,200	41,400	23,400	9,100	9,400	0	0	0	0	97,500
45	Middle Fork Feather River	500	8,100	2,800	400	200	0	200	0	0	12,200
46	South Fork Feather River	0	600	0	0	0	0	200	0	0	800
47	North Yuba River	800	500	800	0	0	0	300	0	0	2,400
48	Challenge	200	9,600	0	200	200	0	1,300	1,800	0	13,300
49	Wyandotte	300	21,800	0	300	300	0	1,400	7,000	0	31,100
50	Anderson	6,800	18,600	0	1,800	600	1,700	1,900	0	0	31,400
51	Corning	21,800	50,300	0	15,200	6,500	24,600	21,900	8,000	0	148,300
52	Los Molinos	15,300	29,500	0	5,300	6,000	19,000	23,000	2,000	0	100,100
53	Fruto	5,700	21,900	0	9,400	3,000	5,700	3,900	1,400	0	51,000
54	Orland	18,400	27,600	0	12,100	6,700	24,900	12,000	3,100	8,700	113,500
55	Durham	4,400	11,300	0	4,000	2,500	19,000	20,000	1,000	23,000	85,200
56	Colusa	37,200	49,200	0	22,600	56,300	55,100	62,500	0	202,600	485,500
57	Gridley	7,700	50,000	0	7,900	12,000	20,300	35,000	1,400	92,200	226,500
58	Browns Valley	100	13,900	100	300	100	100	700	400	0	15,700
59	Cortina	11,200	27,100	0	5,800	6,800	8,900	11,900	0	0	71,700
60	Arbuckle	15,700	13,000	0	6,000	20,800	26,300	14,600	0	14,300	110,700
61	Sutter	1,900	3,500	0	1,500	6,000	3,000	35,000	0	17,600	68,500
62	Marysville	6,900	61,900	0	6,500	5,600	11,600	32,100	1,100	36,000	161,700
63	Pleasant Grove	1,700	3,900	0	1,000	500	2,000	500	0	6,000	15,600
64	West Yolo	1,700	2,800	0	700	600	900	1,400	0	0	8,100
65	Capay	2,400	1,700	0	600	1,400	1,800	2,900	0	0	10,800
66	Woodland	25,700	16,000	0	4,300	53,700	45,100	7,600	0	18,200	170,600
67	East Yolo	11,400	18,000	0	1,000	27,500	40,400	13,800	0	34,700	146,800
	SUBTOTALS	346,090	865,600	98,000	181,600	240,700	358,000	374,800	32,000	453,300	2,950,000

TABLE 36—Continued

PROBABLE ULTIMATE PATTERN OF IRRIGATED LAND USE WITHIN HYDROGRAPHIC UNITS, NORTHEASTERN COUNTIES

(In acres)

Hydrographic unit		Irrigated lands									
Reference number	Name	Alfalfa	Pasture		Grain and grain hay	Truck	Field Crops	Deciduous orchard	Sub-tropical orchard	Rice	Total irrigated
			Improved	Meadow							
	Lahontan Drainage Basin										
68	Surprise Valley	29,700	38,100	10,800	12,400	1,000	6,100	0	0	0	98,100
69	Madeline Plains	11,500	108,600	5,100	17,800	0	0	0	0	0	143,000
70	Eagle Lake	500	600	3,400	100	0	0	0	0	0	4,600
71	Willow Creek	700	6,700	3,200	200	0	0	0	0	0	10,800
72	Secret Valley	1,400	11,500	2,100	1,700	100	700	0	0	0	17,500
73	Susan River	21,800	11,600	9,200	13,800	5,000	14,000	0	0	0	75,400
74	Herlong	29,000	27,300	800	18,300	4,000	16,300	0	0	0	95,700
75	Little Truckee River	300	6,100	2,300	0	0	0	0	0	0	8,700
	SUBTOTALS	94,900	210,500	36,900	64,300	10,100	37,100	0	0	0	453,800
	TOTALS, NORTHEASTERN COUNTIES	549,100	1,156,000	167,700	352,900	288,600	423,100	375,100	32,000	453,300	3,797,800

In some parts of the Sacramento Valley, climatic conditions are favorable for the production of subtropical orchards, such as citrus, olives and figs. This is most significant in the Oroville-Wyandotte area and in the vicinity of Orland and Corning. Rather extensive plantings of orange and olive orchards exist at the present time in these areas and could be expected to expand considerably in the future.

In the probable ultimate pattern, the various crop categories are comprised of the same crops as in the present pattern of land use.

The future crop pattern may be influenced to some extent by Federal supports for certain commodities and acreage limitations imposed as a result of such price support plans. However, even though there may be considerable variances between years in any given period of time due to economic and other factors, the ultimate crop pattern as projected appears reasonable in view of foreseeable activities and adequate for purposes of determining the water requirements.

Results of the probable ultimate crop pattern projected for the Northeastern Counties are presented in Table 36, segregated by hydrographic units. Table 37 presents the results segregated by counties.

Urban Lands

Present urban lands include the developed areas of cities and towns, sawmills, small communities, industrial areas, and resorts. These urban areas are gross delineations of the presently developed area including homes, business districts, streets, vacant lots, industrial areas, etc., and are not limited by municipal boundaries or any specific density of development. The delineation was made during the course of the field survey of presently irrigated and irrigable land. The acreages of present urban lands for each hydrographic unit and county are tabulated in Tables 31 and 32.

Although the ultimate urban water requirement was determined on a population basis, the area of land which is suitable for urban and suburban development was determined by the consulting firm of Pacific Planning and Research. As evidenced by present development, this use may occur on the best irrigable land, dredger tailings or steep slopes. The areas which would probably become urbanized were delineated on quadrangle maps after a review of the character, location and potential of each urban center. Included as urban and suburban areas would be those lands occupied by commercial, industrial, and residential developments, and, in addition, surrounding suburbs, although these latter may have low population densities. They include individual homesites up to approximately five acres. The areas are delineated on Plate A-3, Appendix A, "Future Population, Economic and Recreation Development of California's Northeastern Counties," and encroach to a limited extent on lands classified as irrigable.

The areas of ultimate urban and suburban lands shown on Tables 38 and 39 represent only the areas that would be more compactly developed with population densities ranging from two to six persons per acre. Estimates of areas of ultimate urban and suburban land were prepared from the population and urban land use data compiled by Pacific Planning and Research.

TABLE 37

PROBABLE ULTIMATE PATTERN OF IRRIGATED LAND USE WITHIN THE NORTHEASTERN COUNTIES

(In acres)

County and hydrographic unit		Irrigated lands									
Reference number	Name	Alfalfa	Pasture		Grain and grain hay	Truck	Field crops	Deciduous orchard	Subtropical orchard	Rice	Total irrigated
			Improved	Meadow							
	Butte County										
40	Chico Creek	0	1,500	100	0	0	0	300	0	0	1,900
41	Paradise	400	8,000	0	300	200	0	8,100	3,600	0	20,600
42	North Fork Feather River	0	3,000	0	0	0	0	800	600	0	4,400
45	Middle Fork Feather River	0	600	0	0	0	0	200	0	0	800
46	South Fork Feather River	0	500	0	0	0	0	200	0	0	700
48	Challenge	0	0	0	0	0	0	0	0	0	0
49	Wyandotte	300	21,800	0	300	300	0	1,400	7,000	0	31,100
52	Los Molinos	8,200	12,300	0	3,300	4,000	14,000	10,500	1,500	0	53,800
55	Durham	4,400	11,300	0	4,000	2,500	19,000	20,000	1,000	23,000	85,200
57	Gridley	4,500	43,100	0	5,000	4,000	17,000	13,000	1,400	72,000	160,000
	COUNTY TOTALS	17,800	102,100	100	12,900	11,000	50,000	54,500	15,100	95,000	358,500
	Colusa County										
29	Stony Creek	2,800	5,800	0	1,400	300	1,300	800	0	0	12,400
30	Clear Lake	1,900	3,500	500	1,200	0	800	500	0	0	8,400
53	Fruto	0	0	0	0	0	0	0	0	0	0
56	Colusa	15,000	23,100	0	9,000	25,000	25,000	28,500	0	103,000	228,600
57	Gridley	0	0	0	0	0	0	0	0	1,600	1,600
59	Cortina	8,400	16,200	0	3,700	6,800	6,000	7,600	0	0	48,700
60	Arbuckle	10,700	8,600	0	4,900	13,800	16,700	12,300	0	9,200	76,200
	COUNTY TOTALS	38,800	57,200	500	20,200	45,900	49,800	49,700	0	113,800	375,900
	Glenn County										
11	Lake Pillsbury	0	0	0	0	0	0	0	0	0	0
29	Stony Creek	6,000	9,900	0	3,100	200	4,600	3,100	300	0	27,200
53	Fruto	5,700	21,700	0	9,400	3,000	5,700	3,900	1,400	0	50,800
54	Orland	17,900	27,100	0	12,100	6,700	24,500	12,000	3,100	8,700	112,100
56	Colusa	13,200	16,000	0	10,600	9,600	12,600	16,200	0	50,600	128,800
57	Gridley	0	1,700	0	1,900	0	1,300	0	0	8,600	13,500
59	Cortina	0	800	0	200	0	0	0	0	0	1,000
	COUNTY TOTALS	42,800	77,200	0	37,300	19,500	48,700	35,200	4,800	67,900	333,400
	Lake County										
11	Lake Pillsbury	0	0	0	0	0	0	0	0	0	0
29	Stony Creek	0	0	0	0	0	0	0	0	0	0
30	Clear Lake	11,100	16,300	400	1,800	600	2,200	28,200	0	0	60,600
31	Middletown	1,600	4,100	0	1,800	1,200	1,400	1,900	0	0	12,000
	COUNTY TOTALS	12,700	20,400	400	3,600	1,800	3,600	30,100	0	0	72,600
	Lassen County										
13	Jess Valley	0	700	1,100	0	0	0	0	0	0	1,800
14	Alturas	0	0	0	0	0	0	0	0	0	0
15	Big Valley	14,000	23,500	4,500	11,500	2,000	11,000	0	0	0	66,500
16	McArthur	3,800	8,900	3,800	1,200	100	400	0	0	0	18,200
17	Hat Creek	100	300	0	100	0	0	0	0	0	500
42	North Fork Feather River	600	3,100	4,700	300	0	0	0	0	0	8,700
68	Surprise Valley	700	1,700	600	400	0	100	0	0	0	3,500
69	Madeline Plains	11,500	108,600	5,100	17,800	0	0	0	0	0	143,000
70	Eagle Lake	500	600	3,400	100	0	0	0	0	0	4,600
71	Willow Creek	700	6,700	3,200	200	0	0	0	0	0	10,800
72	Secret Valley	1,400	11,500	2,100	1,700	100	700	0	0	0	17,500
73	Susan River	21,800	11,600	9,200	13,800	5,000	14,000	0	0	0	75,400
74	Herlong	28,100	23,900	800	18,000	4,000	16,000	0	0	0	90,800
	COUNTY TOTALS	83,200	201,100	38,500	65,100	11,200	42,200	0	0	0	441,300
	Modoc County										
1	Tulelake	5,800	7,300	6,300	24,300	10,600	1,100	0	0	0	55,400
12	Goose Lake	6,400	19,800	4,000	2,800	1,200	1,000	0	0	0	35,200
13	Jess Valley	0	2,000	3,200	0	0	0	0	0	0	5,200
14	Alturas	16,500	77,400	15,000	5,700	400	2,200	0	0	0	117,200
15	Big Valley	9,000	16,200	2,200	7,800	1,000	7,000	0	0	0	43,200
16	McArthur	400	300	2,400	200	0	400	0	0	0	3,700
68	Surprise Valley	29.000	36,400	10,200	12,000	1,000	6.000	0	0	0	94,600
	COUNTY TOTALS	67,100	159,400	43,300	52,800	14,200	17,700	0	0	0	354,500
	Plumas County										
40	Chico Creek	0	0	0	0	0	0	0	0	0	0
42	North Fork Feather River	300	2,900	1,900	300	0	0	0	0	0	5,400
43	East Branch Feather River	2,200	12,400	8,500	2,000	2,200	0	1,800	0	0	29,100

TABLE 37—Continued

PROBABLE ULTIMATE PATTERN OF IRRIGATED LAND USE WITHIN THE NORTHEASTERN COUNTIES

(In acres)

County and hydrographic unit		Irrigated lands									
Reference number	Name	Alfalfa	Pasture		Grain and grain hay	Truck	Field crops	Deciduous orchard	Subtropical orchard	Rice	Total irrigated
			Improved	Meadow							
	Plumas County—Continued										
44	Sierra Valley	8,900	29,000	10,300	5,800	7,900	0	0	0	0	61,900
45	Middle Fork Feather River	500	7,500	2,800	400	200	0	0	0	0	11,400
46	South Fork Feather River	0	100	0	0	0	0	0	0		100
47	North Yuba River	0	0	0	0	0	0	0	0	0	0
73	Susan River	0	0	0	0	0	0	0	0	0	0
74	Herlong	0	0	0	0	0	0	0	0	0	0
	COUNTY TOTALS	11,900	51,900	23,500	8,500	10,300	0	1,800	0	0	107,900
	Shasta County										
16	McArthur	12,000	11,100	7,500	4,200	500	2,000	0	0	0	37,300
17	Hat Creek	5,200	6,200	4,000	2,800	0	500	0	0	0	18,700
18	Montgomery Creek	800	2,600	100	400	100	0	1,300	0	0	5,300
19	McCloud River	300	500	0	0	0	0	0	0	0	800
20	Dunsmuir	100	700	0	0	100	100	400	0	0	1,400
21	Shasta Lake	200	900	0	0	400	0	200	0	0	1,700
22	Clear Creek	0	200	0	0	0	0	0	0	0	200
23	Keswick	0	0	0	0	0	0	0	0	0	0
24	Cottonwood Creek	1,400	11,600	0	1,400	400	900	3,200	0	0	18,900
25	Olinda	700	5,000	0	700	100	400	1,500	0	0	8,400
32	Stillwater Plains	2,300	19,700	0	2,900	500	1,500	2,800	0	0	29,700
33	Cow Creek	8,000	18,900	100	2,000	400	1,600	7,500	0	0	38,500
34	Bear Creek	2,100	10,500	0	1,300	200	900	1,900	0	0	16,900
35	Battle Creek	600	5,100	600	400	100	500	1,200	0	0	8,500
38	Mill Creek	0	0	0	0	0	0	0	0	0	0
42	North Fork Feather River	0	0	0	0	0	0	0	0	0	0
50	Anderson	4,600	13,400	0	900	300	1,000	1,400	0	0	21,600
	COUNTY TOTALS	38,300	106,400	12,300	17,000	3,100	9,400	21,400	0	0	207,900
	Sierra County										
44	Sierra Valley	5,300	12,400	13,100	3,300	1,500	0	0	0	0	35,600
45	Middle Fork Feather River	0	0	0	0	0	0	0	0	0	0
47	North Yuba River	800	0	800	0	0	0	0	0	0	1,600
74	Herlong	900	3,400	0	300	0	300	0	0	0	4,900
75	Little Truckee River	300	6,100	2,300	0	0	0	0	0	0	8,700
	COUNTY TOTALS	7,300	21,900	16,200	3,600	1,500	300	0	0	0	50,800
	Siskiyou County										
1	Tulelake	8,800	4,700	5,300	32,000	11,900	5,400	0	0	0	68,100
2	Butte Valley	23,400	7,000	3,900	18,600	12,400	15,300	0	0	0	80,600
3	Klamath River	5,500	10,100	200	2,700	200	500	100	0	0	19,300
4	Shasta Valley	43,900	29,100	10,200	15,100	2,100	4,900	0	0	0	105,300
5	Scott Valley	17,500	15,000	6,900	12,400	400	600	0	0	0	52.800
6	Salmon River	0	400	0	0	0	0	0	0	0	400
15	Big Valley	0	0	0	0	0	0	0	0	0	0
16	McArthur	0	200	1,500	0	0	0	0	0	0	1,700
19	McCloud River	400	1,200	300	0	0	0	0	0	0	1,900
20	Dunsmuir	500	6,000	800	200	0	0	0	0	0	7,500
	COUNTY TOTALS	100,000	73,700	29,100	81,000	27,000	26,700	100	0	0	337,600
	Sutter County										
56	Colusa	8,000	5,200	0	3,000	20,000	10,000	15,000	0	34,000	95,200
57	Gridley	3,200	5,200	0	1,000	8,000	2,000	22,000	0	10,000	51,400
61	Sutter	1,900	3,500	0	1,500	6,000	3,000	35,000	0	17,600	68,500
62	Marysville	1,100	4,900	0	1,000	500	1,500	8,000	0	6,000	23,000
63	Pleasant Grove	1,700	3,900	0	1,000	500	2,000	500	0	6,000	15,600
67	East Yolo	3,000	4,100	0	1,000	5,000	5,000	8,000	0	12,000	38,100
	COUNTY TOTALS	18,900	26,800	0	8,500	40,000	23,500	88,500	0	85,600	291,800
	Tehama County										
24	Cottonwood	7,300	11,500	0	2,100	300	1,700	700	0	0	23,600
26	Red Bank Creek	5,400	8,600	0	1,800	400	1,200	900	0	0	18,300
27	Elder Creek	1,000	2,400	0	600	200	500	300	0	0	5,000
28	Thomes Creek	4,700	9,300	0	2,500	800	2,900	600	300	0	21,100
29	Stony Creek	1,200	1,500	0	800	100	600	100	0	0	4,300
35	Battle Creek	1,500	6,200	1,100	0	0	0	2,300	0	0	11,100
36	Paynes Creek	1,000	1,800	200	0	0	0	200	0	0	3,200
37	Antelope Creek	200	1,300	100	0	0	0	100	0	0	1,700
38	Mill Creek	0	300	700	0	0	0	0	0	0	1,000
39	Deer Creek	0	100	1,600	0	0	0	0	0	0	1,700
40	Chico Creek	0	200	0	0	0	0	0	0	0	200

TABLE 37—Continued

PROBABLE ULTIMATE PATTERN OF IRRIGATED LAND USE WITHIN THE NORTHEASTERN COUNTIES

(In acres)

County and hydrographic unit		Irrigated lands									
Reference number	Name	Alfalfa	Pasture		Grain and grain hay	Truck	Field Crops	Deciduous orchard	Sub-tropical orchard	Rice	Total irrigated
			Improved	Meadow							
	Tehama County—Continued										
50	Anderson	2,200	5,200	0	900	300	700	500	0	0	9,800
51	Corning	21,800	50,300	0	15,200	6,500	24,600	21,900	8,000	0	148,300
52	Los Molinos	7,100	17,200	0	2,000	2,000	5,000	12,500	500	0	46,300
53	Fruto	0	200	0	0	0	0	0	0	0	200
54	Orland	500	500	0	0	0	400	0	0	0	1,400
	COUNTY TOTALS	53,900	116,600	3,700	25,900	10,600	37,600	40,100	8,800	0	297,200
	Trinity County										
7	Upper Trinity River	100	200	0	0	0	0	0	0	0	300
8	Lower Trinity River	500	1,300	0	200	100	0	100	0	0	2,200
9	South Fork Trinity River	1,800	2,800	0	900	100	200	100	0	0	5,900
10	Southern Trinity County	900	2,000	0	800	0	0	0	0	0	3,700
	COUNTY TOTALS	3,300	6,300	0	1,900	200	200	200	0	0	12,100
	Yolo County										
30	Clear Lake	0	200	0	0	0	0	0	0	0	200
56	Colusa	1,000	4,900	0	0	1,700	7,500	2,800	0	15,000	32,900
59	Cortina	2,800	10,100	0	1,900	0	2,900	4,300	0	0	22,000
60	Arbuckle	5,000	4,400	0	1,100	7,000	9,600	2,300	0	5,100	34,500
64	West Yolo	1,700	2,800	0	700	600	900	1,400	0	0	8,100
65	Capay	2,400	1,700	0	600	1,400	1,800	2,900	0	0	10,800
66	Woodland	25,700	16,000	0	4,300	53,700	45,100	7,600	0	18,200	170,600
67	East Yolo	8,400	13,900	0	0	22,500	35,400	5,800	0	22,700	108,700
	COUNTY TOTALS	47,000	54,000	0	8,600	86,900	103,200	27,100	0	61,000	387,800
	Yuba County										
46	South Fork Feather River	0	0	0	0	0	0	0	0	0	0
47	North Yuba River	0	500	0	0	0	0	300	0	0	800
48	Challenge	200	9,600	0	200	200	0	1,300	1,800	0	13,300
58	Brown Valley	100	13,900	100	300	100	100	700	400	0	15,700
62	Marysville	5,800	57,000	0	5,500	5,100	10,100	24,100	1,100	30,000	138,700
	COUNTY TOTALS	6,100	81,000	100	6,000	5,400	10,200	26,400	3,300	30,000	168,500
	TOTALS, NORTH-EASTERN COUNTIES	549,100	1,156,000	167,700	352,900	288,600	423,100	375,100	32,000	453,300	3,797,800

Urban and Suburban Areas *Department of Water Resources Photographs*

TABLE 38

PROBABLE ULTIMATE PATTERN OF URBAN AND SUBURBAN, AND RECREATIONAL LAND USE WITHIN HYDROGRAPHIC UNITS, NORTHEASTERN COUNTIES

(In acres)

Hydrographic unit		Urban and suburban areas	High intensity recreational areas	Medium intensity recreational areas	Low intensity recreational areas	Principal reservoirs	Swamp and marsh lands
Reference number	Name						
	North Coastal Drainage Basin						
1	Tule Lake	1,200	123,400	1,300	981,800	36,600	8,200
2	Butte Valley	900	48,100	2,800	279,500	3,400	100
3	Klamath River	1,600	163,400	223,500	17,200	31,300	0
4	Shasta Valley	7,800	59,600	27,200	171,000	5,200	1,300
5	Scott Valley	2,400	92,400	70,500	0	1,800	100
6	Salmon River	200	58,000	128,800	0	3,800	0
7	Upper Trinity River	500	149,400	133,600	0	13,100	0
8	Lower Trinity River	2,000	225,700	174,500	0	26,500	0
9	South Fork Trinity River	700	192,900	60,800	0	6,400	0
10	Southern Trinity County	0	120,600	34,000	0	6,000	0
11	Lake Pillsbury	0	120,900	8,000	29,900	1,600	0
	SUBTOTALS	17,300	1,354,400	865,000	1,479,400	135,700	9,700
	Central Valley Drainage Basin						
12	Goose Lake	200	96,300	0	47,100	200	0
13	Jess Valley	0	46,700	20,200	51,300	4,400	0
14	Alturas	4,100	120,800	16,100	459,200	14,300	100
15	Big Valley	2,800	207,100	0	334,000	7,800	1,300
16	McArthur	3,000	120,400	46,500	227,700	5,800	700
17	Hat Creek	2,400	232,900	28,000	265,100	1,200	600
18	Montgomery Creek	0	117,600	0	51,900	1,200	[a]
19	McCloud River	400	149,200	7,100	64,400	2,900	0
20	Dunsmuir	4,500	141,000	39,500	15,800	300	0
21	Shasta Lake	0	256,300	0	400	27,500	0
22	Clear Creek	0	124,500	0	400	5,900	0
23	Keswick	0	23,900	0	0	600	0
24	Cottonwood Creek	0	218,400	61,800	257,100	17,600	0
25	Olinda	0	5,700	0	13,200	1,700	0
26	Redbank Creek	3,000	26,900	0	69,600	0	0
27	Elder Creek	0	45,400	1,400	14,400	4,000	0
28	Thomes Creek	200	92,500	16,100	74,400	1,000	0
29	Stony Creek	0	239,400	47,400	20,000	14,300	100
30	Clear Lake	8,400	468,000	0	9,400	53,100	1,000
31	Middletown	1,200	88,600	0	0	2,700	0
32	Stillwater Plains	8,900	2,400	0	0	[a]	0
33	Cow Creek	1,200	178,600	0	10,100	4,800	[a]
34	Bear Creek	0	35,100	0	31,700	[a]	0
35	Battle Creek	100	172,400	0	47,600	700	[a]
36	Paynes Creek	0	58,800	0	20,000	1,500	0
37	Antelope Creek	0	127,100	8,300	15,200	0	0
38	Mill Creek	0	76,600	33,300	2,000	200	0
39	Deer Creek	0	158,500	24,700	0	2,000	0
40	Chico Creek	1,000	114,900	0	0	1,400	0
41	Paradise	7,000	22,100	0	0	3,200	[a]
42	North Fork Feather River	4,000	528,500	10,500	34,500	45,200	0
43	East Branch Feather River	3,200	456,000	97,900	20,500	12,000	0
44	Sierra Valley	3,200	158,300	32,600	11,300	2,400	0
45	Middle Fork Feather River	3,200	370,100	51,300	0	7,500	0
46	South Fork Feather River	1,600	97,800	0	0	3,700	0
47	North Yuba River	1,400	351,100	0	0	3,600	0
48	Challenge	1,200	118,100	0	0	2,300	0
49	Wyandotte	12,000	15,000	0	0	300	0
50	Anderson	12,700	37,800	0	4,700	17,100	[a]
51	Corning	6,600	9,900	0	98,300	[a]	[a]
52	Los Molinos	6,000	62,100	0	0	5,200	0
53	Fruto	100	3,300	1,200	600	300	0
54	Orland	6,000	0	0	2,000	0	100
55	Durham	10,600	800	0	0	0	1,400
56	Colusa	8,500	73,900	0	152,900	0	6,000
57	Gridley	2,000	20,800	0	17,200	100	9,600
58	Brown's Valley	3,000	18,600	0	30,700	1,100	0
59	Cortina	0	53,600	4,600	99,800	2,000	0
60	Arbuckle	6,400	400	0	0	0	0
61	Sutter	13,400	8,100	0	3,000	0	100
62	Marysville	11,300	60,900	0	11,100	5,100	700
63	Plessant Grove	0	1,400	0	3,300	0	0
64	West Yolo	0	20,700	0	27,200	500	0
65	Capay	0	51,600	0	3,200	0	0
66	Woodland	49,300	18,100	0	7,700	0	0
67	East Yolo	7,400	32,000	0	31,700	0	[a]
	SUBTOTALS	221,500	6,337,000	548,500	2,661,700	288,700	21,700

[a] Represents less than 50 acres.

TABLE 38—Continued

PROBABLE ULTIMATE PATTERN OF URBAN AND SUBURBAN, AND RECREATIONAL LAND USE WITHIN HYDROGRAPHIC UNITS, NORTHEASTERN COUNTIES

(In acres)

Hydrographic unit: Reference number	Hydrographic unit: Name	Urban and suburban areas	High intensity recreational areas	Medium intensity recreational areas	Low intensity recreational areas	Principal reservoirs	Swamp and marsh lands
	Lahontan Drainage Basin						
68	Surprise Valley	2,400	167,300	31,900	96,300	300	500
69	Madeline	0	24,400	0	296,800	1,500	0
70	Eagle Lake	0	142,000	12,300	99,400	8,200	200
71	Willow Creek	0	40,700	0	50,400	900	400
72	Secret Valley	0	20,100	0	402,000	600	[a]
73	Susan River	10,900	120,100	1,700	183,400	5,100	1,000
74	Herlong	1,900	94,500	2,400	66,200	0	[a]
75	Little Truckee River	0	49,300	0	0	3,100	100
	SUBTOTALS	15,200	658,400	48,300	1,194,500	19,700	2,200
	TOTALS, NORTHEASTERN COUNTIES	254,000	8,349,800	1,461,800	5,335,600	444,100	33,600

[a] Represents less than 50 acres.

TABLE 39

PROBABLE ULTIMATE PATTERN OF URBAN AND SUBURBAN, AND RECREATIONAL LAND USE WITHIN THE NORTHEASTERN COUNTIES

(In acres)

County and hydrographic unit		Urban and suburban areas	High intensity recreational areas	Medium intensity recreational areas	Low intensity recreational areas	Principal reservoirs	Swamp and marsh lands
Reference number	Name						
	Butte County						
40	Chico Creek	1,000	67,200	0	0	1,400	0
41	Paradise	7,000	22,100	0	0	3,200	[a]
42	North Fork Feather River	1,000	155,800	0	0	8,700	0
45	Middle Fork Feather River	600	91,900	0	0	4,100	0
46	South Fork Feather River	1,300	66,400	0	0	3,000	0
48	Challenge	0	2,500	0	0	0	0
49	Wyandotte	12,000	15,000	0	0	300	0
52	Los Molinos	2,200	4,600	0	0	0	0
55	Durham	10,600	800	0	0	0	1,400
57	Gridley	1,800	11,300	0	9,600	100	4,100
	COUNTY TOTALS	37,500	437,600	0	9,600	20,800	5,500
	Colusa County						
29	Stony Creek	0	55,500	13,300	11,800	1,500	0
30	Clear Lake	0	52,500	0	9,400	[a]	0
53	Fruto	0	0	0	0	0	0
56	Colusa	5,700	18,800	0	93,100	0	2,600
57	Gridley	0	0	0	1,500	0	100
59	Cortina	0	39,200	4,200	69,400	2,000	0
60	Arbuckle	3,800	0	0	0	0	0
	COUNTY TOTALS	9,500	166,000	17,500	185,200	3,500	2,700
	Glenn County						
11	Lake Pillsbury	0	28,300	7,400	0	0	0
29	Stony Creek	0	143,300	32,400	0	6,900	100
53	Fruto	100	3,300	1,200	0	300	0
54	Orland	6,000	0	0	0	0	100
56	Colusa	2,000	18,500	0	32,700	0	2,900
57	Gridley	200	0	0	0	0	1,400
59	Cortina	0	500	400	0	0	0
	COUNTY TOTALS	8,300	193,900	41,400	32,700	7,200	4,500
	Lake County						
11	Lake Pillsbury	0	92,600	600	29,900	1,600	0
29	Stony Creek	0	7,400	0	0	0	0
30	Clear Lake	8,400	388,000	0	0	53,100	1,000
31	Middletown	1,200	88,600	0	0	2,700	0
	COUNTY TOTALS	9,600	576,600	600	29,900	57,400	1,000
	Lassen County						
13	Jess Valley	0	31,400	0	27,900	2,100	0
14	Alturas	0	1,500	0	0	1,200	0
15	Big Valley	2,200	63,100	0	168,400	800	200
16	McArthur	600	44,800	0	149,800	2,200	300
17	Hat Creek	0	42,800	5,500	61,500	0	0
42	North Fork Feather River	0	56,700	7,600	24,700	4,800	0
68	Surprise Valley	0	14,000	0	41,100	0	0
69	Madeline Plains	0	24,400	0	296,800	1,500	0
70	Eagle Lake	0	142,000	12,300	99,400	8,200	200
71	Willow Creek	0	40,700	0	50,400	900	400
72	Secret Valley	0	20,100	0	402,000	600	[a]
73	Susan River	10,900	117,800	1,700	183,100	5,100	1,000
74	Herlong	1,900	87,600	800	65,100	0	[a]
	COUNTY TOTALS	15,600	686,900	27,900	1,570,200	27,400	2,100
	Modoc County						
1	Tulelake	0	37,000	1,300	741,900	22,200	100
12	Goose Lake	200	96,300	0	47,100	200	0
13	Jess Valley	0	15,300	20,200	23,400	2,300	0
14	Alturas	4,100	119,300	16,100	459,200	13,000	100
15	Big Valley	600	144,000	0	158,500	7,100	1,100
16	McArthur	0	12,000	0	3,800	0	[a]
68	Surprise Valley	2,400	153,300	31,900	55,200	300	500
	COUNTY TOTALS	7,300	577,200	69,500	1,489,100	45,100	1,800

TABLE 39—Continued

PROBABLE ULTIMATE PATTERN OF URBAN AND SUBURBAN, AND RECREATIONAL LAND USE WITHIN THE NORTHEASTERN COUNTIES

(In acres)

County and hydrographic unit: Reference number	County and hydrographic unit: Name	Urban and suburban areas	High intensity recreational areas	Medium intensity recreational areas	Low intensity recreational areas	Principal reservoirs	Swamp and marsh lands
	Plumas County						
40	Chico Creek	0	1,000	0	0	0	0
42	North Fork Feather River	3,000	303,300	2,900	9,800	31,800	0
43	East Branch Feather River	3,200	456,000	97,900	20,500	12,000	0
44	Sierra Valley	600	39,800	32,600	11,300	1,500	0
45	Middle Fork Feather River	2,600	277,800	51,300	0	3,400	0
46	South Fork Feather River	300	31,000	0	0	700	0
47	North Yuba River	200	10,000	0	0	0	0
73	Susan River	0	2,300	0	300	0	0
74	Herlong	0	1,600	1,600	1,100	0	0
	COUNTY TOTALS	9,900	1,122,800	186,300	43,000	49,400	0
	Shasta County						
16	McArthur	1,200	33,200	42,000	17,800	3,700	400
17	Hat Creek	2,400	190,100	22,500	203,600	1,300	600
18	Montgomery Creek	0	117,600	0	51,900	1,200	[a]
19	McCloud River	0	54,100	2,000	3,500	1,700	0
20	Dunsmuir	0	73,100	16,800	3,100	0	0
21	Shasta Lake	0	256,300	0	400	27,500	0
22	Clear Creek	0	124,500	0	400	5,900	0
23	Keswick	0	23,900	0	0	600	0
24	Cottonwood Creek	0	66,200	16,000	127,300	2,400	0
25	Olinda	0	5,700	0	13,200	1,700	0
32	Stillwater Plains	8,900	2,400	0	0	[a]	0
33	Cow Creek	1,200	178,600	0	10,100	4,800	[a]
34	Bear Creek	0	35,100	0	31,700	[a]	0
35	Battle Creek	0	58,300	0	19,700	400	[a]
38	Mill Creek	0	3,000	0	0	0	0
42	North Fork Feather River	0	12,700	0	0	0	0
50	Anderson	12,700	9,100	0	800	6,000	[a]
	COUNTY TOTALS	26,400	1,243,900	99,300	483,500	57,200	1,000
	Sierra County						
44	Sierra Valley	2,600	118,500	0	0	800	0
45	Middle Fork Feather River	0	400	0	0	0	0
47	North Yuba River	1,200	292,600	0	0	700	0
74	Herlong	0	5,300	0	0	0	0
75	Little Truckee River	0	49,300	0	0	3,000	100
	COUNTY TOTALS	3,800	466,100	0	0	4,500	100
	Siskiyou County						
1	Tulelake	1,200	86,400	0	239,900	14,300	8,100
2	Butte Valley	900	48,100	2,800	279,500	3,400	100
3	Klamath River	1,600	163,400	223,500	17,200	31,300	0
4	Shasta Valley	7,800	59,600	27,200	171,000	5,200	1,300
5	Scott Valley	2,400	92,400	70,500	0	1,800	100
6	Salmon River	200	58,000	128,800	0	3,800	0
15	Big Valley	0	0	0	7,100	0	0
16	McArthur	1,200	30,400	4,500	56,300	0	0
19	McCloud River	400	95,100	5,100	60,900	1,200	0
20	Dunsmuir	4,500	67,900	22,700	12,700	300	0
	COUNTY TOTALS	20,200	701,300	485,100	844,600	61,300	9,600
	Sutter County						
56	Colusa	600	35,800	0	27,100	0	500
57	Gridley	0	9,500	0	6,100	0	4,000
61	Sutter	13,400	8,100	0	3,000	0	100
62	Marysville	1,300	2,600	0	1,300	0	0
63	Pleasant Grove	0	1,400	0	3,300	0	0
67	East Yolo	1,600	6,400	0	6,500	0	[a]
	COUNTY TOTALS	16,900	63,800	0	47,300	0	4,600
	Tehama County						
24	Cottonwood Creek	0	152,200	45,800	129,800	15,100	0
26	Redbank Creek	3,000	26,900	0	69,600	0	0
27	Elder Creek	0	45,400	1,400	14,400	4,000	0
28	Thomes Creek	200	92,500	16,100	74,400	1,000	0
29	Stony Creek	0	33,200	1,700	8,200	5,900	0
35	Battle Creek	100	114,100	0	27,900	300	0
36	Paynes Creek	0	58,800	0	20,000	1,500	0

TABLE 39—Continued

PROBABLE ULTIMATE PATTERN OF URBAN AND SUBURBAN, AND RECREATIONAL LAND USE WITHIN THE NORTHEASTERN COUNTIES

(In acres)

County and hydrographic unit		Urban and suburban areas	High intensity recreational areas	Medium intensity recreational areas	Low intensity recreational areas	Principal reservoirs	Swamp and marsh lands
Reference number	Name						
	Tehama County—Continued						
37	Antelope Creek	0	127,100	8,300	15,200	0	0
38	Mill Creek	0	73,600	33,300	2,000	300	0
39	Deer Creek	0	158,500	24,700	0	2,000	0
40	Chico Creek	0	46,700	0	0	0	0
50	Anderson	0	28,700	0	3,900	11,100	a
51	Corning	6,600	9,900	0	98,300	a	a
52	Los Molinos	3,800	57,500	0	0	5,200	0
53	Fruto	0	0	0	600	0	0
54	Orland	0	0	0	2,000	0	0
	COUNTY TOTALS	13,700	1,025,100	131,300	466,300	46,400	a
	Trinity County						
7	Upper Trinity River	500	149,400	133,600	0	13,100	0
8	Lower Trinity River	2,000	225,700	174,500	0	26,500	0
9	South Fork Trinity River	700	192,900	60,800	0	6,400	0
10	Southern Trinity County	0	120,600	34,000	0	6,000	0
	COUNTY TOTALS	3,200	688,600	402,900	0	52,000	0
	Yolo County						
30	Clear Lake	0	27,500	0	0	0	0
56	Colusa	200	800	0	0	0	0
59	Cortina	0	13,900	0	30,400	0	0
60	Arbuckle	2,600	400	0	0	0	0
64	West Yolo	0	20,700	0	27,200	500	0
65	Capay	0	51,600	0	3,200	0	0
66	Woodland	49,300	18,100	0	7,700	0	0
67	East Yolo	5,800	25,600	0	25,200	0	a
	COUNTY TOTALS	57,900	158,600	0	93,700	500	a
	Yuba County						
46	South Fork Feather River	0	400	0	0	0	0
47	North Yuba River	0	48,500	0	0	2,900	0
48	Challenge	1,200	115,600	0	0	2,300	0
58	Brown's Valley	3,000	18,600	0	30,700	1,100	0
62	Marysville	10,000	58,300	0	9,800	5,100	700
	COUNTY TOTALS	14,200	241,400	0	40,500	11,400	700
	TOTALS, NORTHEASTERN COUNTIES	254,000	8,349,800	1,461,800	5,335,600	444,100	33,600

a Represents less than 50 acres.

Forest Lands

Recent surveys and appraisals of the forest-area and timber-volume show that 46 per cent of the entire area of the State of California is classed as timber cropland and other forest land. About 17 million acres comprise commercial forest lands capable of producing lumber and other forest products. About 9,300,000 acres of the commercial forest lands are located within the Northeastern Counties. These counties also contain about 6,500,000 acres of non-commercial forest, comprised of lands withdrawn for parks and primitive areas, as well as forest lands incapable of yielding usable wood products. The commercial forest lands, which are predominantly pine, Douglas fir, and fir, are found principally in the mountainous parts of the Northeastern Counties lying in the North Coastal Drainage Basin, and above 3,000 feet on the westerly slopes of the Sierra Nevada in the Central Valley Drainage Basin. The location of the principal forest lands are shown on Plate 5.

As the result of this bountiful natural resource, and the development of the forest products industry during the past century, the production of lumber and other forest products is the leading industry in most of the Northeastern Counties. Lumber production has increased from 1.1 billion board feet, produced by 128 mills in 1940 to 1.9 billion board feet, produced by 208 mills in 1951. The greatest lumber production is found in Siskiyou County, followed by Shasta, Lassen, and Plumas Counties. The production in these four counties accounts for more than one-half of the total for the 15 counties.

Until recent years, forest products from this area have consisted of sawlogs and rough lumber exported

Logging Operation in Siskiyou County

Yreka Studio & Camera Shop, Yreka, Photograph

Sawmill in Plumas County

Department of Water Resources Photograph

for re-manufacture, and some finished lumber for local use and export. In several areas box shook has been an important item, but its production is now being reduced by the growing preference for fiberboard boxes. There is now a trend toward more re-manufacturing of lumber within the area and increased production of plywood and veneer. Only recently have fiberboard plants begun operating within the Northeastern Counties. Wood chips for pulp are produced from salvaged waste and shipped elsewhere for processing.

It has been estimated by the United States Forest Service, upon request by the Department of Water Resources, that the ultimate sustained yield capacity of the commercial forest lands within the Northeastern Counties would be about 2,267 million board feet (International Scale) per year. This is based on the assumption that management would obtain and maintain at least 80 per cent stocking on total commercial forest lands, both private and public lands including present de-forested areas. Based on further information from the Forest Service and from the California Forest and Range Experiment Station, the estimate of sustained yield was converted to estimates of annual production for major forest products. These estimates for the 15 Northeastern Counties include:

1. Lumber—2,186 million board feet (lumber tally)
2. Plywood—357,200 thousand square feet (⅜-inch basis)
3. Pulp—1,097 thousand tons
4. Fiberboard and paper products—701 thousand tons

The amount of possible production for each item was determined for each of the 15 counties. Production was further broken down to the amounts for each hydrographic unit. The area of commercial forest lands within each hydrographic unit was used as a basis of apportioning the production to the various hydrographic units.

Estimated sustained yield capacity of commercial forest lands, and the estimated annual production of major forest products for each county of the Northeastern Counties are presented in Tables 40 and 41, respectively.

TABLE 40

ESTIMATED SUSTAINED YIELD CAPACITY OF COMMERCIAL FOREST LANDS OF THE NORTHEASTERN COUNTIES

County	Commercial forest lands, in thousands of acres	Annual yield per acre, in board feet	Total annual yield in million board feet
Butte	356	380	135
Colusa	27	240	6
Glenn	113	240	27
Lake	175	240	42
Lassen	829	160	133
Modoc	.675	140	94
Plumas	1,228	240	295
Shasta	1,263	240	303
Sierra	393	350	138
Siskiyou	2,323	240	558
Sutter	--	--	--
Tehama	436	380	166
Trinity	1,357	240	326
Yolo	--	--	--
Yuba	116	380	44
TOTALS	9,291		2,267

TABLE 41

ESTIMATED ANNUAL PRODUCTION OF MAJOR FOREST PRODUCTS AT SUSTAINED YIELD WITHIN THE NORTHEASTERN COUNTIES

County	Lumber, in million board feet	Plywood, in thousand square feet*	Pulp, in thousand tons	Fiberboard and paper products, in thousand tons
Butte	286	21,840	244	156
Colusa	6	985	--	--
Glenn	27	4,360	--	--
Lake	42	6,790	--	--
Lassen	134	21,520	--	--
Modoc	95	15,195	--	--
Plumas	149	47,730	--	--
Shasta	417	66,610	431	276
Sierra	140	11,150	--	--
Siskiyou	566	90,285	106	68
Tehama	168	44,440	213	135
Trinity	111	8,000	--	--
Yuba	45	18,290	103	66
TOTALS	2,186	357,200	1,097	701

* ⅜-inch basis.

RECREATIONAL RESOURCES

The northeastern part of the State of California has an exceedingly colorful history woven from its streams and rivers, gold and silver mines, and vast stands of pine and fir. Indians, Chinese, and Yankees, miners, woodsmen, trappers, and cattlemen all have played a part in the fascinating drama of northern California. The Chinese temple in Weaverville, the lava trenches of the Modoc War, Susanville's Fort Defiance are historic reminders of this not so distant past.

Historical romance intrigues the historian and the tourist, but the modern-day resident of the area—the farmer, the lumber mill worker, the commercial and industrial employee, and the small entrepreneur cannot live on the memories of the past. The economic life of individuals and business operations depends upon a stable, prosperous future. The declining economy in a number of the counties within this area indicate a need to evaluate the potential return from full development of the natural resources of the area.

Historically, the economic life of the northern mountain counties has been based upon timber, mining, agricultural operations, and related service industries. In recent years, however, recreational activity

Recreation at Bucks Lake, a Pacific Gas and Electric Company Reservoir

Department of Water Resources Photograph

Fishing a Large Stream

Moulin Studios, San Francisco, Photograph has increased rapidly to a position of major importance in the region's economy. There is now every reason to believe that future recreational activity will substantially increase.

It appears that the Northeastern Counties are on the threshold of a large growth in the development and use of their recreational resources. These counties have, within their borders, some of the finest mountainous terrain in the State. All or parts of eight national forests, one national park, and one national monument are included within their boundaries. The pressure of population upon the older and more intensively developed recreational areas of the State is contributing to the influx of visitors into the Northeastern Counties each year in search of recreational opportunities. Higher incomes, more leisure, and improved transportation tend to increase the mobility of the population and its ability to enjoy the recreational resources of the Northeastern Counties.

According to the United States Forest Service there were 8,351,600 visitor-days use of national forest recreational areas in the Northeastern Counties in 1955, compared with 2,958,500 only five years earlier. This increase, amounting to 182 per cent, in recreational use occurred during a period when the State population was increasing by 23 per cent, and population of the Northeastern County area increased only 10 per cent. It is clear that per capita use of recreational resources has increased substantially in recent years.

The increase in recreational use reflects an increasing national propensity to spend more time in leisure and recreational activities. It has been estimated by the National Association of Travel Organizations that, in 1955, tourists in the United States spent $24,000,000,000 for recreational purposes, about 7½ per cent of the national income. Persons visiting the national parks and forests, for varying periods of time in 1955 totalled 96,000,000, an increase of 140 per cent over 1946. On a per capita basis, these visits more than doubled between 1946 and 1955.

In California, visitor-days use of the national parks and national forests increased from 23,085,000 in 1946 to 35,614,000 in 1955, an increase of 54 per cent. State population increased 36 per cent during this period.

Present development of hotels, resorts, campgrounds, and other facilities in the Northeastern Counties is relatively minor. Despite the historic antiquity of the area, exploitation of its recreational resources is in its early stages. Therefore, the rate of development from this time forward to probable ultimate development can be expected to be rapid, and to exceed the rate of population growth in the state by a considerable degree. While State population is expected to increase three or more times between now and ultimate development, recreational use in the Northeastern County area may increase by 10 times or more.

Potential recreational areas, which may ultimately be developed or utilized, were determined by the firm of Pacific Planning and Research, retained by the Department of Water Resources to conduct studies on this phase of the investigation. These areas were then delineated on United States Geological Survey map quadrangles. After a field inspection of the Northeastern Counties, the recreational areas were segregated by use categories. The categories used are based upon accessibility and probable use and are described as high, medium, and low intensity recreational areas.

High intensity recreational areas are lands of prime recreational potential that are accessible by motor vehicle during the entire vacation season. They include readily accessible rivers, streams, lakes, mountainous areas, and desirable highway frontage. These lands have scenic, climatic, topographic, location, and other resource values which will attract public and private recreational development. Most of the future development is expected to occur in these areas.

Medium intensity recreational areas are lands of prime recreational value but which are not readily accessible by motor vehicle. They include mountainous areas, and lands along streams having physical attributes conducive to recreational development. These areas will be developed to some extent but their greatest use will probably be for fishing, hunting, hiking, camping, etc.

Low intensity recreational areas are lands with generally inferior scenic and topographic qualities, but which may be important for hunting. Each of these categories will be subject, in varying degrees, to development for permanent and summer homes, commercial resorts and motels, organization and group camps, and camping and picnic areas.

For purposes of evaluating present and ultimate water requirements, certain additional land areas were classed as a part of the recreational resource. These land areas are the swamp and marsh lands which are covered by water for most of the year and which support a rather dense vegetative growth. The lands do not have agricultural value but, in most instances, are important to the economy since they provide habitat for waterfowl.

The water surface area of existing reservoirs, as well as natural lakes which are controlled by dams and operated for water supply purposes, are also included in this category. Acreages shown are those at the spillway crest elevation, or at the maximum operating elevation, whichever is applicable.

Table 31, previously presented, summarizes, for each hydrographic unit, the extent of lands presently occupied by swamp and marsh lands and by principal reservoirs. Table 32 summarizes these data for counties.

For conditions of ultimate development, it was assumed that existing swamp and marsh lands that provide habitat for migratory waterfowl would be maintained in their present state rather than be drained and reclaimed. In addition to the present swamp and marsh lands, an area of about 6,000 acres in Lower Klamath Lake was considered to be converted from its present use as winter-irrigated grain land to controlled marsh for waterfowl habitat.

In the ultimate pattern of land use, the water surface areas of the principal reservoirs required for full development were also considered because of their potential recreational value. The reservoir areas so classified were the average water surface area for both presently existing reservoirs and for reservoirs proposed under The California Water Plan. Natural lakes were included when controlled by dams and regulating structures. Natural lakes not developed for use as operating reservoirs were not included in this grouping.

In Table 38, the areas of high, medium, and low intensity recreational areas, as well as the areas of swamp and marsh lands and principal reservoirs, are tabulated for each of the hydrographic units of the Northeastern Counties. The same information segregated by counties is shown in Table 39. The land areas included in these tables, in some instances, coincide with lands presently irrigated and lands classified as irrigable.

The potential recreational development in California's Northeastern Counties, predicated upon full development of the natural resources, is discussed and presented in greater detail in Appendix A "Future Population, Economic and Recreation Development of California's Northeastern Counties". Included within this appendix report are plates depicting the location of lands estimated to have ultimate recreational value and use.

Fish and Wildlife

Fish and wildlife are an important renewable resource of the State of California. Surveys indicate that Californians devote nearly twice as much time to outdoor sports and recreation as do the people of the nation as a whole. Angling license sales in California in 1955 were more than 1,303,000, the second largest number sold in any state in the nation that year. California ranked sixth in number of hunting licenses sold in 1952-53, about 588,000. By 1954-55 licenses issued had increased to nearly 621,000.

A survey in 1955, by the State Department of Fish and Game, indicated that the average angler spent 15 days fishing in fresh water and 11 days fishing in salt water, while the average hunter spent 14 days pursuing game. This amounted to a total of over 31,000,000 man-days spent in such recreational activities in 1955.

The Sacramento River is probably the outstanding example of the effects of stream flow maintenance on fish and fisheries. Prior to the construction of Shasta Dam, summer flows were small and water temperatures were above the tolerable level for salmon. Steelhead trout were rare. However, operation of the Central Valley Project has maintained large continuous flows of cold water in the river and steelhead and salmon population have increased greatly. The Department of Fish and Game now estimates that the average run of steelhead is about 27,000 fish, while in 1953 the king salmon run amounted to at least 300,000 fish. Silver salmon have been introduced into the upper Sacramento River tributaries. They require a year's residence in the stream before migrating to the sea, and therefore are dependent upon a river habitat for the first year of their life. The Sacramento River below the Balls Ferry Bridge was recently opened for year-round fishing.

Smaller streams in the Northeastern Counties are important to fish and game resources. Many thousands of miles of stream support trout populations of sufficient size to afford angling. It has been estimated that there are about 6,000 miles of stream which are normally fishable, with many thousand of miles of other streams fishable on an intermittent basis.

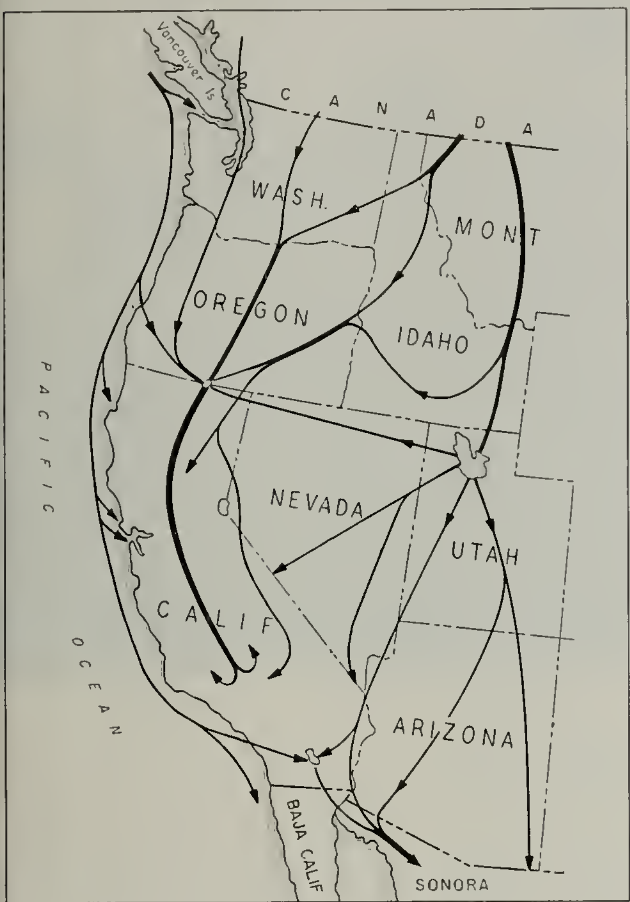
The deer herds of the Northeastern Counties provide another substantial recreational resource. Thousands of hunters visit the mountains during deer hunting season. During the five years 1952-56, deer hunters took an average of 24,678 deer annually in the Northeastern Counties. Using the statewide hunter success ratio of about 20 per cent, this harvest indicates an average of about 125,000 deer hunters each year.

The State Department of Fish and Game has estimated that hunters harvest approximately 7 per cent of the deer herd in a typical year. It is estimated by that Department that approximately 20 per cent of the deer herd could be harvested annually with no harm to the deer population. It is probable, therefore, that about three times the present number of hunters could utilize this resource.

The greatest consumptive water requirement for game in the Northeastern Counties will continue to be for the maintenance of waterfowl areas. The extensive areas of swamps, marshes, water surfaces, and rice lands provide protection and food for great flocks of migratory waterfowl. The economic and recreational importance of these waterfowl is such that they are protected from over-harvesting by international treaties between the governments of the United States, Canada, and Mexico.

To grasp the significance of California's waterfowl resources, it is first necessary to become familiar with the flyway concept and its implications. There are four major flyways on the North American Continent: The Atlantic, Mississippi, Central, and Pacific.

The Pacific Flyway covers California, Oregon, Washington, Idaho, Montana, Nevada, Utah, and Arizona, and is shown on the following illustration.



Pacific Migratory Waterfowl Flyway, Showing Principal Fall Migration Routes

Ducks and geese using the Pacific Flyway nest and breed, for the most part, in Alberta and Saskatchewan. They also originate in British Columbia, Alaska, and Siberia. These breeding areas have only slightly been affected by man's activities, while wintering areas to the south are continually being reduced as a result of increases in population and accompanying increases in land use. Consequently, the two areas are seriously out of balance, with waterfowl populations being limited by insufficient wintering areas.

Throughout recorded history, California has been the principal wintering ground for migratory waterfowl of the Pacific Flyway. An estimated 60 per cent of Pacific Flyway waterfowl winter in California. Extensive marsh areas in the great valleys of the State were formerly utilized by hordes of ducks and geese. Today these same valleys have a much reduced marsh and water acreage, and are crowded with waterfowl during the winter season.

As indicated on the illustration, there are several major routes within the flyway; also a complex of branching routes, concentrations or funneling points, and interchanges between subflyways. As an example, at least seven migration routes converge at Tule Lake-Lower Klamath concentration area, one of the largest in the nation. From there comes the tremendous movement down the Central Valley of California.

A major problem in the management of waterfowl has been that of crop depredation. Large concentrations of Baldpate duck annually flock to green crops in the Imperial Valley and other area of intensive winter vegetable farming. Coots and geese feed on permanent pasture lands throughout the Central Valley, many of them late into the spring. Pintail and Mallard ducks feed heavily on rice in the Central Valley. These problems have been partially resolved by holding waterfowl on large management areas until after harvest, and by special hunts, herding, and other methods.

Present land use in the valley includes large acreage of rice, with attendant high water requirement and with high correlative value as waterfowl area. Increased rice culture would accommodate larger populations of waterfowl. Conversely, decreased rice culture might influence governmental agencies to acquire and manage more areas for waterfowl. In either eventuality, total water requirement in these areas would not be increased, but the requirement nominally chargeable to waterfowl might be increased.

Recreational Use of Reservoirs

Reservoirs used for recreation provide an important resource for the Northeastern Counties. The attractions of natural sites would be multiplied many times with the large bodies of water created by storage dams. Recreational use of Shasta Reservoir and its surrounding area is an outstanding example. Visitor-days to that facility in 1954 were about 223,000. In 1955 they had increased to 426,000 and in 1956 to 629,000 visitor-days.

Future recreational use includes the activities of the vacationer and tourist, the hunter and fisherman. It also includes the establishment of permanent homes, as well as summer homes by those in retirement or semi-retirement. Many, who have their place of work or business elsewhere, are attracted to such areas for relaxation and healthful living.

POPULATION AND EMPLOYMENT

Population data and projections for each of the 15 Northeastern Counties were prepared for the Department of Water Resources by the consulting firm of Pacific Planning and Research. A complete report on these studies is presented in Appendix A, "Future Population, Economic and Recreation Development of California's Northeastern Counties".

Agriculture Creates Large Industries to Process and Transport Products

United States Bureau of Reclamation Photographs

Estimates of present (1956) population were made by the State Department of Finance. These estimates were segregated into urban, rural-farm, and rural-non-farm populations for each county in accordance with percentages in each category derived from the 1950 census. During the course of the land use studies for this investigation, areas of present urban development, including all developments of size sufficient to be mapped, were classified for each hydrographic unit. The extent of urban areas so determined was used to estimate distribution of present urban population and rural-non-farm population throughout the hydrographic units. The county totals of rural-farm population were distributed among the hydrographic units in proportion to the irrigated acreage in each unit. The population of the Northeastern Counties, as shown by the 1956 estimates, was 365,100. This estimate is slightly greater than the 1950 census enumeration, which totaled 330,400 for the Northeastern Counties.

Estimates of ultimate population by Pacific Planning and Research, subdivided into the three categories of urban and suburban, rural-farm, and rural-non-farm, were based, for statistical purposes, on a time in the future (years 2020-2050) when the population of the United States would be about 375,000,000. Correspondingly, the population of California would be about 45,000,000, and the population within the Northeastern Counties would be 1,750,000.

These estimates were substantiated by analysis of the Northeastern Counties with respect to their capacity to sustain the estimated ultimate population through development of their natural resources. At such a time the following conditions were assumed to prevail: the area of irrigated land in the Northeastern Counties would increase to about three times the acreage irrigated in 1954; the number of farms and the farm population would be about twice that in 1950, and agricultural employment would also be double that in 1950; employment in the forest products industries, based on sustained yield production, would be about twice that in 1950, but total manufacturing employment would rise to nearly six times the present level. The largest category of employment would include such items as construction, distribution of products and service activities, while anticipated development of recreational areas would provide for a substantial portion of the service activities.

It was estimated that urban and suburban residents would comprise about 70 per cent of the total population, as compared with 35 per cent in 1950. The remaining population would include both rural-farm and rural-non-farm. The latter classification would consist of permanent residents living outside of urban and suburban areas, widely scattered throughout the desirable habitable areas. While some would be employed in the forest provides industry, or in recreational services, many would have incomes from outside sources. Much of the urban and suburban population would live under similar circumstances, since the urban areas would include extensive suburban developments with low population densities.

Geographical locations and patterns of ultimate growth would generally follow those of present development. The largest concentrations of urban population and industrial and commercial activities are expected in those counties which now have the largest proportions of urban population. These are at present Butte, Shasta, Sutter, Yolo, and Yuba Counties.

Estimated present and probable ultimate populations segregated by urban, urban and suburban, rural-farm, and rural-non-farm categories for each of the fifteen counties are presented in Table 42.

TABLE 42

ESTIMATED PRESENT (1956) AND ULTIMATE POPULATION WITHIN THE NORTHEASTERN COUNTIES

County	Estimated present population (1956)				Estimated ultimate population			
	Urban	Rural farm	Rural-non-farm	Totals	Urban and suburban	Rural farm	Rural-non-farm	Totals
Butte	29,400	10,200	30,600	70,200	210,200	15,800	58,000	284,000
Colusa	3,100	2,900	5,700	11,700	40,100	10,700	17,200	68,000
Glenn	3,200	6,800	6,600	16,600	48,400	16,000	20,600	85,000
Lake	0	2,800	8,500	11,300	29,200	4,300	31,500	65,000
Lassen	7,500	1,400	6,600	15,500	40,500	7,800	19,200	67,500
Modoc	2,700	2,900	3,700	9,300	29,600	7,400	14,100	51,100
Plumas	0	500	11,400	11,900	22,400	1,500	20,800	44,700
Shasta	13,000	5,100	27,900	46,000	140,400	8,200	46,400	195,000
Sierra	0	200	2,200	2,400	7,200	800	8,000	16,000
Siskiyou	6,100	4,500	20,900	31,500	76,300	9,900	41,000	127,200
Sutter	8,700	9,700	10,700	29,100	90,200	12,400	19,200	121,800
Tebama	8,000	6,800	5,900	20,700	71,500	11,000	22,600	105,100
Trinity	0	900	6,000	6,900	9,900	700	11,400	22,000
Yolo	29,200	9,000	15,700	53,900	312,000	16,000	62,000	390,000
Yuba	18,300	3,600	6,200	28,100	75,600	6,000	23,400	105,000
TOTALS	129,200	67,300	168,600	365,100	1,203,500	128,500	415,400	1,747,000

CHAPTER III

WATER UTILIZATION AND REQUIREMENTS

The Legislative directive, under which this investigation has been conducted, states that the determination of the ultimate water needs of the 15 Northeastern Counties shall be predicated upon full development of all the natural resources of these counties. Considering, then, the availability of natural resources as the basis for estimates, and assuming that full development would occur, both consumptive use of water and requirements for water were evaluated. The results are presented in the following sections: unit values of water use, consumptive use of applied water, probable ultimate requirements to meet consumptive uses, and limited seasonal water requirements.

Definitions. In connection with the discussion of the nature and extent of water utilization and requirements in the Northeastern Counties, both at the present time and under probable conditions of ultimate development, the following terms are used as defined:

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

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

Limited Water Requirement—The amount of water that would be available to provide for all beneficial uses, and for irrecoverable losses incidental to such uses, giving consideration to the physical and economic limitations of developing local and imported supplies.

Consumptive Use of Water—This refers to water consumed by vegetative growth in transpiration 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.

Effective Precipitation—That portion of the direct precipitation which is consumptively used and which does not run off or percolate to the ground.

Irrigation Efficiency—The ratio of consumptive use of applied irrigation water to the total amount of such applied water, commonly expressed as a percentage.

Water Service Area Efficiency—The ratio of consumptive use of applied water in a given service area to the amount of water delivered to the area, commonly expressed as a percentage.

Present—This is used generally in reference to land use and water supply conditions prevailing during the period from 1954 to 1956.

Ultimate—This refers to conditions after an unspecified but long period of years in the future when development of natural resources will be at a maximum and essentially stablized. Its use is related to long-range resources planning and development, that is not only physically possible on the basis of land and water resources, but is also practicable and reasonable on the basis of foreseeable economic conditions. 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.

Some enlargement on the explanation of hydrologic concepts contained in the foregoing definitions is probably desirable in order to provide for better understanding of the analyses used in the present investigation for evaluating water utilization and requirements.

Prior to the time the first immigrants entered California and made the first employments of water, the land pattern of the river basins, as well as the regimen of stream flows, were in a state commonly termed "natural conditions". This point in time provides a convenient beginning to consider later changes on the quantity, quality, and regimen of stream flow caused by water development.

Changes in natural conditions occur when man stores water in a reservoir, irrigates land to produce crops, diverts stream flow for municipal or industrial purposes, conveys water to a hydroelectric plant to generate power, or otherwise develops the land and water resources. By such uses he either changes the amount of water available in the stream for other purposes, or imposes a change on the natural characteristics of stream flow. A general expression for such employments of water is the term "water utilization".

Other terms are needed, however, to express more precisely the factors that pertain to the various beneficial employments of water. In that "requirement" is a general term that expresses need for beneficial use of water, it is customary to employ with it certain modifying words that by implication define the exact nature of the requirement. For example, "diversion requirement" is the amount of water needed at the point of diversion on a stream system to provide for losses in conveyance of water to places of use, for the necessary irrigation head to distribute the water in the fields, for the wetting of the soil volume, and for deep percolation, taking into account the re-use of return flows from irrigation or other employments of the water. A "service area requirement" accounts for all the foregoing uses of water in a specified service area, measured, however, at the point or points of entrance of the water to the area, or the equivalent, rather than at a point of diversion on a stream system.

Consumptive water requirements refer to the net loss of water in a given area or stream basin occasioned by water utilization. Requirements for water that cause an impairment in either the quantity or quality of the water supply remaining available for other purposes are herein referred to as "consumptive requirements". In general, they include irrigation, municipal, and industrial requirements.

Only a part of the water which is applied to irrigated land is dissipated through transpiration by crops and evaporation from the land surfaces that have been artificially wetted. For practical purposes, these two losses of irrigation water, known as "consumptive use", are the only actual physical losses to the total quantity of water in a stream basin. For convenience, similar physical losses caused by other employments of water are also termed "consumptive use", although they may be entirely evaporative in character, such as losses from reservoir surfaces, or occasioned by changes in water quality to such a degree that further use of the water would be impracticable.

Nonconsumptive requirements refer to the use of water for fish propagation, power production, or for aesthetic purposes, in which the water is put to beneficial use and then returned to the natural channels. In most instances the regimen is affected, but not the quantity or quality of the water.

Methods fairly reliable, but still subject to much improvement, have been developed for estimating unit values of consumptive use of water by irrigated crops. The quantity of water used is largely independent of the amount of water applied, provided a sufficient quantity is available to the crops at the proper time to maintain good growing conditions. Although this basic use of the water can be reasonably estimated, the quantities involved in conveyance and application losses, re-use of return flow, etc., are difficult to evaluate accurately, for they depend upon the details of works and operation of projects. Irrigation heads will vary with topography and soil characteristics. The amount of return flow will also depend upon topography and soils, and on the method of irrigation. For these reasons, only an approximation can be made of either the diversion requirement or the service area requirement prior to construction and operation of a project.

One phase of the hydrologic analysis of a stream basin is an evaluation of future change in runoff resulting from future uses of the land and water. The change may be either an increase or a decrease in quantity of flow, although it usually results in a stream depletion. The reclamation of a native marsh and its transformation into a well managed irrigated pasture may cause a decrease in the consumptive use of water and an increase in the water supply available for other purposes. Conversely, a change in agricultural practice from grain production to irrigated pasture may result in greater consumptive use of water on the particular area, and a decrease in the water supply available for other purposes.

Normally, as native lands are brought under irrigation, the regimen of downstream flows is influenced and changed. For the most part, the amount of the change of downstream flow is measured by the difference both in consumptive use of water and irrecoverable losses between any two stages of development. The actual effect on the water supply, as related to potential users below the river basin, is the amount of applied water consumptively used and the irrecoverable losses resulting from such use.

In general, the present and probable ultimate consumptive uses of applied water in the Northeastern Counties were determined by application of appropriate unit values of consumptive use of water to the present and probable ultimate patterns of land use. In determining the probable ultimate patterns of land use, due consideration was given to the nature and extent of the present agricultural, urban, and industrial development, to indications of trends in such development, to the availability of the water supply, and to those natural features of the basin such as climate, topography, and soils as they affect the use and re-use of water. Evaluations of ultimate water service area requirements were made by considering efficiencies in use of the water which are presently or would ultimately be achieved by operating agencies.

Certain possible nonconsumptive requirements for water in the Northeastern Counties, such as those for hydroelectric power generation, conservation of fish and wildlife, recreation, etc., may be of varying significance in the design of water resource development works. In most instances, the magnitudes of such nonconsumptive requirements would be dependent upon allocations made in the planning of future projects after consideration of such factors as multipurpose uses, public interest, economics, etc.

UNIT VALUES OF WATER USE

An evaluation of available natural resources has been presented in the previous chapter as the basis of determining present and future water needs. Equally important in this determination are estimates of unit values of water use to compute the seasonal amounts of consumptive use and water requirements. Ideally, unit values of water use for irrigated agriculture, urban areas, industrial production, and recreational development would be based upon measured values. Such data should be measured within the area under consideration to reflect the varying climatic and operational influences, and should be extensive enough to reflect season-to-season variations. In the absence of adequate data, it was necessary to use the available water use measurements conjunctively with supplementary data which express some of the physical conditions that affect consumptive use of water, and from this data, and utilizing judgment to an extent, estimate unit values of water use.

Analyses of all available data were made and tabulated. Extensive studies were initiated to collect new data on water use by irrigated lands, urban and domestic areas, the forest products industry, recreational activities, and evaporation from reservoir surfaces and swamp and marsh lands. Then mean seasonal unit values applicable to the entire Northeastern Counties area were estimated for each of these types of water use. The procedures and results of these studies for the various categories of water use are presented in the following sections.

Irrigation Water Use

Mean seasonal unit values of consumptive use of applied water for irrigated crops within the Northeastern Counties were determined by an empirical method which makes use of measured values of consumptive use and related climatological factors.

It has been stated that the most desirable method of determining unit values of consumptive use of water by irrigated crops would be actual measurement and observation. Past studies show that the most reliable methods of measuring consumptive use of water by growing plants are soil moisture sampling from field plots, and by measuring the use of water by plants grown in tanks simulating field conditions. There is a general lack of this type of basic information. A limited amount of research and experimentation has been carried on for the past 40 years by the United States Department of Agriculture and the University of California. Furthermore, little of the available data, outside of that collected by the University of California at Davis, is applicable to the Northeastern Counties area.

A considerable amount of data regarding diversions, delivery, and application of water to irrigated lands, as well as return flows and stream flow, are available from records of the Sacramento-San Joaquin Water Supervisor, various public and private irrigation water service agencies and the United States Geological Survey. While these data are not often suitable for estimating unit values of consumptive use of water on irrigated lands, they are of value for checking the estimates made by other methods.

Some measurements of consumptive use of water in the area were made by soil moisture sampling procedures during this investigation and during past investigations of the Department of Water Resources. Field work started in 1954 included, in addition to soil moisture depletion from field plots, the installation and maintenance of atmometer stations, evaporation pans and other instruments. Analyses of these and other data furnished by the University of California indicated that measured values of consumptive use correlate well with records of evaporation from atmometers. An atmometer is an evaporation measuring instrument which has a spherical ceramic evaporation surface. The instruments are used in pairs, one of which has a white and the other a black evaporation surface. The evaporation from atmometers is influenced by solar energy, temperature, wind movement and humidity which are the same principal factors influencing transpiration from growing plants. Although much valuable data was gathered during the three-year investigation period, it was not adequate to provide the basis for new estimates of unit values of consumptive use throughout the Northeastern Counties. The basic data collected during this study will, however, be of great value when supplemented by data of future programs of collection and analysis.

A comprehensive study was made of available experimental data on consumptive use of irrigation water, existing records of irrigation deliveries, and return flows from irrigation during the Statewide Water Resources Investigation. The results of this investigation are published in State Water Resources Board Bulletin No. 2, "Water Utilization and Requirements of California", 1955. The method used for determining unit values of consumptive use of irrigation water provided an acceptable standard over a wide range of climatic conditions. This method, generally applicable throughout California, correlates measured values of consumptive use with climatological influence as reflected by mean temperature and the duration of sunshine hours. The derived values are those which would occur under mean conditions of water supply and climate, and represent the average consumptive use of water when an adequate water supply is available to produce optimum crop yields. The basic method was first developed by Harry F. Blaney and Wayne D. Criddle of the Soil Conservation Service, United States Department of Agriculture. However, the basic method was modified to some extent to meet the special needs of this investigation.

The method expresses the relationship among consumptive use of water, average temperature, and daylight hours in a given area. Consumptive use is established from experimental data, or from measured values of use of water. Monthly mean temperatures and monthly per cent of annual daylight hours are secured from published data of the United States Weather Bureau. Other factors, such as humidity, soil depth and quality, and wind movement, which are known to affect water use, are neglected in the correlation, due to the lack of adequate data coverage. The effects of such unevaluated items, however, are contained in an empirical coefficient used in the formula derived from the method.

The first step in estimating the seasonal consumptive use of water by each crop is to divide the season into two periods, termed the "cultural period" and the "noncultural period." The former period varies with each crop, and generally comprises the irrigation season and the growing season of the crop. The noncultural period comprises the remainder of the season. Generally, during this latter period the annual crops have been removed and the land is without vegetation, although in many cases, preparation of the land for the next season is accomplished. Deciduous orchards and perennial forage crops, in most areas, are in a dormant stage during the noncultural period. Generally, the characteristics of consumptive use of water in a given locality are completely different in the cultural period from those in the noncultural period.

The consumptive use of water by a given crop in a given area during the cultural period is expressed by the formula $U = KF$, where:

$U =$ consumptive use of water by the crop, in inches of depth

$F =$ sum of the monthly consumptive use factors (f), for the cultural period

$K =$ an empirical coefficient integrating unevaluated effects

The monthly consumptive use factor, "f," for a given area was derived as the product of mean monthly temperature in degrees Fahrenheit and the monthly total of daytime hours expressed as a percentage of the total for the year.

The empirical coefficient, "K," for each crop is derived by utilizing values of consumptive use of water from data obtained from tank experiments, measurements of field delivery of irrigation water, studies of inflow and outflow of water from irrigated areas, studies of soil moisture depletion on irrigated plots, and from estimates based on the experience and judgment of qualified experts. The "K" coefficient is determined by using measured or estimated consumptive use values and corresponding values of the consumptive use factor, "F," in the basic formula.

To account for variations in the value of "K" because of climatic conditions, the coefficients were analyzed for zones of like climatic conditions. Four major zones for this purpose were selected and are termed Sacramento Valley Floor, East Side Sacramento Valley, West Side Sacremento Valley, all in the Central Valley Drainage Basin, and Mountain Valleys, which latter zone includes areas lying in both the North Coastal and Lahontan Drainage Basins. The consumptive use coefficients determined for each crop within each of these zones are given in Table 43.

The consumptive use of water during the noncultural period supplied by precipitation is determined from appropriate values of unit consumptive use of water, which are based on experimental and investigational data, experience, and judgment. The values used in the current investigation, when not limited by available precipitation, were:

(a) 1-inch of depth of water per month for annual crops or for land without vegetation.

TABLE 43

VALUES OF CONSUMPTIVE USE COEFFICIENT "K" FOR USE IN FORMULA $U = KF$ WITHIN THE NORTHEASTERN COUNTIES

	Sacramento Valley Floor		East Side Sacramento Valley		West Side Sacramento Valley		Mountain Valleys	
	Normal growing season	"K"	Normal growing season	"K"	Normal growing season	"K"	Normal growing season	"K"
Alfalfa	4/1–10/31	0.80	5/1– 9/30	0.85	5/1–10/31	0.80	5/1– 9/30	0.85
Improved pasture	4/1–10/31	0.80	5/1– 9/30	0.85	5/1–10/31	0.80	5/1– 9/30	0.85
Deciduous orchard	4/1–10/31	0.60	5/1– 9/30	0.65	5/1–10/31	0.60	5/1– 9/30	0.65
Subtropical orchard	4/1–10/31	0.60	5/1– 9/30	0.60				
Truck	5/1– 9/30	0.45	5/1– 8/31	0.55	5/1– 8/31	0.55	6/1– 8/31	0.60
Field crops	5/1– 9/30	0.50	5/1– 8/31	0.55	5/1– 8/31	0.60	6/1– 8/31	0.65
Rice	5/1–10/31	[1]						
Grain and grain hay	11/1– 6/30	[1]	5/1– 8/31	0.50	4/1– 7/31	0.50	6/1– 9/30	0.70

[1] Special method used to evaluate consumptive use units, see text.

(b) 1.5-inches of depth of water per month for land devoted to orchards or vineyards.

(c) 2-inches of depth of water per month for forage or cover crops.

Whenever available precipitation was not sufficient to provide the quantity of water believed to be necessary, the total precipitation during the deficient month was considered to have been consumptively used.

The total seasonal unit value of consumptive use of water, regardless of source of water, is the sum of the values applicable to the cultural and noncultural periods. To determine the seasonal unit value of consumptive use of applied water, that is, the water provided by means other than precipitation, an estimate of effective precipitation is necessary.

Effective precipitation is that portion of precipitation that is consumptively used and does not run off the surface or percolate to ground water. The difference between total seasonal unit value of consumptive use of water and seasonal effective precipitation represents that portion of the seasonal consumptive use which must be provided by deliberate application of water to the irrigated area. Effective precipitation is segregated into three portions for the purposes of evaluation:

(a) Precipitation occurring and consumptively used during the cultural period. In California this is generally minor in amount.

(b) Precipitation occurring during the noncultural period and consumptively used during that period. The amount is limited by the previously stated criteria governing consumptive use of water during this period.

(c) Precipitation occurring during the noncultural period and percolating to the root zone of the crop where it is retained for consumptive use during the following cultural period.

In item (c) above, the amount of moisture stored in the root zone of the crop for consumptive use during the following cultural period is based upon assumptions of the depth of the root zone, the moisture holding capacity of the soil, the moisture deficiency in the soil at the end of the cultural period and the amount of precipitation available, in addition to that consumptively used during the noncultural period. The sum of the above three items of effective precipitation which is consumptively used during both the cultural and noncultural period is then subtracted from the total seasonal consumptive use to determine the unit value of consumptive use of applied water. Only the total seasonal amounts of consumptive use of applied water are presented in this bulletin. These amounts, in turn, were used to evaluate water requirements.

Special cultural and irrigation methods in producing rice and winter grown irrigated grain required that consumptive use of these crops be determined differently than by previously described procedures.

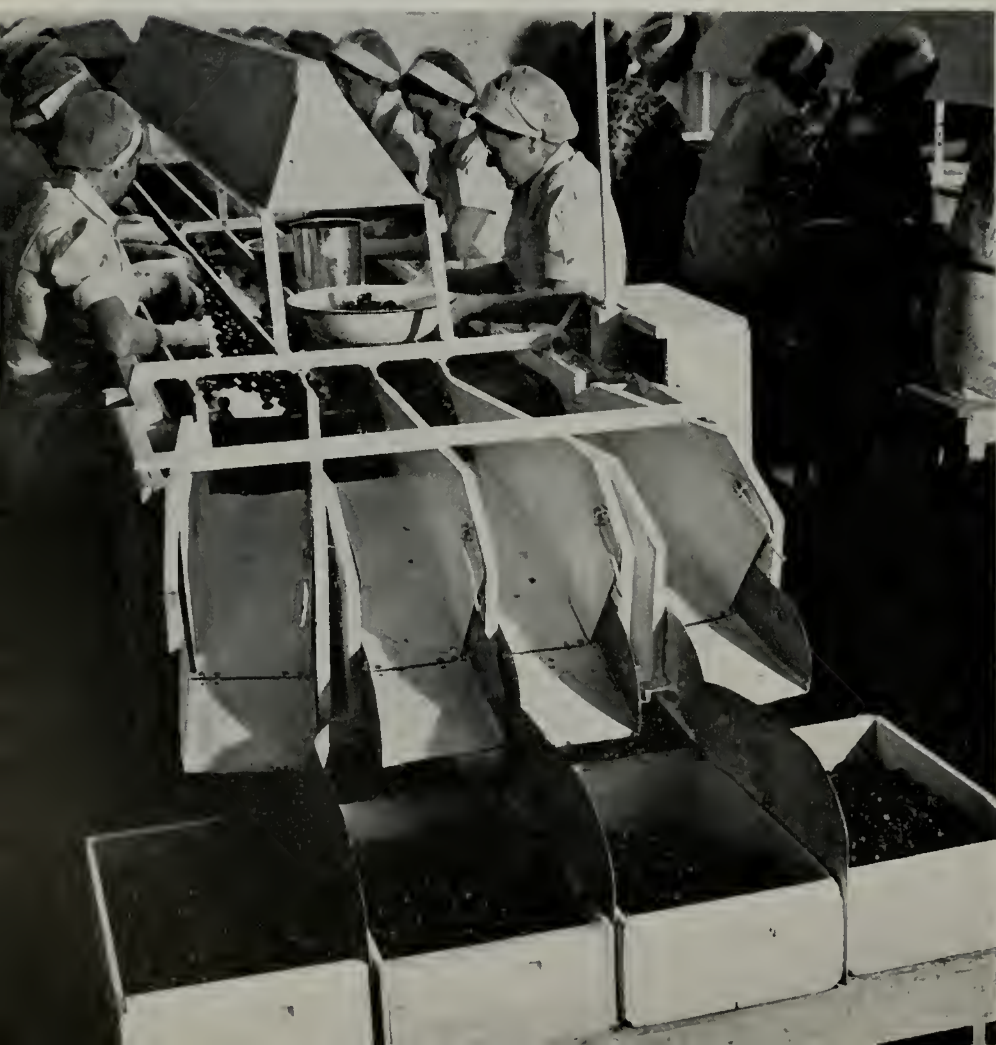
Irrigation practice in rice culture varies considerably from that followed in the production of other crops. Fields are kept flooded from the time of planting to the time the crop matures, when fields are drained to enable harvesting the yield. Planting usually takes place between April 15 and May 15. The fields are drained the following September and harvested during October. The period used for determination of the consumptive use of applied water was the five-month period from May through September.

The volume of irrigation water applied varies considerably and is dependent to a large extent upon soil type and availability of water. The gross amount of irrigation water applied is frequently greatly in excess of the consumptive use, since the maintenance of a small flow through the ponds facilitates the control of fungus and water plants and enhances the crop yield. Existing cultural practices indicate that satisfactory yields are produced when the return flow, or difference between applied water and consumptive use of applied water, amounts to about one foot in depth on the cropped area per season.

Available data for rice farming areas in the Sacramento Valley indicate that the total water applied during the growing season amounts to about 5.4 feet in depth, and that the return flow is about one foot in depth. Reliable estimates of deep percolation below the root zone indicate that about 0.3 foot of water is disposed of in this manner. The unit seasonal value of consumptive use of applied water is, therefore, about 4.1 feet in depth, and that value has been used in estimates of water requirements for the present study.

Winter grown hay and grains, such as barley, oats, and wheat, threshed for grain or cut for hay, are grown extensively throughout the Sacramento Valley. Unit values of water use by irrigated crops of this type during the summer months were estimated by the previously described general method. These crops, however, are also grown during winter months by specialized cultural practices. Winter-grown grain is planted in the fall, matures during the winter months, and is harvested in June and July. Experience indicates that, in general, when the depth of seasonal precipitation is approximately 17 inches or more, normally distributed throughout the season, these crops can be satisfactorily grown without irrigation. In some areas, however, precipitation is not sufficient for this purpose, and the available winter moisture must be supplemented by irrigation.

From monthly precipitation records in a zone of 17-inch depth of mean annual rainfall, it was determined that the precipitation falling during the



Lobor Is Essential in Processing Agricultural Products

United States Bureau of Reclamation Photographs

months from November through April, the cultural period for winter hay and grain, averages about 15 inches in depth. It was assumed that all of this winter precipitation would be consumptively used in maturing the crop, and that it would be adequate in amount for that purpose. The remaining two-inch depth of seasonal precipitation was considered to be consumed by weed growth or evaporated from soil during the noncultural period. It was further assumed that in areas where the normal seasonal depth of precipitation is less than 17 inches, the supplemental irrigation required for maturing winter-grown small grain and hay would be the difference between the actual November-through-April precipitation and the consumptive use requirement, estimated to be equivalent to a depth of 15 inches.

In the northern mountain valleys, extensive areas are cropped to meadow pasture and meadow hay. These areas generally consist of native grasses and receive abundant water supplies from widely prevalent high-water tables and from natural and artificial flooding. Available information indicated that the consumptive use of applied water for such crops was about 25 per cent greater than that required for improved pastures.

It should be recognized that the application of the foregoing empirical methods, based on natural phenomena, to practical engineering problems results in derived mean values of consumptive use of water. Consequently, the computed mean value is not absolute, but merely represents the mean of a range of values which vary from season-to-season and in accordance with land characteristics and agricultural practices. Seasonal climatic variations will cause wide variations in the total amount of water that can be evaporated and transpired from irrigated land. Additionally, the quantity of precipitation stored in the soil during the noncultural period, and the amount of precipitation occurring during the cultural period, will have a definite effect on the volume of applied irrigation water necessary to meet the consumptive requirements of crops.

Values used in this investigation were based on the assumption that sufficient water would be available at all times to meet the normal demand of growing plants for water. However, those familiar with the operation of water service agencies will recognize that agricultural practices, as well as a number of economic factors, will affect the demand for irrigation water and, in turn, the amount of water consumptively used. Estimated mean seasonal unit values of consumptive use of applied water on irrigated lands are presented in Table 44.

Urban and Suburban, and Rural Domestic Water Use

Estimates of unit values of water use for present urban, and ultimate urban and suburban areas of the Northeastern Counties were determined on a per capita basis rather than on a unit area basis. Information relative to population and water use for various types of urban development are more readily available and reliable than data on the extent, density, and water use of land areas occupied by urban development. Furthermore, ultimate population is more readily adaptable to determination under conditions which would exist with full development of the natural resources of the Northeastern Counties than is the future utilization of urban and suburban lands. Urban water use was analyzed for cities and towns within the Northeastern Counties from data submitted to the California Public Utilities Commission by public utility companies, and to the State Controller's Office by municipal water agencies. Records of water use considered were those for the period 1949 through 1955, or for such years as were available when the entire period was not covered.

After determination of the average daily rate of per capita water use in all localities for which data were available, it was found that communities in the Sacramento Valley generally had higher per capita rates of water use than those in the mountainous areas. Data from a number of communities where rates of water consumption deviated widely from the mean range were given little weight or were not included with the records under consideration.

Based on records from eight representative towns in the mountainous area, the present average rate of water consumption in upland communities was determined to be 160 gallons per capita per day. Records from 10 towns and cities within the Sacramento Valley area resulted in an estimated present average rate of water consumption of about 250 gallons per capita per day. From the same data, it was estimated that the present average rate of per capita water use for rural domestic developments, including both farm and nonfarm classifications, would be 130 gallons per capita per day in upland areas, and 200 gallons per capita per day in valley areas.

In the estimation of per capita rates of water use under ultimate conditions of development, consideration was given to the following:

(a) Per capita water use increases as the size and level of development of urban centers increase.

(b) Per capita water use increases as the standard of living increases.

(c) Per capita water use is expected to increase in the future due to an expected increase in the use of air conditioning.

It was assumed that past increases in use of water for urban purposes would not form a completely satisfactory base to project the level of future use. After thorough research and study of water use trends, it was estimated that urban use in upland communities

TABLE 44

ESTIMATED MEAN SEASONAL UNIT VALUES OF CONSUMPTIVE USE OF APPLIED WATER ON IRRIGATED CROPS WITHIN THE NORTHEASTERN COUNTIES

(In feet of depth)

Hydrographic unit		Crops									
Reference number	Name	Alfalfa	Improved pasture	Meadow pasture	Grain and grain hay	Truck crops	Field crops	Deciduous orchard	Subtropical orchard	Rice	Vineyard
1	Tule Lake	1.6	1.7	2.1	0.7	1.1	0.9	--	--	--	--
2	Butte Valley	1.4	1.6	2.0	0.5	1.1	0.7	1.0	--	--	--
3	Klamath River	1.6	1.8	2.2	0.6	1.2	0.7	1.1	--	--	--
4	Shasta Valley	1.9	2.1	2.6	0.6	0.9	0.9	1.4	--	--	--
5	Scott Valley	1.6	1.9	2.4	0.5	0.8	0.7	1.1	--	--	--
6	Salmon River	--	2.1	--	--	--	--	--	--	--	--
7	Upper Trinity River	1.7	2.0	--	--	--	--	--	--	--	--
8	Lower Trinity River	1.7	1.9	--	0.6	1.3	--	1.2	--	--	--
9	South Fork Trinity River	1.6	1.8	--	0.6	1.2	0.9	1.2	--	--	--
10	Southern Trinity County	1.7	2.0	2.5	0.7	--	--	--	--	--	--
11	Lake Pillsbury	--	--	--	--	--	--	--	--	--	--
12	Goose Lake	1.7	1.8	2.3	1.0	0.5	0.6	--	--	--	--
13	Jess Valley	--	1.6	2.0	--	--	--	--	--	--	--
14	Alturas	1.4	1.6	2.0	0.7	0.4	0.5	--	--	--	--
15	Big Valley	1.4	1.6	2.0	0.7	0.4	0.5	--	--	--	--
16	McArthur	1.4	1.6	2.0	0.7	0.4	0.5	--	--	--	--
17	Hat Creek	1.4	1.6	2.0	0.7	--	0.5	--	--	--	--
18	Montgomery Creek	1.4	1.6	2.0	0.7	0.4	0.5	0.8	--	--	--
19	McCloud River	1.4	1.5	1.9	--	--	--	--	--	--	--
20	Dunsmuir	1.4	1.7	2.1	1.0	0.5	0.6	0.9	--	--	--
21	Shasta Lake	1.4	1.6	--	--	0.4	--	0.9	--	--	--
22	Clear Creek	--	2.5	--	--	--	0.9	--	--	--	--
23	Keswick	--	--	--	--	--	--	--	--	--	--
24	Cottonwood Creek	2.5	2.5	--	0.4	0.8	0.9	1.4	1.4	--	--
25	Olinda	2.4	2.5	--	0.4	0.8	0.9	1.4	1.4	--	--
26	Redbank Creek	2.4	2.6	--	0.5	1.0	1.0	1.5	--	--	--
27	Elder Creek	2.4	2.6	--	0.5	1.2	1.0	1.5	--	--	--
28	Thomes Creek	2.4	2.6	--	0.5	1.3	1.0	1.7	--	--	--
29	Stony Creek	2.3	2.6	3.3	0.5	1.2	1.0	1.7	--	--	--
30	Clear Lake	2.0	2.3	2.9	0.5	0.8	0.8	1.3	--	--	1.4
31	Middletown	2.0	2.3	--	0.4	0.7	0.7	1.3	--	--	--
32	Stillwater Plains	2.0	2.2	2.8	0.7	0.8	0.7	1.4	--	--	--
33	Cow Creek	2.0	2.2	2.8	0.7	0.8	0.7	1.4	--	--	--
34	Bear Creek	2.0	2.2	2.8	0.7	0.8	0.7	1.4	--	--	--
35	Battle Creek	2.0	2.2	2.8	0.7	0.8	0.7	1.4	--	--	--
36	Paynes Creek	2.0	2.2	--	--	--	--	1.4	--	--	--
37	Antelope Creek	2.0	1.5	1.9	--	--	--	0.7	--	--	--
38	Mill Creek	--	1.5	1.9	--	--	--	--	--	--	--
39	Deer Creek	--	1.5	1.9	--	--	--	--	--	--	--
40	Chico Creek	--	1.7	2.1	--	--	--	0.8	--	--	--
41	Paradise	2.2	2.2	--	0.3	1.0	--	1.7	1.7	4.1	1.2
42	North Fork Feather River	1.8	1.9	2.3	0.3	--	--	1.8	1.8	--	--
43	East Branch Feather River	1.9	1.9	2.3	0.3	0.9	--	1.6	--	--	--
44	Sierra Valley	1.8	1.9	2.3	0.3	0.8	--	--	--	--	--
45	Middle Fork Feather River	1.8	1.9	2.3	0.3	0.8	--	1.7	--	--	--
46	South Fork Feather River	--	1.9	2.3	--	--	--	1.7	--	--	--
47	North Yuba River	1.8	2.0	2.6	--	--	--	1.4	--	--	--
48	Challenge	2.0	2.0	2.5	0.3	1.0	--	1.7	1.7	--	--
49	Wyandotte	2.4	2.4	--	0.3	1.1	1.1	2.2	2.2	4.1	1.3
50	Anderson	2.1	2.3	--	0.4	0.8	0.9	1.4	--	4.1	0.9
51	Corning	2.4	2.7	3.4	0.6	0.9	1.0	1.7	1.8	--	1.2
52	Los Molinos	2.3	2.5	3.1	0.5	0.8	1.0	1.5	1.6	4.1	--
53	Fruto	2.3	2.6	--	0.5	--	1.0	1.6	--	4.1	--
54	Orland	2.6	2.7	3.4	0.6	0.9	1.0	1.7	1.8	4.1	1.2
55	Durham	2.3	2.6	3.3	0.5	0.8	1.0	1.6	1.7	4.1	1.1
56	Colusa	2.5	2.6	3.3	0.6	0.9	1.0	1.7	1.9	4.1	1.3
57	Gridley	2.3	2.6	3.3	0.6	0.8	1.0	1.6	1.7	4.1	1.1
58	Browns Valley	--	2.2	2.8	0.8	0.8	1.0	1.3	1.4	--	1.2
59	Cortina	2.4	2.6	--	0.7	0.8	1.0	1.6	--	4.1	--
60	Arbuckle	2.4	2.6	--	0.5	0.9	1.0	1.6	1.6	4.1	1.2

TABLE 44—Continued

ESTIMATED MEAN SEASONAL UNIT VALUES OF CONSUMPTIVE USE OF APPLIED WATER ON IRRIGATED CROPS WITHIN THE NORTHEASTERN COUNTIES

(In feet of depth)

Hydrographic unit		Crops									
Reference number	Name	Alfalfa	Improved pasture	Meadow pasture	Grain and grain hay	Truck crops	Field crops	Deciduous orchard	Sub-tropical orchard	Rice	Vineyard
61	Sutter	2.5	2.6	3.3	0.7	0.9	1.1	1.6	1.6	4.1	1.1
62	Marysville	2.3	2.6	3.3	0.6	0.8	1.0	1.6	1.6	4.1	1.1
63	Pleasant Grove	2.3	2.5	--	0.5	0.8	1.0	1.5	1.5	4.1	1.1
64	West Yolo	2.0	2.3	--	0.4	0.8	0.8	1.3	--	--	--
65	Capay	2.5	2.7	--	0.5	0.9	1.0	1.6	--	--	1.1
66	Woodland	2.5	2.7	--	0.5	0.9	1.0	1.6	1.6	4.1	1.2
67	East Yolo	2.4	2.5	3.1	0.5	0.7	0.9	1.5	--	4.1	1.1
68	Surprise Valley	1.7	1.8	2.3	1.0	0.6	0.9	--	--	--	
69	Madeline Plains	1.5	1.7	2.1	1.0	--	--	--	--	--	--
70	Eagle Lake	2.3	2.3	2.9	0.8	--	--	--	--	--	--
71	Willow Creek	2.3	2.3	2.9	0.8	0.8	--	--	--	--	--
72	Secret Valley	2.3	2.3	2.9	0.8	0.8	1.2	--	--	--	--
73	Susan River	2.3	2.3	2.9	0.8	0.8	1.0	--	--	--	--
74	Herlong	2.3	2.3	2.9	0.8	0.8	1.1	--	--	--	--
75	Little Truckee River	2.2	1.6	2.0	--	--	--	--	--	--	--

would increase to about the present level of use in the valley areas of 250 gallons per capita per day. It was then assumed that ultimate use in valley communities would increase a proportionate amount and would approximate 390 gallons per capita per day. This estimate is about 60 per cent greater than the present average per capita use in the City of Sacramento.

The values of water use estimated for rural domestic use under ultimate conditions for both rural-farm and rural-non-farm classifications were 300 gallons per capita per day in the valley areas and 200 gallons per capita per day in upland areas. The values discussed above and presented in Table 45 refer to urban and domestic delivery requirements at the point of use. Consumptive use was estimated as 50 per cent of the delivery requirement.

Forest Products Water Use

The estimates of water use for urban areas include amounts sufficient to provide for light manufacturing and other industries normally found in urban areas. Separate estimates were made of potential water use by the forest products industries, since these amounts may be a significant item in the future requirements of a community. The ultimate output of the forest products industry, based upon United States Forest Service estimates of the sustained yield of commercial forests lands within the Northeastern Counties, was estimated by the consulting firm of Pacific Planning and Research as a step in evaluating the ultimate population of the area. The major categories into which the products were grouped are lumber, plywood, fiberboard and paper products, and pulp. Unit values of water use for these items were obtained from information made available by the United States Forest Service and various private companies.

TABLE 45

ESTIMATED UNIT VALUES OF WATER DELIVERY REQUIREMENT FOR URBAN AND SUBURBAN DEVELOPMENTS, AND FOR RURAL DOMESTIC USES WITHIN THE NORTHEASTERN COUNTIES

(In gallons per capita per day)

Item	Present	Ultimate
Urban and suburban		
Valley communities	250	390
Upland communities	160	250
Rural domestic		
Valley communities	200	300
Upland communities	130	200

Consumptive use of processing water in the production of fiberboard and paper products, and pulp was assumed to be 10 per cent of the gross requirement. The values used in this report to determine consumptive use and total water requirements are shown in Table 46.

TABLE 46

ESTIMATED UNIT VALUES OF WATER REQUIREMENT AND CONSUMPTIVE USE FOR THE FOREST PRODUCTS INDUSTRY WITHIN THE NORTHEASTERN COUNTIES

Item	Unit	Requirement	Consumptive use
Lumber	Gallons per board foot of product	1.0	1.0
Plywood	Gallons per board foot of logs used	1.0	1.0
Fiberboard and paper products	Gallons per ton of chips	10,000	1,000
Pulp	Gallons per ton of chips	60,000	6 000

Use of Water for Recreational Development

Included in the ultimate consumptive use and requirements for water are estimates of water needed for recreational activities. These estimates were based on user-days as determined by the firm of Pacific Planning and Research and tabulated in Appendix A, "Future Population, Economic and Recreation Development of California's Northeastern Counties." The categories comprised permanent and summer residences, commercial resorts and motels, organizational camps, and camping and picnic areas. The unit values of water use, largely estimated from experience and judgment, represent both delivery requirement and consumptive use, and are shown in Table 47.

TABLE 47

ESTIMATED UNIT VALUES OF CONSUMPTIVE USE OF WATER FOR RECREATIONAL ACTIVITIES WITHIN THE NORTHEASTERN COUNTIES

(In gallons per user-day)

Type of use	Unit value of delivery and consumptive use of water
Permanent and summer residences	150
Commercial resorts and motels	100
Organizational camps	50
Camping and picnic areas	10

Net Reservoir Evaporation

Unit values of net seasonal reservoir evaporation were evaluated or were considered equivalent to the sum of the amount of monthly reservoir surface evaporation that would be in excess of monthly precipitation. In general, net seasonal reservoir evaporation is the sum of the monthly reservoir surface evaporation during the period, March through October, less the precipitation during the same period. The difference represents an increase in water loss from the reservoir area, since it is assumed that all of the precipitation occurring during this period was consumptively used by native vegetation prior to construction of the storage works. Evaporation during the period November through February is not included in the net seasonal reservoir evaporation total, since approximately the same amount of water would have been lost to consumptive use by native vegetation as would be lost by evaporation. In most instances additional runoff would occur at the dam site after construction, since part of the winter rainfall on the reservoir area would have been stored in the soil to be released and consumptively used during the summer period. Estimates of net reservoir evaporation, however, have not been reduced by the amount of this additional runoff.

Estimates of unit values of net seasonal evaporation from existing reservoirs were made on a monthly basis as explained above. Monthly evaporation from each reservoir was determined by relating elevation to available pan evaporation records adjusted for evaporation from large water surface areas. Mean seasonal precipitation on the reservoir was determined from an isohyetal map and reduced to monthly values in proportion to the monthly distribution of the precipitation at a nearby representative station.

Estimates of unit values of net seasonal evaporation from future reservoirs were determined from a relationship derived by correlating net seasonal evaporation from existing reservoirs with both elevation and precipitation at future reservoir sites.

Based on a review of available data pertaining to use of water by swamp and marsh lands, mean seasonal unit values of consumptive use of water were estimated as 30 per cent greater than mean seasonal water surface evaporation. The unit of water use on these lands, comparable to consumptive use of applied water, was determined by subtracting the mean seasonal precipitation.

CONSUMPTIVE USE OF APPLIED WATER

Estimates were made of the amount of water consumptively used in the Northeastern Counties under present and probable ultimate conditions. In general, these estimates were derived by applying the appropriate unit values of water use to the present and estimated ultimate patterns of land use.

Present Use of Applied Water

Present consumptive use of applied water on irrigated lands, swamp and marsh lands, and principal reservoirs was estimated by multiplying the estimated acreage of each type of land use by its respective mean unit value of consumptive use of applied water. Total consumptive use of water in urban and rural domestic development was estimated as the product of the population for each category times the appropriate value of per capita water use. The estimate of consumptive use for present urban and rural domestic purposes includes water use for industrial and recreational purposes.

Unit values of consumptive use of applied water for irrigated crops were determined on the basis of a full water supply, sufficient to meet the optimum moisture needs of the crop. In many areas of the Northeastern Counties full seasonal water supplies are not presently available, and crops are subject to a deficient irrigation supply during summer and fall months. Where this condition exists, the computed values of consumptive use of applied water were reduced to approximate consumptive use under present water supply conditions. The ratio of actual consumptive use to optimum consumptive use, expressed as a

Furrow Irrigation in the Sacramento Valley

Department of Water Resources Photograph

Irrigation by Sprinkler

Department of Water Resources Photograph

TABLE 48

ESTIMATED MEAN SEASONAL CONSUMPTIVE USE OF APPLIED WATER ON PRESENT SERVICE AREAS (1954 TO 1956) WITHIN HYDROGRAPHIC UNITS, NORTHEASTERN COUNTIES

(In acre-feet)

Hydrographic unit		Irrigated lands	Urban and rural domestic population	Swamp and marsh lands	Net reservoir evaporation	Totals
Reference number	Name					
	North Coastal Drainage Basin					
1	Tulelake	91,400	300	9,800	95,400	196,900
2	Butte Valley	18,400	300	400	7,200	26,300
3	Klamath River	8,800	100	0	2,400	11,300
4	Shasta Valley	56,300	700	3,700	4,600	65,300
5	Scott Valley	44,300	100	200	0	44,600
6	Salmon River	200	a	0	0	200
7	Upper Trinity River	3,400	a	0	34,000	37,400
8	Lower Trinity River	600	a	0	0	600
9	South Fork Trinity River	1,400	400	0	0	1,800
10	Southern Trinity County	300	a	0	0	300
11	Lake Pillsbury	0	0	0	4,300	4,300
	SUBTOTALS	225,100	1,900	14,100	147,900	389,000
	Central Valley Drainage Basin					
12	Goose Lake	19,500	a	0	400	19,900
13	Jess Valley	9,000	a	0	6,900	15,900
14	Alturas	58,200	500	200	29,100	88,000
15	Big Valley	37,100	200	4,000	3,500	44,800
16	McArthur	47,200	300	2,300	2,700	52,500
17	Hat Creek	15,600	200	1,700	2,700	20,200
18	Montgomery Creek	2,100	a	0	200	2,300
19	McCloud River	3,500	300	0	0	3,800
20	Dunsmuir	4,900	500	0	0	5,400
21	Shasta Lake	0	a	0	69,700	69,700
22	Clear Creek	200	a	0	6,500	6,700
23	Keswick	0	0	0	1,600	1,600
24	Cottonwood Creek	3,500	a	0	100	3,600
25	Olinda	2,000	300	0	100	2,400
26	Redbank Creek	600	100	0	0	700
27	Elder Creek	0	a	0	0	a
28	Thomes Creek	1,600	100	0	0	1,700
29	Stony Creek	2,700	a	300	7,900	10,900
30	Clear Lake	27,100	700	2,400	119,600	149,800
31	Middletown	3,700	100	0	300	4,100
32	Stillwater Plains	1,100	1,300	0	100	2,500
33	Cow Creek	16,300	a	a	0	16,300
34	Bear Creek	5,000	a	0	0	5,000
35	Battle Creek	6,900	100	a	200	7,200
36	Paynes Creek	800	a	0	0	800
37	Antelope Creek	300	a	0	0	300
38	Mill Creek	1,500	a	0	0	1,500
39	Deer Creek	2,700	a	0	0	2,700
40	Chico Creek	500	a	0	0	500
41	Paradise	2,400	400	a	900	3,700
42	North Fork Feather River	13,100	200	0	67,500	80,800
43	East Branch Feather River	18,500	400	0	800	19,700
44	Sierra Valley	31,700	100	0	0	31,800
45	Middle Fork Feather River	7,300	300	0	400	8,000
46	South Fork Feather River	200	a	0	200	400
47	North Yuba River	2,700	200	0	900	3,800
48	Challenge	2,500	a	0	600	3,100
49	Wyandotte	15,500	a	100	200	15,800
50	Anderson	50,600	2,600	200	0	53,400
51	Corning	90,200	1,400	a	100	91,700
52	Los Molinos	61,000	4,000	a	0	65,000
53	Fruto	2,200	a	0	0	2,200
54	Orland	118,200	1,200	200	0	119,600
55	Durham	123,300	2,700	4,400	0	130,400
56	Colusa	1,070,800	2,400	26,500	200	1,099,900
57	Gridley	466,800	2,400	34,300	0	503,500
58	Browns Valley	5,900	a	0	900	6,800
59	Cortina	3,900	a	0	0	3,900
60	Arbuckle	60,300	400	0	0	60,700
61	Sutter	155,000	2,100	300	0	157,400
62	Marysville	208,500	4,300	2,000	0	214,800
63	Pleasant Grove	30,100	a	0	0	30,100
64	West Yolo	400	a	0	1,500	1,900
65	Capay	4,200	a	0	0	4,200
66	Woodland	197,900	3,300	0	0	201,200
67	East Yolo	213,800	3,100	200	0	217,100
	SUBTOTALS	3,230,600	36,200	79,100	325,800	3,671,700

TABLE 48—Continued

ESTIMATED MEAN SEASONAL CONSUMPTIVE USE OF APPLIED WATER ON PRESENT SERVICE AREAS (1954 TO 1956) WITHIN HYDROGRAPHIC UNITS, NORTHEASTERN COUNTIES

(In acre-feet)

Hydrographic unit: Reference number	Hydrographic unit: Name	Irrigated lands	Urban and rural domestic population	Swamp and marsh lands	Net reservoir evaporation	Totals
	Lahontan Drainage Basin					
68	Surprise Valley	41,900	100	1,500	800	44,300
69	Madeline Plains	9,700	[a]	0	4,300	14,000
70	Eagle Lake	8,400	[a]	600	0	9,000
71	Willow Creek	8,200	[a]	1,200	100	9,500
72	Secret Valley	6,700	[a]	100	1,600	8,400
73	Susan River	31,100	800	3,000	11,500	46,400
74	Herlong	10,200	300	100	0	10,600
75	Little Truckee River	5,500	[a]	400	0	5,900
	SUBTOTALS	121,700	1,200	6,900	18,300	148,100
	TOTALS, NORTHEASTERN COUNTIES	3,577,400	39,300	100,100	492,000	4,208,800

[a] Less than 50 acre-feet.

TABLE 49

ESTIMATED MEAN SEASONAL CONSUMPTIVE USE OF APPLIED WATER ON PRESENT SERVICE AREAS (1954 TO 1956) WITHIN THE NORTHEASTERN COUNTIES

(In acre-feet)

County and hydrographic unit		Irrigated lands	Urban and rural domestic population	Swamp and marsh lands	Net reservoir evaporation	Totals
Reference number	Name					
	Butte County					
40	Chico Creek	500	[a]	0	0	500
41	Paradise	2,400	200	[a]	900	3,500
42	North Fork Feather River	600	[a]	0	1,000	1,600
45	Middle Fork Feather River	100	[a]	0	0	100
46	South Fork Feather River	200	[a]	0	200	400
48	Challenge	0	[a]	0	0	[a]
49	Wyandotte	15,500	[a]	100	200	15,800
52	Los Molinos	30,700	3,300	[a]	0	34,000
55	Durham	123,300	2,700	4,400	0	130,400
57	Gridley	335,600	1,900	14,400	200	352,100
	COUNTY TOTALS	508,900	8,100	18,900	2,500	538,400
	Colusa County					
29	Stony Creek	1,000	[a]	0	4,500	5,500
30	Clear Lake	1,700	[a]	0	100	1,800
53	Fruto	0	0	0	0	0
56	Colusa	525,700	1,100	12,100	0	538,900
57	Gridley	1,300	[a]	200	0	1,500
59	Cortina	2,000	[a]	0	0	2,000
60	Arbuckle	39,800	200	0	0	40,000
	COUNTY TOTALS	571,500	1,300	12,300	4,600	589,700
	Glenn County					
11	Lake Pillsbury	0	0	0	0	0
29	Stony Creek	1,400	[a]	300	3,400	5,100
53	Fruto	2,100	[a]	0	0	2,100
54	Orland	117,700	1,200	200	0	119,100
56	Colusa	294,800	600	12,400	0	307,800
57	Gridley	46,300	100	5,300	0	51,700
59	Cortina	0	0	0	0	0
	COUNTY TOTALS	462,300	1,900	18,200	3,400	485,800
	Lake County					
11	Lake Pillsbury	0	0	0	4,300	4,300
29	Stony Creek	0	0	0	0	0
30	Clear Lake	25,400	700	2,400	119,500	148,100
31	Middletown	3,700	100	0	300	4,100
	COUNTY TOTALS	29,100	800	2,400	124,100	156,400
	Lassen County					
13	Jess Valley	1,900	[a]	0	4,800	6,700
14	Alturas	0	0	0	300	300
15	Big Valley	21,600	100	500	1,800	24,000
16	McArthur	9,300	[a]	1,200	2,200	12,700
17	Hat Creek	900	[a]	0	0	900
42	North Fork Feather River	3,600	200	0	10,200	14,000
68	Surprise Valley	2,400	[a]	0	0	2,400
69	Madeline Plains	9,700	[a]	0	4,300	14,000
70	Eagle Lake	8,400	[a]	600	0	9,000
71	Willow Creek	8,200	[a]	1,200	100	9,500
72	Secret Valley	6,700	[a]	100	1,600	8,400
73	Susan River	31,100	800	3,000	11,500	46,400
74	Herlong	7,000	300	100	0	7,400
	COUNTY TOTALS	110,800	1,400	6,700	36,800	155,700
	Modoc County					
1	Tulelake	53,000	100	300	57,700	111,100
12	Goose Lake	19,500	[a]	0	400	19,900
13	Jess Valley	7,100	[a]	0	2,100	9,200
14	Alturas	58,200	500	200	28,800	87,700
15	Big Valley	15,500	100	3,500	1,700	20,800
16	McArthur	5,300	[a]	100	0	5,400
68	Surprise Valley	39,500	100	1,500	800	41,900
	COUNTY TOTALS	198,100	800	5,600	91,500	296,000
	Plumas County					
40	Chico Creek	0	0	0	0	0
42	North Fork Feather River	8,900	200	0	56,300	65,400
43	East Branch Feather River	18,500	400	0	800	19,700

TABLE 49—Continued

ESTIMATED MEAN SEASONAL CONSUMPTIVE USE OF APPLIED WATER ON PRESENT SERVICE AREAS (1954 TO 1956) WITHIN THE NORTHEASTERN COUNTIES

(In acre-feet)

County and hydrographic unit		Irrigated lands	Urban and rural domestic population	Swamp and marsh lands	Net reservoir evaporation	Totals
Reference number	Name					
	Plumas County—Continued					
44	Sierra Valley	15,700	a	0	0	15,700
45	Middle Fork Feather River	7,200	300	0	400	7,900
46	South Fork Feather River	0	0	0	0	0
47	North Yuba River	0	a	0	0	a
73	Susan River	0	0	0	0	0
74	Herlong	0	0	0	0	0
	COUNTY TOTALS	50,300	900	0	57,500	108,700
	Shasta County					
16	McArthur	28,100	200	1,000	500	29,800
17	Hat Creek	14,700	200	1,700	2,700	19,300
18	Montgomery Creek	2,100	a	0	200	2,300
19	McCloud River	1,000	a	0	0	1,000
20	Dunsmuir	300	a	0	0	300
21	Shasta Lake	0	a	0	69,700	69,700
22	Clear Creek	200	a	0	6,500	6,700
23	Keswick	0	0	0	1,600	1,600
24	Cottonwood Creek	2,900	a	0	100	3,000
25	Olinda	2,000	300	0	100	2,400
32	Stillwater Plains	1,100	1,300	0	100	2,500
33	Cow Creek	16,300	a	a	0	16,300
34	Bear Creek	5,000	a	0	0	5,000
35	Battle Creek	2,600	100	a	200	2,900
38	Mill Creek	0	0	0	0	0
42	North Fork Feather River	0	0	0	0	0
50	Anderson	40,900	2,500	100	0	43,500
	COUNTY TOTALS	117,200	4,600	2,800	81,700	206,300
	Sierra County					
44	Sierra Valley	16,000	100	0	0	16,100
45	Middle Fork Feather River	0	0	0	0	0
47	North Yuba River	2,600	100	0	300	3,000
74	Herlong	3,200	a	0	0	3,200
75	Little Truckee River	5,500	a	400	0	5,900
	COUNTY TOTALS	27,300	200	400	300	28,200
	Siskiyou County					
1	Tulelake	38,400	200	9,500	37,700	85,800
2	Butte Valley	18,400	300	400	7,200	26,300
3	Klamath River	8,800	100	0	2,400	11,300
4	Shasta Valley	56,300	700	3,700	4,600	65,300
5	Scott Valley	44,300	100	200	0	44,600
6	Salmon River	200	a	0	0	200
15	Big Valley	0	0	0	0	0
16	McArthur	4,500	100	0	0	4,600
19	McCloud River	2,500	300	0	0	2,800
20	Dunsmuir	4,600	500	0	0	5,100
	COUNTY TOTALS	178,000	2,300	13,800	51,900	246,000
	Sutter County					
56	Colusa	171,300	500	2,000	0	173,800
57	Gridley	83,600	400	14,400	0	98,400
61	Sutter	155,000	2,100	300	0	157,400
62	Marysville	40,200	200	0	0	40,400
63	Pleasant Grove	30,100	a	0	0	30,100
67	East Yolo	68,700	100	200	0	69,000
	COUNTY TOTALS	548,900	3,300	16,900	0	569,100
	Tehama County					
24	Cottonwood Creek	600	a	0	0	600
26	Redbank Creek	600	100	0	0	700
27	Elder Creek	0	a	0	0	a
28	Thomes Creek	1,600	100	0	0	1,700
29	Stony Creek	300	a	0	0	300
35	Battle Creek	4,300	a	0	0	4,300
36	Paynes Creek	800	a	0	0	800
37	Antelope Creek	300	a	0	0	300
38	Mill Creek	1,500	a	0	0	1,500
39	Deer Creek	2,700	a	0	0	2,700
40	Chico Creek	0	0	0	0	0

TABLE 49—Continued

ESTIMATED MEAN SEASONAL CONSUMPTIVE USE OF APPLIED WATER ON PRESENT SERVICE AREAS (1954 TO 1956) WITHIN THE NORTHEASTERN COUNTIES

(In acre-feet)

County and hydrographic unit		Irrigated lands	Urban and rural domestic population	Swamp and marsh lands	Net reservoir evaporation	Totals
Reference number	Name					
	Tehama County—Continued					
50	Anderson	9,700	100	100	0	9,900
51	Corning	90,200	1,400	a	100	91,700
52	Los Molinos	30,300	700	0	0	31,000
53	Fruto	100	0	0	0	100
54	Orland	500	a	0	0	500
	COUNTY TOTALS	143,500	2,400	100	100	146,100
	Trinity County					
7	Upper Trinity River	3,400	a	0	34,000	37,400
8	Lower Trinity River	600	a	0	0	600
9	South Fork Trinity River	1,400	400	0	0	1,800
10	Southern Trinity River	300	a	0	0	300
	COUNTY TOTALS	5,700	400	0	34,000	40,100
	Yolo County					
30	Clear Lake	0	0	0	0	0
56	Colusa	79,000	200	0	0	79,200
59	Cortina	1,900	a	0	0	1,900
60	Arbuckle	20,500	200	0	0	20,700
64	West Yolo	400	a	0	1,500	1,900
65	Capay	4,200	a	0	0	4,200
66	Woodland	197,900	3,300	0	0	201,200
67	East Yolo	145,100	3,000	a	0	148,100
	COUNTY TOTALS	449,000	6,700	0	1,500	457,200
	Yuba County					
46	South Fork Feather River	0	0	0	0	0
47	North Yuba River	100	100	0	600	800
48	Challenge	2,500	a	0	600	3,100
58	Browns Valley	5,900	a	0	900	6,800
62	Marysville	168,300	4,100	2,000	0	174,400
	COUNTY TOTALS	176,800	4,200	2,000	2,100	185,100
	TOTALS, NORTHEASTERN COUNTIES	3,577,400	39,300	100,100	492,000	4,208,800

a Less than 50 acre-feet.

percentage, was estimated by comparison of developed water supplies to potential consumptive use, and from information furnished by watermasters on availability of water in watermaster service areas. Irrigated lands on the Sacramento Valley floor were evaluated as having a full water supply available, while in some of the mountain valleys in Siskiyou, Modoc, Lassen, and Plumas Counties, it was estimated that the available water supply would meet as little as 30 per cent of the potential consumptive use.

Estimates of mean seasonal consumptive use of applied water on present water service areas in the Northeastern Counties, based on present developed water supplies, are presented in Tables 48 and 49, by hydrographic units and counties, respectively.

Probable Ultimate Use of Applied Water

The procedures utilized in estimating probable ultimate consumptive use of applied water in the Northeastern Counties were similar to those employed to estimate present consumptive use. The amount of water that will be used on ultimately irrigated lands was estimated by multiplying the forecast ultimate acreage of each crop type by its respective unit value of consumptive use of applied water. Ultimate seasonal consumptive use of applied water by urban and suburban, rural domestic, recreational, industrial and swamp and marsh areas and principal reservoirs was estimated as the product of the ultimate level of development and the corresponding unit value of water use.

Estimates of ultimate consumptive use of applied water for irrigated lands are based on the assumption that a full seasonal water supply would be available to the net crop acreage that might ultimately be irrigated in any one season.

Consumptive use of applied water for urban and suburban, and rural domestic purposes, was computed as the product of the appropriate population estimates and the unit value of per capita water use.

TABLE 50

PROBABLE ULTIMATE MEAN SEASONAL CONSUMPTIVE USE OF APPLIED WATER WITHIN HYDROGRAPHIC UNITS, NORTHEASTERN COUNTIES

(In acre-feet)

Hydrographic unit: Reference number	Hydrographic unit: Name	Irrigated lands	Urban, suburban, rural, domestic population	Forest products industry	Recreation areas	Swamp and marsh lands	Net reservoir evaporation	Totals
	North Coastal Drainage Basin							
1	Tulelake	134,700	1,600	200	4,000	31,100	95,400	267,000
2	Butte Valley	95,200	1,000	200	1,800	400	8,600	107,200
3	Klamath River	30,800	2,000	700	2,100	0	68,500	104,100
4	Shasta Valley	185,500	4,900	1,200	1,400	3,700	12,900	209,600
5	Scott Valley	80,900	2,000	200	900	200	4,600	88,800
6	Salmon River	800	500	200	1,000	0	8,700	11,200
7	Upper Trinity River	3,100	500	100	2,300	0	34,000	40,000
8	Lower Trinity River	3,800	1,300	100	3,300	0	58,300	66,800
9	South Fork Trinity River	9,600	700	100	2,100	0	18,500	31,000
10	Southern Trinity County	7,200	300	100	1,300	0	21,300	30,200
11	Lake Pillsbury	0	800	100	1,200	0	4,300	6,400
	SUBTOTALS	551,600	15,600	3,200	21,400	35,400	335,100	962,300
	Central Valley Drainage Basin							
12	Goose Lake	59,300	400	[a]	400	0	400	60,500
13	Jess Valley	12,900	200	[a]	400	0	6,900	20,400
14	Alturas	182,200	3,000	100	1,800	200	36,600	223,900
15	Big Valley	132,900	1,900	200	1,600	4,000	20,200	160,800
16	McArthur	91,400	2,400	200	1,800	2,300	15,800	113,900
17	Hat Creek	28,100	1,900	500	3,300	1,700	2,800	38,300
18	Montgomery Creek	6,800	200	200	1,200	0	3,100	11,500
19	McCloud River	4,200	800	800	1,300	0	6,500	13,600
20	Dunsmuir	14,600	3,000	700	1,200	0	800	20,300
21	Shasta Lake	2,100	300	100	1,900	0	69,700	74,100
22	Clear Creek	500	200	100	900	0	15,400	17,100
23	Keswick	0	100	[a]	200	0	1,600	1,900
24	Cottonwood Creek	89,300	700	200	3,600	0	52,500	146,300
25	Olinda	17,000	900	[a]	100	0	5,300	23,300
26	Redbank Creek	39,200	3,600	0	600	0	0	43,400
27	Elder Creek	10,100	100	[a]	400	0	12,400	23,000
28	Thomes Creek	42,200	500	100	1,200	0	3,000	47,000
29	Stony Creek	84,700	900	[a]	2,300	300	44,100	132,300
30	Clear Lake	116,400	9,900	[a]	3,500	2,400	132,700	264,900
31	Middletown	17,600	1,100	[a]	600	0	8,100	27,400
32	Stillwater Plains	55,300	12,600	0	[a]	0	100	68,000
33	Cow Creek	71,200	1,500	100	1,400	[a]	14,000	88,200
34	Bear Creek	31,700	300	[a]	500	0	0	32,500
35	Battle Creek	39,400	800	200	1,500	[a]	2,100	44,000
36	Paynes Creek	6,800	100	[a]	500	0	4,700	12,100
37	Antelope Creek	2,700	300	[a]	1,000	0	0	4,000
38	Mill Creek	1,800	200	100	700	0	500	3,300
39	Deer Creek	3,200	400	100	1,200	0	4,100	9,000
40	Chico Creek	3,300	2,200	200	1,200	0	3,600	10,500
41	Paradise	38,700	8,100	100	300	[a]	9,400	56,600
42	North Fork Feather River	36,600	5,200	500	4,500	0	143,900	190,700
43	East Branch Feather River	52,800	2,000	200	3,500	0	27,300	85,800
44	Sierra Valley	168,300	1,400	100	1,200	0	5,400	176,400
45	Middle Fork Feather River	23,400	3,400	200	3,300	0	19,000	49,300
46	South Fork Feather River	1,500	2,500	100	1,100	0	8,900	14,100
47	Nortb Yuba River	4,900	1,400	200	2,400	0	8,300	17,200
48	Challenge	25,100	2,700	100	1,300	0	6,000	35,200
49	Wyandotte	71,900	13,700	[a]	200	100	700	86,600
50	Anderson	64,300	16,900	8,800	300	200	54,100	144,500
51	Corning	279,300	8,400	2,100	700	[a]	100	290,600
52	Los Molinos	173,900	7,900	2,100	500	[a]	50,000	234,400
53	Fruto	93,400	500	0	[a]	0	900	94,800
54	Orland	222,300	8,600	0	[a]	200	0	231,100
55	Durham	190,900	12,200	2,500	[a]	4,400	0	210,000
56	Colusa	1,277,100	13,100	0	1,900	26,500	200	1,318,800
57	Gridley	618,800	4,100	2,500	500	34,300	0	660,200
58	Browns Valley	33,000	3,600	0	600	0	3,200	40,400
59	Cortina	136,800	2,000	0	1,200	0	6,500	146,500
60	Arbuckle	201,600	7,100	0	[a]	0	0	208,700
61	Sutter	151,800	10,600	0	100	300	0	162,800
62	Marysville	398,100	13,600	2,100	900	2,000	15,900	432,600
63	Pleasant Grove	41,900	200	0	100	0	0	42,200
64	West Yolo	13,200	1,400	0	600	0	1,500	16,700
65	Capay	18,600	3,400	0	700	0	0	22,700
66	Woodland	289,800	60,400	0	300	0	0	350,500
67	East Yolo	291,500	10,800	0	800	200	0	303,300
	SUBTOTALS	6,086,400	275,700	25,500	63,300	79,100	828,300	7,358,300

TABLE 50—Continued

PROBABLE ULTIMATE MEAN SEASONAL CONSUMPTIVE USE OF APPLIED WATER WITHIN HYDROGRAPHIC UNITS, NORTHEASTERN COUNTIES

(In acre-feet)

Hydrographic unit		Irrigated lands	Urban, suburban, rural, domestic population	Forest products industry	Recreation areas	Swamp and marsh lands	Net reservoir evaporation	Totals
Reference number	Name							
	Lahontan Drainage Basin							
68	Surprise Valley	162,400	2,100	a	900	1,500	800	167,700
69	Madeline Plains	230,400	300	a	1,000	0	4,300	236,000
70	Eagle Lake	12,500	400	100	800	600	19,300	33,700
71	Willow Creek	26,500	100	a	300	1,200	2,300	30,400
72	Secret Valley	38,000	100	0	1,300	100	1,600	41,100
73	Susan River	132,500	4,500	100	900	3,000	12,900	153,900
74	Herlong	167,600	1,100	a	500	100	1,700	171,000
75	Little Truckee River	15,000	100	100	300	400	6,800	22,700
	SUBTOTALS	784,900	8,700	300	6,000	6,900	49,700	856,500
	TOTALS, NORTHEASTERN COUNTIES	7,422,900	300,000	29,000	90,700	121,400	1,213,100	9,177,100

a Less than 50 acre-feet.

Consumptive use of applied water was estimated to be 50 per cent of the urban delivery requirements.

The ultimate consumptive use of applied water for recreational purposes was determined by multiplying the estimated user-days for each type of use in the recreational areas by the appropriate unit value of gallons per user-day. The totals were then expressed in acre-feet per season and totaled for both hydrographic units and counties.

The probable ultimate consumptive use for forest products manufacture was estimated by multiplying the estimated annual production of lumber and other forest products that would be ultimately processed, on a sustained yield basis, by the appropriate average unit values of water consumed in processing.

For the purposes of evaluating consumptive use, the evaporation from water surfaces under ultimate conditions was estimated as the surface area in acres at maximum operating levels for existing reservoirs and those included in the Northeastern Counties under The California Water Plan, times the mean seasonal net evaporation loss.

Seasonal consumptive use of applied water from swamp and marsh lands was computed by multiplying the mean seasonal unit value of consumptive use by the estimated acreage of such lands.

Tables 50 and 51 show, by hydrographic units and counties, respectively, estimates of probable ultimate mean seasonal consumptive use of applied water within the Northeastern Counties.

TABLE 51

PROBABLE ULTIMATE MEAN SEASONAL CONSUMPTIVE USE OF APPLIED WATER WITHIN THE NORTHEASTERN COUNTIES

(In acre-feet)

County and hydrographic unit: Reference number	County and hydrographic unit: Name	Irrigated lands	Urban, suburban, and rural domestic population	Forest products industry	Recreational areas	Swamp and marsh lands	Net reservoir evaporation	Totals
	Butte County							
40	Chico Creek	3,000	2,100	200	900	0	3,600	9,800
41	Paradise	38,700	8,100	100	300	[a]	9,400	56,600
42	North Fork Feather River	8,200	3,400	400	2,100	0	63,700	77,800
45	Middle Fork Feather River	1,500	2,000	100	1,200	0	11,800	16,600
46	South Fork Feather River	1,300	2,400	100	900	0	7,700	12,400
48	Challenge	0	100	[a]	[a]	0	0	100
49	Wyandotte	71,900	13,700	[a]	200	100	700	86,600
52	Los Molinos	87,200	2,900	0	100	[a]	0	90,200
55	Durham	190,900	12,200	2,500	[a]	4,400	0	210,000
57	Gridley	464,000	3,300	2,500	300	14,400	200	484,700
	COUNTY TOTALS	866,700	50,200	5,900	6,000	18,900	97,100	1,044,800
	Colusa County							
29	Stony Creek	25,200	700	[a]	500	0	4,500	30,900
30	Clear Lake	15,200	600	0	400	0	100	16,300
53	Fruto	0	0	0	0	0	0	0
56	Colusa	621,200	6,600	0	700	12,100	0	640,600
57	Gridley	6,600	[a]	0	[a]	200	0	6,800
59	Cortina	90,500	900	0	700	0	6,500	98,600
60	Arbuckle	137,100	3,800	0	0	0	0	140,900
	COUNTY TOTALS	895,800	12,600	0	2,300	12,300	11,100	934,100
	Glenn County							
11	Lake Pillsbury	0	300	[a]	300	0	0	600
29	Stony Creek	51,600	1,800	[a]	1,400	300	21,100	76,200
53	Fruto	92,900	500	0	[a]	0	900	94,300
54	Orland	219,200	8,600	0	0	200	0	228,000
56	Colusa	337,200	3,900	0	400	12,400	0	353,900
57	Gridley	42,100	300	0	0	5,300	0	47,700
59	Cortina	2,200	[a]	0	[a]	0	0	2,200
	COUNTY TOTALS	745,200	15,400	0	2,100	18,200	22,000	802,900
	Lake County							
11	Lake Pillsbury	0	500	100	900	0	4,300	5,800
29	Stony Creek	0	100	[a]	100	0	0	200
30	Clear Lake	100,700	6,300	[a]	2,800	2,400	132,600	244,800
31	Middletown	17,600	1,100	[a]	600	0	8,100	27,400
	COUNTY TOTALS	118,300	8,000	100	4,400	2,400	145,000	278,200
	Lassen County							
13	Jess Valley	3,300	100	[a]	200	0	4,800	8,400
14	Alturas	0	[a]	0	[a]	0	2,900	2,900
15	Big Valley	80,600	1,100	100	700	500	1,800	84,800
16	McArthur	28,200	400	100	600	1,200	5,600	36,100
17	Hat Creek	700	200	100	300	0	0	1,300
42	North Fork Feather River	17,900	200	[a]	300	0	10,200	28,600
68	Surprise Valley	6,100	100	0	200	0	0	6,400
69	Madeline Plains	230,400	300	[a]	1,000	0	4,300	236,000
70	Eagle Lake	12,500	400	100	800	600	19,300	33,700
71	Willow Creek	26,500	100	[a]	300	1,200	2,300	30,400
72	Secret Valley	38,000	100	0	1,300	100	1,600	41,100
73	Susan River	132,500	4,500	100	900	3,000	12,900	153,900
74	Herlong	157,100	1,100	[a]	500	100	1,700	160,500
	COUNTY TOTALS	733,800	8,600	500	7,100	6,700	67,400	824,100
	Modoc County							
1	Tule Lake	76,500	200	100	2,300	300	57,700	137,100
12	Goose Lake	59,300	400	[a]	400	0	400	60,500
13	Jess Valley	9,600	100	[a]	200	0	2,100	12,000
14	Alturas	182,200	3,000	100	1,800	200	33,700	221,000
15	Big Valley	52,300	800	100	900	3,500	18,400	76,000
16	McArthur	6,200	100	[a]	[a]	100	0	6,400
68	Surprise Valley	156,300	2,000	[a]	700	1,500	800	161,300
	COUNTY TOTALS	542,400	6,600	300	6,300	5,600	113,100	674,300

TABLE 51—Continued

PROBABLE ULTIMATE MEAN SEASONAL CONSUMPTIVE USE OF APPLIED WATER WITHIN THE NORTHEASTERN COUNTIES

(In acre-feet)

County and hydrographic unit: Reference number	County and hydrographic unit: Name	Irrigated lands	Urban, suburban, and rural domestic population	Forest products industry	Recreational areas	Swamp and marsh lands	Net reservoir evaporation	Totals
	Plumas County							
40	Chico Creek	0	a	0	a	0	0	a
42	North Fork Feather River	10,500	1,600	100	2,000	0	70,000	84,200
43	East Branch Feather River	52,800	2,000	200	3,500	0	27,300	85,800
44	Sierra Valley	102,900	400	a	500	0	3,500	107,300
45	Middle Fork Feather River	21,900	1,400	100	2,100	0	7,200	32,700
46	South Fork Feather River	200	100	a	200	0	1,200	1,700
47	North Yuba River	0	100	a	100	0	0	200
73	Susan River	0	a	a	a	0	0	a
74	Herlong	0	a	a	a	0	0	a
	COUNTY TOTALS	188,300	5,600	400	8,400	0	109,200	311,900
	Shasta County							
16	McArthur	53,700	1,100	a	700	1,000	10,200	66,700
17	Hat Creek	27,400	1,700	400	3,000	1,700	2,800	37,000
18	Montgomery	6,800	200	200	1,200	0	3,100	11,500
19	McCloud River	1,200	a	100	400	0	3,900	5,600
20	Dunsmuir	1,800	200	100	700	0	0	2,800
21	Shasta Lake	2,100	300	100	1,900	0	69,700	74,100
22	Clear Creek	500	200	100	900	0	15,400	17,100
23	Keswick	0	100	a	200	0	1,600	1,900
24	Cottonwood	38,700	300	100	1,500	0	7,200	47,800
25	Olinda	17,000	900	a	100	0	5,300	23,300
32	Stillwater Plains	55,300	12,600	0	a	0	100	68,000
33	Cow Creek	71,200	1,500	100	1,400	a	14,000	88,200
34	Bear Creek	31,700	300	a	500	0	a	32,500
35	Battle Creek	16,500	400	100	600	a	1,100	18,700
38	Mill Creek	0	0	0	a	0	0	a
42	North Fork Feather River	0	0	a	100	0	0	100
50	Anderson	45,300	16,800	8,800	100	100	19,000	90,100
	COUNTY TOTALS	369,200	36,600	10,100	13,300	2,800	153,400	585,400
	Sierra County							
44	Sierra Valley	65,400	1,000	100	700	0	1,900	69,100
45	Middle Fork Feather River	0	0	a	a	0	0	a
47	North Yuba River	3,500	800	200	1,700	0	1,300	7,500
74	Herlong	10,500	0	a	a	0	0	10,500
75	Little Truckee River	15,000	100	100	300	400	6,800	22,700
	COUNTY TOTALS	94,400	1,900	400	2,700	400	10,000	109,800
	Siskiyou County							
1	Tule Lake	58,200	1,400	100	1,700	30,800	37,700	129,900
2	Butte Valley	95,200	1,000	200	1,800	400	8,600	107,200
3	Klamath River	30,800	2,000	700	2,100	0	68,500	104,100
4	Shasta Valley	185,500	4,900	1,200	1,400	3,700	12,900	209,600
5	Scott Valley	80,900	2,000	200	900	200	4,600	88,800
6	Salmon River	800	500	200	1,000	0	8,700	11,200
15	Big Valley	0	0	a	a	0	0	
16	McArthur	3,300	800	100	500	0	0	4,700
19	McCloud River	3,000	800	700	900	0	2,600	8,000
20	Dunsmuir	12,800	2,800	600	500	0	800	17,500
	COUNTY TOTALS	470,500	16,200	4,000	10,800	35,100	144,400	681,000
	Sutter County							
56	Colusa	228,200	2,100	0	800	2,000	0	233,100
57	Gridley	106,100	500	0	200	14,400	0	121,200
61	Sutter	151,800	10,600	0	100	300	0	162,800
62	Marysville	55,200	1,100	0	100	0	0	56,400
63	Pleasant Grove	41,900	200	0	100	0	0	42,200
67	East Yolo	87,200	1,600	0	200	200	0	89,200
	COUNTY TOTALS	670,400	16,100	0	1,500	16,900	0	704,900
	Tehama County							
24	Cottonwood Creek	50,600	400	100	2,100	0	45,300	98,500
26	Redbank Creek	39,200	3,600	0	600	0	0	43,400
27	Elder Creek	10,100	100	a	400	0	12,400	23,000
28	Thomes Creek	42,200	500	100	1,200	0	3,000	47,000
29	Stony Creek	7,900	100	a	300	0	18,500	26,800
35	Battle Creek	22,900	400	100	900	0	1,000	25,300

TABLE 51—Continued

PROBABLE ULTIMATE MEAN SEASONAL CONSUMPTIVE USE OF APPLIED WATER WITHIN THE NORTHEASTERN COUNTIES

(In acre-feet)

County and hydrographic unit: Reference number	County and hydrographic unit: Name	Irrigated lands	Urban, suburban, and rural domestic population	Forest products industry	Recreational areas	Swamp and marsh lands	Net reservoir evaporation	Totals
	Tehama County—Continued							
36	Paynes Creek	6,800	100	a	500	0	4,700	12,100
37	Antelope Creek	2,700	300	a	1,000	0	0	4,000
38	Mill Creek	1,800	200	100	700	0	500	3,300
39	Deer Creek	3,200	400	100	1,200	0	4,100	9,000
40	Chico Creek	300	100	a	300	0	0	700
50	Anderson	19,000	100	0	200	100	35,100	54,500
51	Corning	279,300	8,400	2,100	700	a	100	290,600
52	Los Molinos	86,700	5,000	2,100	400	0	50,000	144,200
53	Fruto	500	a	0	a	0	0	500
54	Orland	3,100	a	0	a	0	0	3,100
	COUNTY TOTALS	576,300	19,700	4,700	10,500	100	174,700	786,000
	Trinity County							
7	Upper Trinity River	3,100	500	100	2,300	0	34,000	40,000
8	Lower Trinity River	3,800	1,300	100	3,300	0	58,300	66,800
9	South Fork Trinity River	9,600	700	100	2,100	0	18,500	31,000
10	Southern Trinity County	7,200	300	100	1,300	0	21,300	30,200
	COUNTY TOTALS	23,700	2,800	400	9,000	0	132,100	168,000
	Yolo County							
30	Clear Lake	500	1,200	0	300	0	0	2,000
56	Colusa	90,500	500	0	a	0	0	91,000
59	Cortina	44,100	1,100	0	500	0	0	45,700
60	Arbuckle	64,500	3,300	0	a	0	0	67,800
64	West Yolo	13,200	1,400	0	600	0	1,500	16,700
65	Capay	18,600	3,400	0	700	0	0	22,700
66	Woodland	289,800	60,400	0	300	0	0	350,500
67	East Yolo	204,300	9,200	0	600	a	0	214,100
	COUNTY TOTALS	725,500	80,500	0	3,000	0	1,500	810,500
	Yuba County							
46	South Fork Feather River	0	a	a	a	0	0	a
47	North Yuba River	1,400	500	a	600	0	2,000	9,500
48	Challenge	25,100	2,600	100	1,300	0	6,000	35,100
58	Browns Valley	33,000	3,600	0	600	0	3,200	40,400
62	Marysville	342,900	12,500	2,100	800	2,000	15,900	376,200
	COUNTY TOTALS	402,400	19,200	2,200	3,300	2,000	32,100	461,200
	TOTALS, NORTHEASTERN COUNTIES	7,422,900	300,000	29,000	90,700	121,400	1,213,100	9,177,100

a Less than 50 acre-feet.

PROBABLE ULTIMATE WATER REQUIREMENTS TO MEET CONSUMPTIVE USES

A determination was made of the probable ultimate requirement for water for each hydrographic unit and county in the area under investigation. This estimate represents the gross amount of water required to meet both demands for consumptive use of applied water and irrecoverable losses incidental to its application, taking into consideration the re-use of return flow from water applied within the unit. Such an estimate is the measure of the required water supply that ultimately should be developed for the particular hydrographic unit or county. In general, the estimates of water requirements were derived by dividing the consumptive use of applied water by the appropriate water service area efficiency factor.

The various water requirements are considered and evaluated separately: for irrigated agriculture; for urban, suburban, and domestic population; for the forest products industry; and for recreation. The estimates of probable ultimate mean seasonal water requirements to meet consumptive demands are summarized for hydrographic units and counties within the Northeastern Counties in Tables 53 and 54, respectively.

Water Requirements for Irrigated Agriculture

Ultimate seasonal water requirements for irrigation in the Northeastern Counties were estimated by applying appropriate water service area efficiency factors to the seasonal consumptive use of applied water for each hydrographic unit. The resulting estimates represent the amounts of water which should be developed and delivered to the land at one or more strategically located points within the units to provide for irrigation use and for irrecoverable losses incidental to such use.

The first step in determination of the ultimate irrigation requirement for water was to divide each hydrographic unit into subareas, largely on the basis of topographic and geologic conditions. Irrigable lands within these subareas were segregated, on the basis of geological conditions, into lands overlying free ground water basins and those overlying confined ground water basins or nonwater-bearing materials. In the former case, relatively high water service area efficiencies were assumed, while in the latter case the water service area efficiency was estimated to be somewhat lower. Available data and experience in irrigation practice in comparable existing fully developed irrigated areas was considered in developing estimated ultimate water service area efficiencies.

For each hydrographic unit a weighted average water service area efficiency was computed, based on previously computed subarea efficiencies of irrigated lands overlying absorptive and nonabsorptive materials. Re-use of return flow from one subarea by another subarea which is topographically situated and geologically adapted to use of the return flow was also considered as an element in the overall efficiency. Return flows of irrigation water were thus routed through the entire hydrographic unit in order to determine the total requirement for irrigation water.

In Table 52 are presented the probable ultimate irrigation water service area efficiencies within hydrographic units of Northeastern Counties. Although, as stated above, water service area efficiencies include consideration of the re-use of water applied within the service area, they do not include allowances for unconsumed applied water, either surface or underground, from an upper hydrographic unit flowing into and fulfilling a portion of the requirement of a downstream unit.

TABLE 52

PROBABLE ULTIMATE IRRIGATION WATER SERVICE AREA EFFICIENCIES WITHIN HYDROGRAPHIC UNITS, NORTHEASTERN COUNTIES

Hydrographic unit		Efficiency, in per cent	Hydrographic unit		Efficiency, in per cent
Reference number	Name		Reference number	Name	
	North Coastal Drainage Basin		38	Mill Creek	50
1	Tulelake	65	39	Deer Creek	50
2	Butte Valley	60	40	Chico Creek	50
3	Klamath River	50	41	Paradise	75
4	Shasta Valley	55	42	North Fork Feather River	50
5	Scott Valley	55	43	East Branch Feather River	75
6	Salmon River	50	44	Sierra Valley	80
7	Upper Trinity River	50	45	Middle Fork Feather River	70
8	Lower Trinity River	50	46	South Fork Feather River	50
9	South Fork Trinity River	50	47	North Yuba River	50
10	Southern Trinity County	55	48	Challenge	75
11	Lake Pillsbury	55	49	Wyandotte	75
			50	Anderson	50
	Central Valley Drainage Basin		51	Corning	75
12	Goose Lake	50	52	Los Molinos	80
13	Jess Valley	70	53	Fruto	60
14	Alturas	70	54	Orland	75
15	Big Valley	70	55	Durham	80
16	McArthur	60	56	Colusa	70
17	Hat Creek	55	57	Gridley	75
18	Montgomery Creek	50	58	Browns Valley	50
19	McCloud River	50	59	Cortina	50
20	Dunsmuir	50	60	Arbuckle	60
21	Shasta Lake	50	61	Sutter	80
22	Clear Creek	50	62	Marysville	90
23	Keswick	50	63	Pleasant Grove	60
24	Cottonwood Creek	50	64	West Yolo	55
25	Olinda	50	65	Capay	85
26	Redbank Creek	50	66	Woodland	85
27	Elder Creek	50	67	East Yolo	70
28	Thomes Creek	50			
29	Stony Creek	60		**Lahontan Drainage Basin**	
30	Clear Lake	60	68	Surprise Valley	60
31	Middletown	50	69	Madeline Plains	50
32	Stillwater Plains	50	70	Eagle Lake	50
33	Cow Creek	50	71	Willow Creek	70
34	Bear Creek	50	72	Secret Valley	70
35	Battle Creek	50	73	Susan River	70
36	Paynes Creek	50	74	Herlong	70
37	Antelope Creek	50	75	Little Truckee River	50

Seasonal water requirements for irrigated agriculture, as evaluated herein, are mean values since they apply to mean seasonal conditions of water supply and climate. It has been further assumed that a full supply of water would be available to crops at all times and that optimum growing conditions would be maintained. It is recognized that seasonal variations in climate will cause appreciable variations in water requirements, and that the most critical effects will occur during periods of hot dry weather, with its resulting increased demands upon water sources. These periodic variations in water requirements during the irrigation seasons should be considered in planning for future water resource development.

Water Requirements for Urban and Suburban, and Rural Domestic Population

Water requirements for cities and towns, and for rural domestic uses were estimated by multiplying the estimated population in each category, within each hydrographic unit, by appropriate unit values of delivery requirements.

Estimates of population made by Pacific Planning and Research assume full development of all natural resources within the Northeastern Counties. Under present conditions, agriculture and timber resources now support, either directly or indirectly, about two-thirds of the existing population. Under ultimate conditions, it is expected that employment in agriculture and forest products industries will double with an attendant increase in population. However, it is anticipated that a substantial portion of the population in the Northeastern Counties, at the time of ultimate development, will be supported by recreational activities and their attendant services.

No unusual water requirements are anticipated for industrial purposes in urban areas. The requirements for forest products industries which may ultimately be located in the Northeastern Counties have been estimated separately.

Estimates of ultimate seasonal water requirements for urban and suburban, and rural domestic populations within hydrographic units and counties are presented in Tables 53 and 54, respectively.

Water Requirements for the Forest Products Industry

Seasonal water requirements for the forest products industry were computed by applying to the estimated production of each item, within each hydrographic unit, its unit value of seasonal water requirement. For fiberboard, paper products and pulp, only a minor amount of the processing water required is actually consumed. The unconsumed water returns to the stream system, preferably with treatment to remove chemicals that could create water pollution problems.

It was assumed that the water requirement for lumber production would be divided in proportion to the commercial forest lands within the hydrographic units. Assumptions as to the location of the processing plants for plywood, fiberboard, paper products, and pulp were such as to result in the maximum water requirement occurring within the Northeastern Counties.

Studies for the Statewide Water Resources Investigation, pertaining to suitable locations for the establishment of pulp and paper products industries, or related industries that utilize chemical processes, assumed that such industries should be located on or near tidewater. However the State Water Pollution Control Board, in a recent study entitled "Cooperative Study on Waste Treatment and Disposal Aspects of Development of Pulp and Paper Resources of California," analyzed the water supply and water pollution aspects of the industry. It was stated in this report that, "It appears that there would be sufficient water at the sites considered on the Sacramento River to make development of pulp industry practicable, if the waste disposal problem is solved."

Since the purpose of the Northeastern Counties Investigation is to evaluate the ultimate seasonal water requirement based upon full development of the natural resources, it is logical to assume that pollution problems will be overcome by technological advances, and that pulp and fiber products industries will be located near the source of raw materials. With these plants located near the forests and lumber mills full use could be made of logging wastes which are not presently utilized.

It was therefore assumed, for the purpose of estimating seasonal water requirements, that mills producing these products would be located in Siskiyou, Shasta, Tehama, Butte, and Yuba Counties. Within these counties mills would process pulp materials received from both local forests and sawmills and from the remaining timber producing counties in the area of investigation, excepting Trinity and Lake Counties. Pulp material from Trinity County was assumed to be processed in Shasta County, Tehama County, and in areas outside the Northeastern Counties, in approximately equal parts. Pulp material originating in Lake County was assumed to be processed entirely outside the Northeastern Counties area.

Estimates of ultimate seasonal water requirements for the forest products industry are presented in Tables 53 and 54 for hydrographic units and counties, respectively.

Water Requirements for Recreational Development

Estimates of water requirements for probable ultimate recreational services and facilities were based upon a survey of the recreational potential of the

Fort Jones, Siskiyou County, a Northern California Town

Yreka Studio & Camera Shop Photograph

Rural Domestic Development Near Dunsmuir

Department of Water Resources Photograph

Northeastern Counties by the firm of Pacific Planning and Research. The report on the procedure and results of the survey is included in Appendix A.

Seasonal water requirements for fish and wildlife were estimated by the State Department of Fish and Game. Fish and wildlife requirements for water other than the consumptive use of water by swamp and marsh lands and evaporation from reservoirs, such as maintenance of stream flow for fish life, and small incidental quantities to support the natural upland and big game, are nonconsumptive.

The requirements for stream flow maintenance should be determined for each stream as water project planning and development is considered. Where feasible, it should be made available in sufficient quantity and quality to provide for suitable temperature, velocity, depth, and permanence of flow throughout the year.

Reservoir stages should be balanced for each water resource development, as related to the various multipurpose uses, including the production of fish and other recreational aspects. Stable reservoirs, with minimum fluctuations, are most desirable from a fish conservation point of view. Operation of reservoirs should include, where feasible, provisions for the maintenance of a permanent pool of water above and beyond that required for silt storage.

Recreational attractions and present recreational development are described briefly for each county in Appendix A. In nearly all the Northeastern Counties, recreational development centers around the scenic mountains, lakes, and streams. However, even desert or swamp areas, often thought of as undesirable, provide a source of recreational attraction. Recreational activities include fishing, hunting, water sports, snow sports, hiking, nature studies, and many associated activities. With the prospect of a continuing rapid growth in population, an anticipated greater number of leisure hours in the future, and a relatively high income level in the State, it can be anticipated that all areas with high recreational potential will be developed to the maximum and more intensively utilized. Use of recreational facilities will not be confined to California residents, but these facilities will attract visitors from adjacent states and elsewhere in the nation.

The survey to determine recreational potential included a classification of lands in order to generally delimit those areas which will be subject to future recreational development. Classifications into which these lands were segregated provided a means of estimating the intensity of development that may ultimately occur. The probable ultimate recreational use was then estimated in terms of user-days, and the ultimate water requirements were computed as the product of the number of user-days for each category of recreational use and the appropriate unit value of seasonal water requirement.

Presented in Tables 53 and 54 are estimates of the probable ultimate requirements for recreational areas. Also presented in Tables 53 and 54 are estimates of water requirements to maintain swamp and marsh lands, as well as allowances for net reservoir evaporation from water surfaces of future man-made reservoirs.

TOTAL SEASONAL WATER REQUIREMENTS

Tables 53 and 54 present estimates of the total seasonal water requirements for each hydrographic unit, and for each of the fifteen counties within the Northeastern Counties. This presentation summarizes all of the water requirements resulting from consumptive demands, and gives consideration to the re-use of water within each unit. The values do not, however, consider the re-use of applied water within lower hydrographic units. A part of the water applied to irrigated lands, delivered to urban areas, and used in industry, subsequently returns to the stream channels where it is available for use in lower hydrographic units. In addition to the residue of undeveloped water supplies, all return flows from the Central Valley region of the Northeastern Counties would be available in the Sacramento-San Joaquin Delta for use elsewhere in California.

TABLE 53

PROBABLE ULTIMATE MEAN SEASONAL WATER REQUIREMENTS WITHIN HYDROGRAPHIC UNITS, NORTHEASTERN COUNTIES

(In acre-feet)

Hydrographic unit: Reference number	Hydrographic unit: Name	Irrigated lands	Urban, suburban, and rural population	Forest products industry	Recreational areas	Swamp and marsh lands	Net reservoir evaporation	Totals
	North Coastal Drainage Basin							
1	Tulelake	207,200	3,300	200	4,000	31,100	95,400	341,200
2	Butte Valley	158,600	2,100	200	1,800	400	8,600	171,700
3	Klamath River	61,700	4,000	700	2,100	0	68,500	137,000
4	Shasta Valley	341,800	9,700	10,900	1,400	3,700	12,900	380,400
5	Scott Valley	147,000	4,000	200	900	200	4,600	156,900
6	Salmon River	1,700	1,000	200	1,000	0	8,700	12,600
7	Upper Trinity River	6,300	1,000	100	2,300	0	34,000	43,700
8	Lower Trinity River	7,700	2,700	100	3,300	0	58,300	72,100
9	South Fork Trinity River	19,200	1,400	100	2,100	0	18,500	41,300
10	Southern Trinity County	13,200	500	100	1,300	0	21,300	36,400
11	Lake Pillsbury	0	1,800	100	1,200	0	4,300	7,400
	SUBTOTALS	964,400	31,500	12,900	21,400	35,400	335,100	1,400,700
	Central Valley Drainage Basin							
12	Goose Lake	118,600	900	[a]	400	0	400	120,300
13	Jess Valley	18,400	300	[a]	400	0	6,900	26,000
14	Alturas	260,300	5,900	100	1,800	200	36,600	304,900
15	Big Valley	189,800	4,000	200	1,600	4,000	20,200	219,800
16	McArthur	132,100	4,800	200	1,800	2,300	15,800	157,000
17	Hat Creek	44,500	3,700	500	3,300	1,700	2,800	56,500
18	Montgomery Creek	13,400	500	200	1,200	0	3,100	18,400
19	McCloud River	8,500	1,700	5,700	1,300	0	6,500	23,700
20	Dunsmuir	29,200	6,100	5,600	1,200	0	800	42,900
21	Shasta Lake	4,100	600	100	1,900	0	69,700	76,400
22	Clear Creek	1,000	300	100	900	0	15,400	17,700
23	Keswick	0	200	[a]	200	0	1,600	2,000
24	Cottonwood Creek	178,500	1,500	200	3,600	0	52,500	236,300
25	Olinda	34,000	1,800	[a]	100	0	5,300	41,200
26	Redbank Creek	78,300	7,200	0	600	0	0	86,100
27	Elder Creek	20,300	200	[a]	400	0	12,400	33,300
28	Thomes Creek	84,500	1,100	100	1,200	0	3,000	89,900
29	Stony Creek	141,100	1,700	[a]	2,300	300	44,100	189,500
30	Clear Lake	193,900	20,100	[a]	3,500	2,400	132,700	352,600
31	Middletown	35,300	2,200	[a]	600	0	8,100	46,200
32	Stillwater Plains	110,700	25,200	0	[a]	0	100	136,000
33	Cow Creek	142,100	3,000	100	1,400	[a]	14,000	160,600
34	Bear Creek	63,300	700	[a]	500	0	0	64,500
35	Battle Creek	77,200	1,600	200	1,500	[a]	2,100	82,600
36	Paynes Creek	13,600	300	[a]	500	0	4,700	19,100
37	Antelope Creek	5,300	600	[a]	1,000	0	0	6,900
38	Mill Creek	3,600	400	100	700	0	500	5,300
39	Deer Creek	6,400	800	100	1,200	0	4,100	12,600
40	Chico Creek	6,700	4,400	200	1,200	0	3,600	16,100
41	Paradise	51,500	16,200	100	300	[a]	9,400	77,500
42	North Fork Feather River	73,100	10,500	500	4,500	0	143,900	232,500
43	East Branch Feather River	70,300	4,000	200	3,500	0	27,300	105,300
44	Sierra Valley	210,300	2,800	100	1,200	0	5,400	219,800
45	Middle Fork Feather River	34,200	6,800	200	3,300	0	19,000	63,500
46	South Fork Feather River	3,000	5,100	100	1,100	0	8,900	18,200
47	North Yuba River	9,800	2,900	200	2,400	0	8,300	23,600
48	Challenge	33,500	5,300	100	1,300	0	6,000	46,200
49	Wyandotte	95,900	27,400	[a]	200	100	700	124,300
50	Anderson	128,700	33,800	87,800	300	200	54,100	304,900
51	Corning	372,400	16,900	21,700	700	[a]	100	411,800
52	Los Molinos	217,400	15,800	21,700	500	[a]	50,000	305,400
53	Fruto	155,700	1,000	0	[a]	0	900	157,600
54	Orland	296,300	17,100	0	[a]	200	0	313,600
55	Durham	238,600	24,400	24,900	[a]	4,400	0	292,300
56	Colusa	1,824,400	26,300	0	1,900	26,500	200	1,879,300
57	Gridley	825,000	8,500	24,900	500	34,300	0	893,200
58	Browns Valley	66,000	7,200	0	600	0	3,200	77,000
59	Cortina	273,600	4,100	0	1,200	0	6,500	285,400
60	Arbuckle	336,000	14,400	0	[a]	0	0	350,400
61	Sutter	189,700	21,200	0	100	300	0	211,300
62	Marysville	442,300	27,300	21,000	900	2,000	15,900	509,400
63	Pleasant Grove	69,900	200	0	100	0	0	70,200
64	West Yolo	24,000	2,800	0	600	0	1,500	28,900
65	Capay	21,900	6,900	0	700	0	0	29,500
66	Woodland	340,100	120,800	0	300	0	0	461,200
67	East Yolo	416,300	21,700	0	800	200	0	439,000
	SUBTOTALS	8,834,600	553,200	217,200	63,300	79,100	828,300	10,575,700

TABLE 53—Continued

PROBABLE ULTIMATE MEAN SEASONAL WATER REQUIREMENTS WITHIN HYDROGRAPHIC UNITS, NORTHEASTERN COUNTIES

(In acre-feet)

Hydrographic unit		Irrigated lands	Urban, suburban, and rural population	Forest products industry	Recreational areas	Swamp and marsh lands	Net reservoir evaporation	Totals
Reference number	Name							
	Lahontan Drainage Basin							
68	Surprise Valley	270,600	4,100	[a]	900	1,500	800	277,900
69	Madeline Plains	460,800	700	[a]	1,000	0	4,300	466,800
70	Eagle Lake	24,900	900	100	800	600	19,300	46,600
71	Willow Creek	37,800	300	[a]	300	1,200	2,300	41,900
72	Secret Valley	54,300	200	0	1,300	100	1,600	57,500
73	Susan River	189,300	9,000	100	900	3,000	12,900	215,200
74	Herlong	239,400	2,300	[a]	500	100	1,700	244,000
75	Little Truckee River	30,000	200	100	300	400	6,800	37,800
	SUBTOTALS	1,307,100	17,700	300	6,000	6,900	49,700	1,387,700
	TOTALS, NORTHEASTERN COUNTIES	11,106,100	602,400	230,400	90,700	121,400	1,213,100	13,364,100

[a] Less than 50 acre-feet.

TABLE 54

PROBABLE ULTIMATE MEAN SEASONAL WATER REQUIREMENTS WITHIN THE NORTHEASTERN COUNTIES

(In acre-feet)

County and hydrographic unit		Irrigated lands	Urban, suburban, and rural population	Forest products industry	Recreational areas	Swamp and marsh lands	Net reservoir evaporation	Totals
Reference number	Name							
	Butte County							
40	Chico Creek	6,000	4,200	200	900	0	3,600	14,900
41	Paradise	51,500	16,200	100	300	a	9,400	77,500
42	North Fork Feather River	16,400	6,900	400	2,100	0	63,700	89,506
45	Middle Fork Feather River	3,000	4,000	100	1,200	0	11,800	20,100
46	South Fork Feather River	2,600	4,800	100	900	0	7,700	16,100
48	Challenge	0	100	a	a	0	0	100
49	Wyandotte	95,900	27,400	a	200	100	700	124,300
52	Los Molinos	109,000	5,800	0	100	a	0	114,900
55	Durham	238,600	24,400	24,900	a	4,400	0	292,300
57	Gridley	618,700	6,700	24,900	300	14,400	200	665,200
	COUNTY TOTALS	1,141,700	100,500	50,700	6,000	18,900	97,100	1,414,900
	Colusa County							
29	Stony Creek	41,900	1,400	a	500	0	4,500	48,300
30	Clear Lake	25,300	1,300	0	400	0	100	27,100
53	Fruto	0	0	0	0	0	0	0
56	Colusa	887,400	13,300	0	700	12,100	0	913,500
57	Gridley	8,700	a	0	a	200	0	8,900
59	Cortina	181,000	1,900	0	700	0	6,500	190,100
60	Arbuckle	228,500	7,700	0	0	0	0	236,200
	COUNTY TOTALS	1,372,800	25,600	0	2,300	12,300	11,100	1,424,100
	Glenn County							
11	Lake Pillsbury	0	700	a	300	0	0	1,000
29	Stony Creek	86,000	3,700	a	1,400	300	21,100	112,500
53	Fruto	154,800	1,000	0	a	0	900	156,700
54	Orland	292,200	17,100	0	0	200	0	309,500
56	Colusa	481,700	7,800	0	400	12,400	0	502,300
57	Gridley	56,200	700	0	0	5,300	0	62,200
59	Cortina	4,400	a	0	a	0	0	4,400
	COUNTY TOTALS	1,075,300	31,000	0	2,100	18,200	22,000	1,148,600
	Lake County							
11	Lake Pillsbury	0	1,100	100	900	0	4,300	6,400
29	Stony Creek	0	100	a	100	0	0	200
30	Clear Lake	167,800	12,700	a	2,800	2,400	132,600	318,300
31	Middletown	35,300	2,200	a	600	0	8,100	46,200
	COUNTY TOTALS	203,100	16,100	100	4,400	2,400	145,000	371,100
	Lassen County							
13	Jess Valley	4,700	200	a	200	0	4,800	9,900
14	Alturas	0	a	0	a	0	2,900	2,900
15	Big Valley	115,100	2,300	100	700	500	1,800	120,500
16	McArthur	42,000	800	100	600	1,200	5,600	50,300
17	Hat Creek	1,200	300	100	300	0	0	1,900
42	North Fork Feather River	35,700	400	a	300	0	10,200	46,600
68	Surprise Valley	10,100	100	0	200	0	0	10,400
69	Madeline Plains	460,800	700	a	1,000	0	4,300	466,800
70	Eagle Lake	24,900	900	100	800	600	19,300	46,600
71	Willow Creek	37,800	300	a	300	1,200	2,300	41,900
72	Secret Valley	54,300	200	0	1,300	100	1,600	57,500
73	Susan River	189,300	9,000	100	900	3,000	12,900	215,200
74	Herlong	224,400	2,300	a	500	100	1,700	229,000
	COUNTY TOTALS	1,200,300	17,500	500	7,100	6,700	67,400	1,299,500
	Modoc County							
1	Tulelake	117,700	400	100	2,300	300	57,700	178,506
12	Goose Lake	118,600	900	a	400	0	400	120,300
13	Jess Valley	13,700	100	a	200	0	2,100	16,100
14	Alturas	260,300	5,900	100	1,800	200	33,700	302,000
15	Big Valley	74,700	1,700	100	900	3,500	18,400	99,300
16	McArthur	7,100	100	a	a	100	0	7,300
68	Surprise Valley	260,500	4,000	a	700	1,500	800	267,500
	COUNTY TOTALS	852,600	13,100	300	6,300	5,600	113,100	991,000

TABLE 54—Continued

PROBABLE ULTIMATE MEAN SEASONAL WATER REQUIREMENTS WITHIN THE NORTHEASTERN COUNTIES

(In acre-feet)

County and hydrographic unit		Irrigated lands	Urban, suburban, and rural population	Forest products industry	Recreational areas	Swamp and marsh lands	Net reservoir evaporation	Totals
Reference number	Name							
	Plumas County							
40	Chico Creek	0	a	0	a	0	0	a
42	North Fork Feather River	21,000	3,200	100	2,000	0	70,000	96,300
43	East Branch Feather River	70,300	4,000	200	3,500	0	27,300	105,300
44	Sierra Valley	128,600	800	a	500	0	3,500	133,400
45	Middle Fork Feather River	31,200	2,800	100	2,100	0	7,200	43,400
46	South Fork Feather River	400	300	a	200	0	1,200	2,100
47	North Yuba River	0	100	a	100	0	0	200
73	Susan River	0	a	a	a	0	0	a
74	Herlong	0	a	a	a	0	0	a
	COUNTY TOTALS	251,500	11,200	400	8,400	0	109,200	380,700
	Shasta County							
16	McArthur	79,500	2,200	a	700	1,000	10,200	93,600
17	Hat Creek	43,300	3,400	400	3,000	1,700	2,800	54,600
18	Montgomery Creek	13,400	500	200	1,200	0	3,100	18,400
19	McCloud River	2,500	a	100	400	0	3,900	6,900
20	Dunsmuir	3,600	400	100	700	0	0	4,800
21	Shasta Lake	4,100	600	100	1,900	0	69,700	76,400
22	Clear Creek	1,000	300	100	900	0	15,400	17,700
23	Keswick	0	200	a	200	0	1,600	2,000
24	Cottonwood Creek	77,300	600	100	1,500	0	7,200	86,700
25	Olinda	34,000	1,800	a	100	0	5,300	41,200
32	Stillwater Plains	110,700	25,200	0	a	0	100	136,000
33	Cow Creek	142,100	3,000	100	1,400	a	14,000	160,600
34	Bear Creek	63,300	700	a	500	0	a	64,500
35	Battle Creek	31,300	700	100	600	a	1,100	33,800
38	Mill Creek	0	0	0	a	0	0	a
42	North Fork Feather River	0	0	a	100	0	0	100
50	Anderson	90,600	33,500	87,800	100	100	19,000	231,100
	COUNTY TOTALS	696,700	73,100	89,100	13,300	2,800	153,400	1,028,400
	Sierra County							
44	Sierra Valley	81,800	2,000	100	700	0	1,900	86,500
45	Middle Fork Feather River	0	a	a	a	0	0	a
47	North Yuba River	7,000	1,700	200	1,700	0	1,300	11,900
74	Herlong	14,900	a	a	a	0	0	14,900
75	Little Truckee River	30,000	200	100	300	400	6,800	37,800
	COUNTY TOTALS	133,700	3,900	400	2,700	400	10,000	151,100
	Siskiyou County							
1	Tulelake	89,500	2,900	100	1,700	30,800	37,700	162,700
2	Butte Valley	158,600	2,100	200	1,800	400	8,600	171,700
3	Klamath River	61,700	4,000	700	2,100	0	68,500	137,000
4	Shasta River	341,800	9,700	10,900	1,400	3,700	12,900	380,400
5	Scott Valley	147,000	4,000	200	900	200	4,600	156,900
6	Salmon River	1,700	1,000	200	1,000	0	8,700	12,600
15	Big Valley	0	0	a	a	0	0	a
16	McArthur	3,500	1,700	100	500	0	0	5,800
19	McCloud River	6,000	1,700	5,600	900	0	2,600	16,800
20	Dunsmuir	25,600	5,700	5,500	500	0	800	38,100
	COUNTY TOTALS	835,400	32,800	23,500	10,800	35,100	144,400	1,082,000
	Sutter County							
56	Colusa	326,000	4,200	0	800	2,000	0	333,000
57	Gridley	141,400	1,100	0	200	14,400	0	157,100
61	Sutter	189,700	21,200	0	100	300	0	211,300
62	Marysville	61,300	2,300	0	100	0	0	63,700
63	Pleasant Grove	69,900	200	0	100	0	0	70,200
67	East Yolo	124,500	3,200	0	200	200	0	128,100
	COUNTY TOTALS	912,800	32,200	0	1,500	16,900	0	963,400
	Tehama County							
24	Cottonwood Creek	101,200	900	100	2,100	0	45,300	149,600
26	Redbank Creek	78,300	7,200	0	600	0	0	86,100
27	Elder Creek	20,300	200	a	400	0	12,400	33,300
28	Thomes Creek	84,500	1,100	100	1,200	0	3,000	89,900
29	Stony Creek	13,200	200	a	300	0	18,500	32,200
35	Battle Creek	45,900	900	100	900	0	1,000	48,800

TABLE 54—Continued

PROBABLE ULTIMATE MEAN SEASONAL WATER REQUIREMENTS WITHIN THE NORTHEASTERN COUNTIES

(In acre-feet)

County and hydrographic unit		Irrigated lands	Urban, suburban, and rural population	Forest products industry	Recreational areas	Swamp and marsh lands	Net reservoir evaporation	Totals
Reference number	Name							
	Tehama County—Continued							
36	Paynes Creek	13,600	300	a	500	0	4,700	19,100
37	Antelope Creek	5,300	600	a	1,000	0	0	6,900
38	Mill Creek	3,600	400	100	700	0	500	5,300
39	Deer Creek	6,400	800	100	1,200	0	4,100	12,600
40	Chico Creek	700	200	a	300	0	0	1,200
50	Anderson	38,100	300	0	200	100	35,100	73,800
51	Corning	372,400	16,900	21,700	700	a	100	411,800
52	Los Molinos	108,400	10,000	21,700	400	0	50,000	190,500
53	Fruto	900	a	0	a	0	0	900
54	Orland	4,100	a	0	a	0	0	4,100
	COUNTY TOTALS	896,900	40,000	43,900	10,500	100	174,700	1,166,100
	Trinity County							
7	Upper Trinity River	6,300	1,000	100	2,300	0	34,000	43,700
8	Lower Trinity River	7,700	2,700	100	3,300	0	58,300	72,100
9	South Fork Trinity River	19,200	1,400	100	2,100	0	18,500	41,300
10	Southern Trinity County	13,200	500	100	1,300	0	21,300	36,400
	COUNTY TOTALS	46,400	5,600	400	9,000	0	132,100	193,500
	Yolo County							
30	Clear Lake	800	2,400	0	300	0	0	3,500
56	Colusa	129,300	1,000	0	a	0	0	130,300
59	Cortina	88,200	2,200	0	500	0	0	90,900
60	Arbuckle	107,500	6,700	0	a	0	0	114,200
64	West Yolo	24,000	2,800	0	600	0	1,500	28,900
65	Capay	21,900	6,900	0	700	0	0	29,500
66	Woodland	340,100	120,800	0	300	0	0	461,200
67	East Yolo	291,800	18,500	0	600	a	0	310,900
	COUNTY TOTALS	1,003,600	161,300	0	3,000	0	1,500	1,169,400
	Yuba County							
46	South Fork Feather River	0	a	a	a	0	0	a
47	North Yuba River	2,800	1,100	a	600	0	7,000	11,500
48	Challenge	33,500	5,200	100	1,300	0	6,000	46,100
58	Brown's Valley	66,000	7,200	0	600	0	3,200	77,000
62	Marysville	381,000	25,000	21,000	800	2,000	15,900	445,700
	COUNTY TOTALS	483,300	38,500	21,100	3,300	2,000	32,100	580,300
	TOTALS, NORTHEASTERN COUNTIES	11,106,100	602,400	230,400	90,700	121,400	1,213,100	13,364,100

[a] Less than 50 acre-feet.

LIMITED SEASONAL WATER REQUIREMENTS

It has been previously stated that estimates of ultimate water requirements must be practicable and reasonable, and that a quantitative evaluation must give full consideration to the physical availability of water resources and the practicability of development. A review of estimates of water requirements based on land resources only indicated that certain hydrographic units would be areas of water deficiency. That is, the available water supply for the unit would be inadequate in quantity to meet water requirements established on a land area basis. Other hydrographic units would have adequate water resources to satisfy the computed water requirements, but possibilities for development would be difficult and costly. Consequently three types of areas, with reference to the relationship of supply and demand, are found in the Northeastern Counties:

(1) Those hydrographic units in which the total water supply is less than the total estimated future demand for water, and for which interbasin exchange or transfer would be physically difficult and expensive to accomplish.

(2) Those hydrographic units in which the total water supply exceeds the computed water requirements, but possibilities for development are limited. The known plans for developing water would be expensive, and economic feasibility is not anticipated under foreseeable economic conditions.

(3) Those hydrographic units in which the total water supply exceeds the computed water requirements, and the ease and practicability of development is apparent. Generally these units are on the floor of the Sacramento Valley where water supplies can be regulated and conveyed to the areas of demand within present standards of permissible cost. The degree of economic and financial feasibility for each service area would, however, require detailed investigation and study.

In evaluating practicable and reasonable ultimate irrigation requirements, those areas in which the water supply is less than the water requirement based on full development of all resources were given special consideration. It is evident that between the two extreme types of areas previously enumerated there will be many for which available information or knowledge of future economic conditions does not permit, at this time, a supportable conclusion on the economics of projects which might meet their demands.

The hydrographic units listed below are those for which it was determined that water supply developments to meet total ultimate water requirements would be impracticable and unreasonable. In each unit the available local water supply is less than the estimated ultimate water requirement necessary to serve all lands. Although further development of local water supplies could be expected, importation of all supplemental water requirements does not appear practicable on the basis of present knowledge.

Hydrographic unit	*Name*	*County*
2	Butte Valley	Siskiyou
14	Alturas	Modoc
15	Big Valley	Modoc and Lassen
44	Sierra Valley	Plumas and Sierra
68	Surprise Valley	Modoc
69	Madeline Plains	Lassen
70	Eagle Lake	Lassen
71	Willow Creek	Lassen
72	Secret Valley	Lassen
73	Susan River	Lassen
74	Herlong	Lassen

Following this determination, limited ultimate seasonal water requirements for these hydrographic units were computed as follows:

(1) For each of the units, pertinent published and unpublished reports were studied to secure data on physical plans for developing the available water supply.

(2) From these plans, firm seasonal yields of water were determined and potential service areas were approximated.

(3) On the basis of topographic and geologic conditions the irrigable lands overlying potential ground water basins, within the units, were approximately delineated.

(4) Utilizing these data as a basis, tempered by judgment and observation, the total gross irrigable land was reduced to an area that could ultimately be served by the available water resources.

(5) A crop pattern was projected on the net irrigable land determined in Step 4, and the ultimate seasonal consumptive use was computed by the application of appropriate unit values of seasonal consumptive use to each crop type.

(6) The ultimate seasonal water requirements were computed by applying estimated water service area efficiency factors to the computed quantities of consumptive use of applied water.

Water requirements were limited for irrigated lands only. No reductions were made in the water requirements for urban, industrial, recreational, or evaporation uses. Results of the estimated limited probable ultimate mean seasonal water requirements for irrigated lands are shown in Tables 55 and 56.

TABLE 55

LIMITED PROBABLE ULTIMATE MEAN SEASONAL WATER REQUIREMENTS WITHIN HYDROGRAPHIC UNITS, NORTHEASTERN COUNTIES

(In acre-feet)

Hydrographic unit: Reference number	Hydrographic unit: Name	Irrigated lands	Urban, suburban, and rural population	Forest products industry	Recreational areas	Swamp and marsh lands	Net reservoir evaporation	Totals
	North Coastal Drainage Basin							
1	Tulelake	207,200	3,300	200	4,000	31,100	95,400	341,200
2	Butte Valley*	115,000	2,100	200	1,800	400	8,600	128,100
3	Klamath River	61,700	4,000	700	2,100	0	68,500	137,000
4	Shasta Valley	341,800	9,700	10,900	1,400	3,700	12,900	380,400
5	Scott Valley	147,000	4,000	200	900	200	4,600	156,900
6	Salmon River	1,700	1,000	200	1,000	0	8,700	12,600
7	Upper Trinity River	6,300	1,000	100	2,300	0	34,000	43,700
8	Lower Trinity River	7,700	2,700	100	3,300	0	58,300	72,100
9	South Fork Trinity River	19,200	1,400	100	2,100	0	18,500	41,300
10	Southern Trinity County	13,200	500	100	1,300	0	21,300	36,400
11	Lake Pillsbury	0	1,800	100	1,200	0	4,300	7,400
	SUBTOTALS	920,800	31,500	12,900	21,400	35,400	335,100	1,357,100
	Central Valley Drainage Basin							
12	Goose Lake	118,600	900	a	400	0	400	120,300
13	Jess Valley	18,400	300	a	400	0	6,900	26,000
14	Alturas*	166,800	5,900	100	1,800	200	36,600	211,400
15	Big Valley*	149,600	4,000	200	1,600	4,000	20,200	179,600
16	McArthur	132,100	4,800	200	1,800	2,300	15,800	157,000
17	Hat Creek	44,500	3,700	500	3,300	1,700	2,800	56,500
18	Montgomery Creek	13,400	500	200	1,200	0	3,100	18,400
19	McCloud River	8,500	1,700	5,700	1,300	0	6,500	23,700
20	Dunsmuir	29,200	6,100	5,600	1,200	0	800	42,900
21	Shasta Lake	4,100	600	100	1,900	0	69,700	76,400
22	Clear Creek	1,000	300	100	900	0	15,400	17,700
23	Keswick	0	200	a	200	0	1,600	2,000
24	Cottonwood Creek	178,500	1,500	200	3,600	0	52,500	236,300
25	Olinda	34,000	1,800	a	100	0	5,300	41,200
26	Redbank Creek	78,300	7,200	0	600	0	0	86,100
27	Elder Creek	20,300	200	a	400	0	12,400	33,300
28	Thomes Creek	84,500	1,100	100	1,200	0	3,000	89,900
29	Stony Creek	141,100	1,700	a	2,300	300	44,100	189,500
30	Clear Lake	193,900	20,100	a	3,500	2,400	132,700	352,600
31	Middletown	35,300	2,200	a	600	0	8,100	46,200
32	Stillwater Plains	110,700	25,200	0	a	0	100	136,000
33	Cow Creek	142,100	3,000	100	1,400	a	14,100	160,600
34	Bear Creek	63,300	700	a	500	0	0	64,500
35	Battle Creek	77,200	1,600	200	1,500	a	2,100	82,600
36	Paynes Creek	13,600	300	a	500	0	4,700	19,100
37	Antelope Creek	5,300	600	a	1,000	0	0	6,900
38	Mill Creek	3,600	400	100	700	0	500	5,300
39	Deer Creek	6,400	800	100	1,200	0	4,100	12,600
40	Chico Creek	6,700	4,400	200	1,200	0	3,600	16,100
41	Paradise	51,500	16,200	100	300	a	9,400	77,500
42	North Fork Feather River	73,100	10,500	500	4,500	0	143,900	232,500
43	East Branch Feather River	70,300	4,000	200	3,500	0	27,300	105,300
44	Sierra Valley*	128,600	2,800	100	1,200	0	5,400	138,100
45	Middle Fork Feather River	34,200	6,800	200	3,300	0	19,000	63,500
46	South Fork Feather River	3,000	5,100	100	1,100	0	8,900	18,200
47	North Yuba River	9,800	2,900	200	2,400	0	8,300	23,600
48	Challenge	33,500	5,300	100	1,300	0	6,000	46,200
49	Wyandotte	95,900	27,400	a	200	100	700	124,300
50	Anderson	128,700	33,800	87,800	300	200	54,100	304,900
51	Corning	372,400	16,900	21,700	700	a	100	411,800
52	Los Molinos	217,400	15,800	21,700	500	a	50,000	305,400
53	Fruto	155,700	1,000	0	a	0	900	157,600
54	Orland	296,300	17,100	0	a	200	0	313,600
55	Durham	238,600	24,400	24,900	a	4,400	0	292,300
56	Colusa	1,824,400	26,300	0	1,900	26,500	200	1,879,300
57	Gridley	825,000	8,500	24,900	500	34,300	0	899,200
58	Browns Valley	66,000	7,200	0	600	0	3,200	77,000
59	Cortina	273,600	4,100	0	1,200	0	6,500	285,400
60	Arbuckle	336,000	14,400	0	a	0	0	350,400
61	Sutter	189,700	21,200	0	100	300	0	211,300
62	Marysville	442,300	27,300	21,000	900	2,000	15,900	509,400
63	Pleasant Grove	69,900	200	0	100	0	0	70,200
64	West Yolo	24,000	2,800	0	600	0	1,500	28,900
65	Capay	21,900	6,900	0	700	0	0	29,500
66	Woodland	340,100	120,800	0	300	0	0	461,200
67	East Yolo	416,300	21,700	0	800	200	0	439,000
	SUBTOTALS	8,619,200	553,200	217,200	63,300	79,100	828,300	10,360,300

TABLE 55—Continued

LIMITED PROBABLE ULTIMATE MEAN SEASONAL WATER REQUIREMENTS WITHIN HYDROGRAPHIC UNITS, NORTHEASTERN COUNTIES

(In acre-feet)

Hydrographic unit		Irrigated lands	Urban, suburban, and rural population	Forest products industry	Recreational areas	Swamp and marsh lands	Net reservoir evaporation	Totals
Reference number	Name							
	Lahontan Drainage Basin							
68	Surprise Valley*	112,000	4,100	[a]	900	1,500	800	119,300
69	Madeline Plains*	30,000	700	[a]	1,000	0	4,300	36,000
70	Eagle Lake*	18,400	900	100	800	600	19,300	40,100
71	Willow Creek*	37,800	300	[a]	300	1,200	2,300	41,900
72	Secret Valley*	37,800	200	0	1,300	100	1,600	41,000
73	Susan River*	93,000	9,000	100	900	3,000	12,900	118,900
74	Herlong*	22,600	2,300	[a]	500	100	1,700	27,200
75	Little Truckee River	30,000	200	100	300	400	6,800	37,800
	SUBTOTALS	381,600	17,700	300	6,000	6,900	49,700	462,200
	TOTALS, NORTHEASTERN COUNTIES	9,921,600	602,400	230,400	90,700	121,400	1,213,100	12,179,600

[a] Less than 50 acre-feet.

* Hydrographic unit in which probable ultimate water requirement would be limited by available water supply.

TABLE 56

LIMITED PROBABLE ULTIMATE MEAN SEASONAL WATER REQUIREMENTS WITHIN THE NORTHEASTERN COUNTIES

(In acre-feet)

County and hydrographic unit		Irrigated lands	Urban, suburban, and rural population	Forest products industry	Recreational areas	Swamp and marsh lands	Net reservoir evaporation	Totals
Reference number	Name							
	Butte County							
40	Chico Creek	6,000	4,200	200	900	0	3,600	14,900
41	Paradise	51,500	16,200	100	300	a	9,400	77,500
42	North Fork Feather River	16,400	6,900	400	2,100	0	63,700	89,500
45	Middle Fork Feather River	3,000	4,000	100	1,200	0	11,800	20,100
46	South Fork Feather River	2,600	4,800	100	900	0	7,700	16,100
48	Challenge	0	100	a	a	0	0	100
49	Wyandotte	95,900	27,400	a	200	100	700	124,300
52	Los Molinos	109,000	5,800	0	100	a	0	114,900
55	Durham	238,600	24,400	24,900	a	4,400	0	292,300
57	Gridley	618,700	6,700	24,900	300	14,400	200	665,200
	COUNTY TOTALS	1,141,700	100,500	50,700	6,000	18,900	97,100	1,414,900
	Colusa County							
29	Stony Creek	41,900	1,400	a	500	0	4,500	48,300
30	Clear Lake	25,300	1,300	0	400	0	100	27,100
53	Fruto	0	0	0	0	0	0	0
56	Colusa	887,400	13,300	0	700	12,100	0	913,500
57	Gridley	8,700	a	0	a	200	0	8,900
59	Cortina	181,000	1,900	0	700	0	6,500	190,100
60	Arbuckle	228,500	7,700	0	0	0	0	236,200
	COUNTY TOTALS	1,372,800	25,600	0	2,300	12,300	11,100	1,424,100
	Glenn County							
11	Lake Pillsbury	0	700	a	300	0	0	1,000
29	Stony Creek	86,000	3,700	a	1,400	300	21,100	112,500
53	Fruto	154,800	1,000	0	a	0	900	156,700
54	Orland	292,200	17,100	0	0	200	0	309,500
56	Colusa	481,700	7,800	0	400	12,400	0	502,300
57	Gridley	56,200	700	0	0	5,300	0	62,200
59	Cortina	4,400	a	0	a	0	0	4,400
	COUNTY TOTALS	1,075,300	31,000	0	2,100	18,200	22,000	1,148,600
	Lake County							
11	Lake Pillsbury	0	1,100	100	900	0	4,300	6,400
29	Stony Creek	0	100	a	100	0	0	200
30	Clear Lake	167,800	12,700	a	2,800	2,400	132,600	318,300
31	Middletown	35,300	2,200	a	600	0	8,100	46,200
	COUNTY TOTALS	203,100	16,100	100	4,400	2,400	145,000	371,100
	Lassen County							
13	Jess Valley	4,700	200	a	200	0	4,800	9,900
14	Alturas	0	a	0	a	0	2,900	2,900
15	Big Valley*	97,200	2,300	100	700	500	1,800	102,600
16	McArthur	42,000	800	100	600	1,200	5,600	50,300
17	Hat Creek	1,200	300	100	300	0	0	1,900
42	North Fork Feather River	35,700	400	a	300	0	10,200	46,600
68	Surprise Valley*	4,500	100	0	200	0	0	4,800
69	Madeline Plains*	30,000	700	a	1,000	0	4,300	36,000
70	Eagle Lake*	18,400	900	100	800	600	19,300	40,100
71	Willow Creek*	37,800	300	a	300	1,200	2,300	41,900
72	Secret Valley*	37,800	200	0	1,300	100	1,600	41,000
73	Susan River*	93,000	9,000	100	900	3,000	12,900	118,900
74	Herlong*	17,400	2,300	a	500	100	1,700	22,000
	COUNTY TOTALS	419,700	17,500	500	7,100	6,700	67,400	518,900
	Modoc County							
1	Tulelake	117,700	400	100	2,300	300	57,700	178,500
12	Goose Lake	118,600	900	a	400	0	400	120,300
13	Jess Valley	13,700	100	a	200	0	2,100	16,100
14	Alturas*	166,800	5,900	100	1,800	200	33,700	208,500
15	Big Valley*	52,400	1,700	100	900	3,500	18,400	77,000
16	McArthur	7,100	100	a	a	100	0	7,300
68	Surprise Valley*	107,500	4,000	a	700	1,500	800	114,500
	COUNTY TOTALS	583,800	13,100	300	6,300	5,600	113,100	722,200

TABLE 56—Continued

LIMITED PROBABLE ULTIMATE MEAN SEASONAL WATER REQUIREMENTS WITHIN THE NORTHEASTERN COUNTIES

(In acre-feet)

County and hydrographic unit		Irrigated lands	Urban, suburban, and rural population	Forest products industry	Recreational areas	Swamp and marsh lands	Net reservoir evaporation	Totals
Reference number	Name							
	Plumas County							
40	Chico Creek	0	a	0	a	0	0	a
42	North Fork Feather River	21,000	3,200	100	2,000	0	70,000	96,300
43	East Branch Feather River	70,300	4,000	200	3,500	0	27,300	105,300
44	Sierra Valley*	81,400	800	a	500	0	3,500	86,200
45	Middle Fork Feather River	31,200	2,800	100	2,100	0	7,200	43,400
46	South Fork Feather River	400	300	a	200	0	1,200	2,100
47	North Yuba River	0	100	a	100	0	0	200
73	Susan River	0	a	a	a	0	0	a
74	Herlong	0	a	a	a	0	0	a
	COUNTY TOTALS	204,300	11,200	400	8,400	0	109,200	333,500
	Shasta County							
16	McArthur	79,500	2,200	a	700	1,000	10,200	93,600
17	Hat Creek	43,300	3,400	400	3,000	1,700	2,800	54,600
18	Montgomery Creek	13,400	500	200	1,200	0	3,100	18,400
19	McCloud River	2,500	a	100	400	0	3,900	6,900
20	Dunsmuir	3,600	400	100	700	0	0	4,800
21	Shasta Lake	4,100	600	100	1,900	0	69,700	76,400
22	Clear Creek	1,000	300	100	900	0	15,400	17,700
23	Keswick	0	200	a	200	0	1,600	2,000
24	Cottonwood Creek	77,300	600	100	1,500	0	7,200	86,700
25	Olinda	34,000	1,800	a	100	0	5,300	41,200
32	Stillwater Plains	110,700	25,200	0	a	0	100	136,000
33	Cow Creek	142,100	3,000	100	1,400	a	14,000	160,600
34	Bear Creek	63,300	700	a	500	0	a	64,500
35	Battle Creek	31,300	700	100	600	a	1,100	33,800
38	Mill Creek	0	0	0	a	0	0	a
42	North Fork Feather River	0	0	a	100	0	0	100
50	Anderson	90,600	33,500	87,800	100	100	19,000	231,100
	COUNTY TOTALS	696,700	73,100	89,100	13,300	2,800	153,400	1,028,400
	Sierra County							
44	Sierra Valley*	47,200	2,000	100	700	0	1,900	51,900
45	Middle Fork Feather River	0	a	a	a	0	0	a
47	North Yuba River	7,000	1,700	200	1,700	0	1,300	11,900
74	Herlong*	5,200	a	a	a	0	0	5,200
75	Little Truckee River	30,000	200	100	300	400	6,800	37,800
	COUNTY TOTALS	89,400	3,900	400	2,700	400	10,000	106,800
	Siskiyou County							
1	Tulelake	89,500	2,900	100	1,700	30,800	37,700	162,700
2	Butte Valley*	115,000	2,100	200	1,800	400	8,600	128,100
3	Klamath River	61,700	4,000	700	2,100	0	68,500	137,000
4	Shasta River	341,800	9,700	10,900	1,400	3,700	12,900	380,400
5	Scott Valley	147,000	4,000	200	900	200	4,600	156,900
6	Salmon River	1,700	1,000	200	1,000	0	8,700	12,600
15	Big Valley	0	0	a	a	0	0	a
16	McArthur	3,500	1,700	100	500	0	0	5,800
19	McCloud River	6,000	1,700	5,600	900	0	2,600	16,800
20	Dunsmuir	25,600	5,700	5,500	500	0	800	38,100
	COUNTY TOTALS	791,800	32,800	23,500	10,800	35,100	144,400	1,038,400
	Sutter County							
56	Colusa	326,000	4,200	0	800	2,000	0	333,000
57	Gridley	141,400	1,100	0	200	14,400	0	157,100
61	Sutter	189,700	21,200	0	100	300	0	211,300
62	Marysville	61,300	2,300	0	100	0	0	63,700
63	Pleasant Grove	69,900	200	0	100	0	0	70,200
67	East Yolo	124,500	3,200	0	200	200	0	128,100
	COUNTY TOTALS	912,800	32,200	0	1,500	16,900	0	963,400
	Tehama County							
24	Cottonwood Creek	101,200	900	100	2,100	0	45,300	149,600
26	Redbank Creek	78,300	7,200	0	600	0	0	86,100
27	Elder Creek	20,300	200	a	400	0	12,400	33,300
28	Thomes Creek	84,500	1,100	100	1,200	0	3,000	89,900
29	Stony Creek	13,200	200	a	300	0	18,500	32,200
35	Battle Creek	45,900	900	100	900	0	1,000	48,800

TABLE 56—Continued

LIMITED PROBABLE ULTIMATE MEAN SEASONAL WATER REQUIREMENTS WITHIN THE NORTHEASTERN COUNTIES

(In acre-feet)

County and hydrographic unit: Reference number	County and hydrographic unit: Name	Irrigated lands	Urban, suburban, and rural population	Forest products industry	Recreational areas	Swamp and marsh lands	Net reservoir evaporation	Totals
	Tehama County—Continued							
36	Paynes Creek	13,600	300	a	500	0	4,700	19,100
37	Antelope Creek	5,300	600	a	1,000	0	0	6,900
38	Mill Creek	3,600	400	100	700	0	500	5,300
39	Deer Creek	6,400	800	100	1,200	0	4,100	12,600
40	Chico Creek	700	200	a	300	0	0	1,200
50	Anderson	38,100	300	0	200	100	35,100	73,800
51	Corning	372,400	16,900	21,700	700	a	100	411,800
52	Los Molinos	108,400	10,000	21,700	400	0	50,000	190,500
53	Fruto	900	a	0	a	0	0	900
54	Orland	4,100	a	0	a	0	0	4,100
	COUNTY TOTALS	896,900	40,000	43,900	10,500	100	174,700	1,166,100
	Trinity County							
7	Upper Trinity River	6,300	1,000	100	2,300	0	34,000	43,700
8	Lower Trinity River	7,700	2,700	100	3,300	0	58,300	72,100
9	South Fork Trinity River	19,200	1,400	100	2,100	0	18,500	41,300
10	Southern Trinity County	13,200	500	100	1,300	0	21,300	36,400
	COUNTY TOTALS	46,400	5,600	400	9,000	0	132,100	193,500
	Yolo County							
30	Clear Lake	800	2,400	0	300	0	0	3,500
56	Colusa	129,300	1,000	0	a	0	0	130,300
59	Cortina	88,200	2,200	0	500	0	0	90,900
60	Arbuckle	107,500	6,700	0	a	0	0	114,200
64	West Yolo	24,000	2,800	0	600	0	1,500	28,900
65	Capay	21,900	6,900	0	700	0	0	29,500
66	Woodland	340,100	120,800	0	300	0	0	461,200
67	East Yolo	291,800	18,500	0	600	a	0	310,900
	COUNTY TOTALS	1,003,600	161,300	0	3,000	0	1,500	1,169,400
	Yuba County							
46	South Fork Feather River	0	a	a	a	0	0	*
47	North Yuba River	2,800	1,100	a	600	0	7,000	11,500
48	Challenge	33,500	5,200	100	1,300	0	6,000	46,100
58	Brown's Valley	66,000	7,200	0	600	0	3,200	77,000
62	Marysville	381,000	25,000	21,000	800	2,000	15,900	445,700
	COUNTY TOTALS	483,300	38,500	21,100	3,300	2,000	32,100	580,300
	TOTALS, NORTHEASTERN COUNTIES	9,921,600	602,400	230,400	90,700	121,400	1,213,100	12,179,600

a Less than 50 acre-feet.

* Hydrographic unit in which probable ultimate water requirement would be limited by available water supply.

CHAPTER IV

SUMMARY AND RECOMMENDATIONS

The people and the Legislature have recognized the importance of developing the water resources of California to satisfy the growing demand for water in order that a healthy economy may be maintained. Realizing the need for such development, yet also recognizing that present and future interests of areas of surplus water must be safeguarded, the Legislature, has from time to time, provided funds for planning coordinated statewide water resources developments. To insure that some areas of the State do not expand to the detriment of other areas, the Legislature has stated the policy that in connection with the Central Valley Project, the watersheds wherein water originates, and areas adjacent thereto which may be reasonably served therefrom, shall not be deprived of any water needed for their future development. Further, procedures have been established by which the Department of Water Resources shall make and file applications to appropriate water which is or may be required in the development of a general or coordinated plan looking toward the development, ultilization, or conservation of the water resources of the State. But no priority shall be released nor assignment made of any such appropriation that will deprive the county in which the appropriated water originates of any water necessary for the development of the county.

As a result of these policies, and in connection with current water resources development planning, for local needs as well as for export, the necessity for thorough evaluation of the probable ultimate seasonal water requirements of areas of surplus is evident.

SUMMARY

In 1947, the Legislature provided funds for initiation of the Statewide Water Resources Investigation, to formulate a comprehensive master plan for the full control, conservation, protection, distribution, and utilization of all the State's water resources for the benefit of all areas of the State. This extensive study included estimates of the water requirements, both present and future, for all beneficial purposes for each area of California, as best those requirements could be foreseen. The estimates of water requirements published in Bulletin No. 2, "Water Utilization and Requirements of California," were based largely on data obtained from field surveys during 1949 and 1950. While the surveys utilized the most recent and suitable maps or aerial photographs, they were admittedly of a reconnaissance nature that could have been improved by more accurate data and by more advanced field and office procedures, had the necessary funds, personnel, and time been available.

During the intervening years, since 1950, a very significant growth has occurred in California. Expanding agriculture and industry, growing demands for developed water supplies, and resulting depletion of local water resources, particularly in many areas of the central and southern portions of the State, have stimulated a statewide interest in the waters of northern California, a region of general water surplus. In 1954, the Legislature directed a revaluation of the ultimate water needs of the 15 Northeastern Counties of the State, the determination to be predicated upon full development of all natural resources in the designated counties.

The 15 Northeastern Counties comprise Butte, Colusa, Glenn, Lake, Lassen, Modoc, Plumas, Shasta, Sierra, Siskiyou, Sutter, Tehama, Trinity, Yolo, and Yuba Counties. Collectively, they occupy 23 per cent of the State's area, contain 3 per cent of the present (1956) population, and comprise the watersheds for 40 per cent of California's water resources.

This chapter summarizes information relating to the natural resources of the Northeastern Counties of California, as their development affects the need for water; and to their present and probable ultimate water utilization and water requirements, as have been evaluated and presented in detail in the preceding chapters of this report.

TABLE 57

ESTIMATED PRESENT AND PROBABLE ULTIMATE POPULATION WITHIN THE NORTHEASTERN COUNTIES

County	Estimated present (1956) population	Estimated ultimate population
Butte	70,200	284,000
Colusa	11,700	68,000
Glenn	16,600	85,000
Lake	11,300	65,000
Lassen	15,500	67,500
Modoc	9,300	51,100
Plumas	11,900	44,700
Shasta	46,000	195,000
Sierra	2,400	16,000
Siskiyou	31,500	127,200
Sutter	29,100	121,800
Tehama	20,700	105,100
Trinity	6,900	22,000
Yolo	53,900	390,000
Yuba	28,100	105,000
TOTAL	365,100	1,747,000

Natural Resources

A great agricultural economy occupies the rich flat lands of the Sacramento Valley and much of the lower foothill areas, and extends into the mountain valleys and adjoining grazing land. Magnificent stands of timber are located in the mountainous portions of the North Coastal Drainage Basin and above 3,000 feet on the Sierra Nevada in the Central Valley Drainage Basin. Mineral resources, including construction materials, ores, and oil and gas, are found in many locations. Many thousands of visitors each year utilize the outstanding recreational and scenic opportunities of the region for vacationing, hunting, and fishing. The catalyzing factor, making possible the full use and enjoyment of the multitude of resources, is the natural abundance of water.

Agricultural crops now grown in the Northeastern Counties are many and varied. Pasture, rice, alfalfa, orchard, and truck comprise the principal crops grown on the 1,574,000 acres of land presently irrigated. For purposes of the current studies, it was assumed that similar crops would be grown in the Northeastern Counties under ultimate development. The ultimate irrigated area was estimated to be slightly more than twice that of the present, or approximately 3,800,000 acres.

Northern California crops are marketed throughout the United States, while some are distributed to world markets. Many products are processed for marketing within the area. Portions of the fruits and vegetable crops are canned and frozen prior to shipment. Other products, such as sugar beets, rice, and nuts are partially or completely processed within the area before distribution.

A large share of California's commercial stand of timber is found in the Northeastern Counties. These timbered areas are shown on Plate 5. It was estimated that under ultimate conditions, with adequate management and extensive restocking of public and private lands, including the presently deforested area, a sustained yield of about two and one-quarter billion board feet of lumber could be harvested annually from the nine million acres of commercial forest lands of the Northeastern Counties. Many timber by-products are now processed in these counties, and it is expected that eventually most logging and milling residues will be used in allied manufacturing processes. It is expected, also, that this industry will expand appreciably in the portion of the Northeastern Counties lying in the Central Valley Basin.

With the further establishment of certain timber by-product industries, such as the manufacture of pulp and rayon, serious problems relating to disposal of associated wastes and their effect on water quality may arise. It has been assumed, however, that pollution problems will be overcome as they arise, and that suitable regulation and control will be exercised to insure the maintenance of good quality water below the industrial plants.

TABLE 58

AREAS OF PRESENTLY IRRIGATED LANDS AND ESTIMATED ULTIMATE IRRIGATED LANDS WITHIN THE NORTHEASTERN COUNTIES

(In acres)

County	Present (1954-1956)	Ultimate
Butte	175,590	358,500
Colusa	174,410	375,900
Glenn	150,540	333,400
Lake	16,220	72,600
Lassen	74,720	441,300
Modoc	151,320	354,500
Plumas	52,300	107,900
Shasta	62,050	207,900
Sierra	23,640	50,800
Siskiyou	136,190	337,600
Sutter	224,450	291,800
Tehama	64,700	297,200
Trinity	3,470	12,100
Yolo	196,940	387,800
Yuba	67,410	168,500
TOTAL	1,573,950	3,797,800

TABLE 59

AREAS OF COMMERCIAL FOREST LAND AND THEIR ESTIMATED SUSTAINED YIELD CAPACITY WITHIN THE NORTHEASTERN COUNTIES

County	Commercial forest land, in acres	Yield, in thousand board-feet
Butte	356,000	135,000
Colusa	27,000	6,000
Glenn	113,000	27,000
Lake	175,000	42,000
Lassen	829,000	133,000
Modoc	675,000	94,000
Plumas	1,228,000	295,000
Shasta	1,263,000	303,000
Sierra	393,000	138,000
Siskiyou	2,323,000	558,000
Sutter	0	0
Tehama	463,000	166,000
Trinity	1,357,000	326,000
Yolo	0	0
Yuba	116,000	44,000
TOTALS	9,291,000	2,267,000

California's early growth was stimulated by widespread production of gold and other minerals. The Northeastern Counties area was the center of this industry. Because of recent unfavorable economic conditions, the mining of gold has fallen from its former commanding position, although some production still results from the working of auriferous gravels, largely by dredges. In general, these extractive industries do not impose significant water supply problems, their requirements being relatively small as related to other uses of water.

Historically, the economic life of the Northeastern Counties has depended upon timber, mining, and agricultural operations, and related service industries. In recent years, however, recreational activity has increased rapidly to a position of major importance in the region's economy. It appears that the Northeastern Counties are on the threshold of substantial growth in the development and use of their recreational resources. These counties are favored with some of the finest mountain country in California and in the west. All or parts of eight national forests are included in their boundaries, as well as one national park and one national monument. The pressure of population in the older, more developed recreational areas elsewhere in California is sending more people into the Northeastern Counties each year in search of recreational opportunities.

TABLE 60

AREAS OF PROBABLE ULTIMATE HIGH INTENSITY RECREATION USE WITHIN THE NORTHEASTERN COUNTIES
(In acres)

County	Areas
Butte	437,600
Colusa	166,000
Glenn	193,900
Lake	576,600
Lassen	686,900
Modoc	577,200
Plumas	1,122,800
Shasta	1,243,900
Sierra	466,100
Siskiyou	701,300
Sutter	63,800
Tehama	1,025,100
Trinity	688,600
Yolo	158,600
Yuba	241,400
TOTAL	8,349,800

The water of the Northeastern Counties is its most significant natural resource, and is of prime importance to the State as a whole. Although the land area is only about one-fourth of the total for California, the flow of streams in the 15 counties is about 40 per cent of that for the entire State. The immensely valuable water resource, like all others, must be conserved, protected, and developed in order to yield benefits to the residents of the region and to those requiring water elsewhere in California.

The Klamath and Trinity River system, and the Sacramento River and its tributaries include the major streams of the Northeastern Counties. The Sacramento River, rising on the slopes of Mt. Shasta, flows through rugged canyon reaches and then through more than a hundred miles of the flat fertile lands of the Sacramento Valley. In the valley it furnishes irrigation water to support the important agricultural economy. The Klamath River, on the other hand, rising in Oregon, flows in California through rough, mountainous areas bordered by little irrigable land and is subject to only minor development for local needs.

The gross inequalities in geographical and seasonal distribution of runoff and precipitation, characteristic of California, are present within the Northeastern Counties. Precipitation varies widely, from a maximum seasonal depth of over 100 inches in western Siskiyou County to a minimum of less than 10 inches in eastern Modoc and Lassen Counties. Several higher zones of precipitation, in which the depth averages from 50 to 70 inches seasonally, occur over the crests of the Klamath Mountains, the Coast Range, and the Cascade Mountains, and west of the crest of the Sierra Nevada. Precipitation from storms passing eastward or southeastward over the Northeastern Counties decreases from the crest of the Coast Range to the Sacramento Valley floor, where it averages about 20 inches seasonally. Seasonal distribution is similar to that for other portions of California, with approximately three-quarters of the precipitation occurring in the winter period from November through March.

In general, northern California streams maintain year-round flow, but are subject to high flows during the winter and spring, and low flows during the summer and fall. In addition to this characteristic seasonal variation, there occur series of years for which precipitation and runoff depart significantly from the normal. In this connection, the period from 1928 through 1934 was one of the most severe drought periods of record.

Ground water is found throughout the numerous basins of the Northeastern Counties. However, it occurs principally in the Sacramento Valley where vast underground storage capacity exists. Smaller quantities are found in the shallow alluvial valleys of the Coast Range and northern Sierra Nevada. Ground water development for irrigation has occurred principally in the alluvial deposits of the Sacramento Valley, but has been undertaken, to some extent, throughout all the Northeastern Counties.

Both surface and ground water supplies of the Northeastern Counties are generally of good mineral quality. Water quality problems exist in certain areas, but they are local in character and generally occur in springs, closed lake basins, or certain ground water aquifers.

As the Northeastern Counties develop in the future, as the population grows, as the timber, mining, agricultural, and recreational industries mature, and as the urban centers expand in area and density, vigilance must be exercised by responsible agencies in order to maintain water supplies at a level of suitable quality for beneficial uses. Natural recreational areas are of particular significance to the future economy of the Northeastern Counties. The abundant fish and wildlife comprise a vital part of the recreational resource and their preservation and maintenance is of prime importance to the entire State.

Water Utilization and Water Requirements

The nature and extent of water utilization and water requirements in the Northeastern Counties, both at present and under probable conditions of ultimate development, were evaluated during this investigation. The presently irrigated areas, as well as urban and suburban areas, were first located and delineated by field survey. In the course of the survey, all of the lands were classified as to their suitability for development under probable ultimate conditions. The resulting data were utilized as the basis for estimating present and probable ultimate water needs with full development of all natural resources. In portions of the Northeastern Counties lands suitable for irrigation exceed the amount of the available local water supply and import of supplemental supplies does not seem practicable. In these instances the evaluation of ultimate water requirements was limited to the local water supplies available.

Consumptive Use of Applied Water. The quantity of water consumptively used was estimated by applying the appropriate unit value of consumptive water use to the acreage of each of the various classes and types of land use, and totaling the results for each hydrographic unit and county. Estimates of ultimate urban and industrial water use were based on population estimates derived from forecast development of all natural resources. Estimates of consumptive use of applied water assumed a full water supply, sufficient to meet the optimum moisture needs of the crops. However, in many areas of the Northeastern Counties, full seasonal water supplies are not presently available, and crops are subject to deficient irrigation supplies during summer and fall months. Where this condition exists, the computed present consumptive use of applied water was adjusted to actual use under conditions of present water supply development.

Estimates of ultimate seasonal consumptive use of applied water, however, were based on the assumption that an adequate water supply would at all times be available. In those portions of the Northeastern Counties in which water supply development is inherently limited by inadequacy of the resources, potential areas of water service were reduced to those which could be adequately served by the quantity of water that can be practicably developed.

Water Requirements. In broad generalization, the gross amount of the requirement for developed irrigation water supplies necessary to fully meet the consumptive uses, operational requirements, and irrecoverable losses, was derived by dividing the quantity of consumptive use of applied water by an appropriate service area efficiency factor. This factor was chosen to account for unavoidable losses within the particular service area under consideration. Water requirements for urban, suburban and rural populations, as well as forest products industry and recreational areas, were estimated from the expected level of development and an appropriate unit value of water requirement. For swamp and marsh lands and reservoir water surfaces the water requirement was generally estimated as equal to the net evaporative losses.

TABLE 61

ESTIMATED PRESENT AND PROBABLE ULTIMATE MEAN SEASONAL CONSUMPTIVE USE OF APPLIED WATER WITHIN THE NORTHEASTERN COUNTIES

(In acre-feet)

County	Present (1954-56)	Probable ultimate
Butte	538,400	1,044,800
Colusa	589,700	934,100
Glenn	485,800	802,900
Lake	156,400	278,200
Lassen	155,700	824,100
Modoc	296,000	674,300
Plumas	108,700	311,900
Shasta	206,300	585,400
Sierra	28,200	109,800
Siskiyou	246,000	681,000
Sutter	569,100	704,900
Tehama	146,100	786,000
Trinity	40,100	168,000
Yolo	457,200	810,500
Yuba	185,100	461,200
TOTALS	4,208,800	9,177,100

Most nonconsumptive requirements for water are not readily susceptible of evaluation, except as they relate to actual water development projects, and should be evaluated with consideration to all water requirements at the time projects are implemented. For this reason, nonconsumptive water requirements are discussed only generally and are not summarized in this chapter.

As has been indicated, the requirement for irrigation water was estimated as the sum of the products of appropriate unit values of consumptive use of applied irrigation water and the areas of the various irrigated crop types, divided by estimated irrigation water service area efficiencies, or by an equivalent procedure. In many instances, data available from agencies serving irrigation water permitted direct derivation of the present efficiency factor. Where such data were not available or applicable, the efficiency of water use was estimated on the basis of available information on conveyance and distribution losses, re-use of return flows from previously applied irrigation water, flushing water required to maintain salt balance, and topographic and geologic conditions affecting the application and use of irrigation water. Of primary importance among the topographic and geologic factors are the existence, extent, and type of ground water basins, and their position with relation to sources of water supply and to other water service areas.

The total requirement for water in each service area was estimated as the sum of the individual requirements for the several classes of water use, with allowance for usable return flow from applied water within the area. Similar consideration governed the evaluation of total water requirements of larger land areas.

TABLE 62

PROBABLE ULTIMATE MEAN SEASONAL WATER REQUIREMENTS WITHIN THE NORTHEASTERN COUNTIES

(In acre-feet)

County	Irrigated lands	Urban, suburban and rural population	Forest products industry	Recreational areas	Swamp and marsh lands	Net reservoir evaporation	Totals
Butte	1,141,700	100,500	50,700	6,000	18,900	97,100	1,414,900
Colusa	1,372,800	25,600	0	2,300	12,300	11,100	1,424,100
Glenn	1,075,300	31,000	0	2,100	18,200	22,000	1,148,600
Lake	203,100	16,100	100	4,400	2,400	145,000	371,100
Lassen	1,200,300	17,500	500	7,100	6,700	67,400	1,299,500
Modoc	852,600	13,100	300	6,300	5,600	113,100	991,000
Plumas	251,500	11,200	400	8,400	0	109,200	380,700
Sbasta	696,700	73,100	89,100	13,300	2,800	153,400	1,028,400
Sierra	133,700	3,900	400	2,700	400	10,000	151,100
Siskiyou	835,400	32,800	23,500	10,800	35,100	144,400	1,082,000
Sutter	912,800	32,200	0	1,500	16,900	0	963,400
Tehama	896,900	40,000	43,900	10,500	100	174,700	1,166,100
Trinity	46,400	5,600	400	9,000	0	132,100	193,500
Yolo	1,003,600	161,300	0	3,000	0	1,500	1,169,400
Yuba	483,300	38,500	21,100	3,300	2,000	32,100	580,300
TOTALS, NORTHEASTERN COUNTIES	11,106,100	602,400	230,400	90,700	121,400	1,213,100	13,364,100

Limited Seasonal Water Requirements. A comparison of average seasonal natural runoff and probable ultimate mean seasonal requirements for water in each of the three major drainage basins in the Northeastern Counties is shown in Table 63. This table shows that while the natural runoff for the entire Northeastern County area is greater than the ultimate requirement for water, the ultimate mean seasonal water requirements within the Lahontan area are greater than the natural runoff. There are also hydrographic units within the North Coastal and Central Valley drainage basins where the ultimate requirements exceed the available water supply. After consideration was given to possibilities for developing additional water from either local or imported sources, estimates were made of limited ultimate mean seasonal water requirements that could be served from available water supplies. Table 64 shows the limited water requirements, within counties, for areas where the water requirements based on full land use would be greater than the available water supply. Table 65 shows the limited ultimate mean seasonal water requirement compared to natural runoff.

TABLE 63

ESTIMATED AVERAGE SEASONAL NATURAL RUNOFF AND PROBABLE ULTIMATE MEAN SEASONAL REQUIREMENTS FOR WATER IN MAJOR DRAINAGE BASINS, NORTHEASTERN COUNTIES

(In acre-feet)

Drainage basin	Natural runoff	Probable ultimate mean seasonal requirement for water
North Coastal	9,630,000	1,400,000
Central Valley	16,640,000	10,570,000
Lahontan	650,000	1,390,000
TOTALS	26,920,000	13,360,000

TABLE 64

LIMITED PROBABLE ULTIMATE MEAN SEASONAL WATER REQUIREMENTS WITHIN THE NORTHEASTERN COUNTIES

(In acre-feet)

County	Irrigated lands	Urban, suburban and rural population	Forest products industry	Recreational areas	Swamp and marsh lands	Net reservoir evaporation	Totals
Butte	1,141,700	100,500	50,700	6,000	18,900	97,100	1,414,900
Colusa	1,372,800	25,600	0	2,300	12,300	11,100	1,424,100
Glenn	1,075,300	31,000	0	2,100	18,200	22,000	1,148,600
Lake	203,100	16,100	100	4,400	2,400	145,000	371,100
Lassen*	419,700	17,500	500	7,100	6,700	67,400	518,900
Modoc*	583,800	13,100	300	6,300	5,600	113,100	722,200
Plumas*	204,300	11,200	400	8,400	0	109,200	333,500
Shasta	696,700	73,100	89,100	13,300	2,800	153,400	1,028,400
Sierra*	89,400	3,900	400	2,700	400	10,000	106,800
Siskiyou*	791,800	32,800	23,500	10,800	35,100	144,400	1,038,400
Sutter	912,800	32,200	0	1,500	16,900	0	963,400
Tehama	896,900	40,000	43,900	10,500	100	174,700	1,166,100
Trinity	46,400	5,600	400	9,000	0	132,100	193,500
Yolo	1,003,600	161,300	0	3,000	0	1,500	1,169,400
Yuba	483,300	38,500	21,100	3,300	2,000	32,100	580,300
TOTALS, NORTHEASTERN COUNTIES	9,921,600	602,400	230,400	90,700	121,400	1,213,100	12,179,600

* Counties in which the probable ultimate water requirement would be limited by available water supply.

TABLE 65

ESTIMATED AVERAGE SEASONAL NATURAL RUNOFF AND LIMITED PROBABLE ULTIMATE MEAN SEASONAL REQUIREMENTS FOR WATER IN MAJOR DRAINAGE BASINS, NORTHEASTERN COUNTIES

(In acre-feet)

Drainage basin	Natural runoff	Limited probable ultimate mean seasonal requirement for water
North Coastal	9,630,000	1,360,000
Central Valley	16,640,000	10,360,000
Lahontan	650,000	460,000
TOTALS	26,920,000	12,180,000

RECOMMENDATIONS

It is recommended that:

1. Adequate funds be made available on a regular basis for continuing investigations of water requirements in California, as presently authorized by Section 232 of the California Water Code.

2. The Department of Water Resources be authorized to proceed with an adequately financed program of basic data collection regarding the relationships of soils, water, and plants as they affect utilization of the State's water resources, said program to be fully coordinated with the similar activities of federal and other State agencies.

3. The estimates of ultimate water requirements in the Northeastern Counties and other areas in California, for which comparable estimates have been made, be reviewed periodically.

Appendix A

FUTURE POPULATION, ECONOMIC AND RECREATION DEVELOPMENT OF CALIFORNIA'S NORTH-EASTERN COUNTIES

STATE OF CALIFORNIA

DEPARTMENT OF WATER RESOURCES

DIVISION OF RESOURCES PLANNING

INTRODUCTORY STATEMENT

The Northeastern Counties Investigation was conducted by the State of California, Department of Water Resources, under legislative authorization which provided for the determination of the ultimate water needs of 15 northeastern California counties, predicated upon full development of all natural resources. To assist in the analysis of the expanding water needs of these counties that will inevitably result from population increases and the growth of industry and commerce, including recreation, the Department employed the firm of Pacific Planning and Research, formerly known as Harold F. Wise and Associates, consultants in planning and urban economics.

This appendix report, prepared by the firm of Pacific Planning and Research, sets forth the data and conclusions relating to ultimate population, economic development that might result from full use of the natural resources, and recreation potential which could be expected under ultimate conditions. These data are the basis for the Department's estimates of water requirements for urban, domestic, industrial, and recreation uses, as presented in Department of Water Resources Bulletin No. 58, "Northeastern Counties Investigation."

HAROLD F. WISE & ASSOCIATES

PLANNING AND URBAN ECONOMICS

707 Forum Building, Sacramento 14, California

March 15, 1957

telephone GIlbert 2-4877

Mr. William L. Berry
Chief, Division of Water Resources Planning
California State Department of Water Resources
P. O. Box 1079
Sacramento 5, California

Dear Mr. Berry:

There is submitted a report in two parts, on probable ultimate population, economic and recreation development in California's northeastern counties, predicated upon full development of their natural resources.

The report is intended to assist the Department in its determinations of ultimate water requirements in the northeastern counties.

The first part of the report deals with population and the probable future pattern of economic development. It is estimated that domestic water requirements will be those of a population of approximately 1,750,000, of whom about 70 percent will live in urban areas. No unusual water requirements are now anticipated for industrial purposes, apart from processing of pulp and paper products.

The second part of the report deals with potential development of recreation resources, including recreation use of reservoir areas. The study indicates that the area can support a very great expansion of recreation facilities and recreation use. It is anticipated that the bulk of the population of the northeastern county area will ultimately be supported by activities related to development and use of its recreation resources, and its desirability as a place to live.

Sincerely,

Samuel E. Wood

Samuel E. Wood
Resident Partner.

principal office: 546 University Avenue, Palo Alto, California
other offices: Ravenswood, West Virginia; Tulsa, Oklahoma; Abilene, Texas; New York City, New York

NORTHEASTERN COUNTIES INVESTIGATION

I. Probable Ultimate Population and Economic Development.

II. Potential Ultimate Recreation Development.

Report prepared by

PACIFIC PLANNING AND RESEARCH
(Formerly Harold F. Wise and Associates)
Consultants in
PLANNING AND URBAN ECONOMICS

for the

STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES

March 1957

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---

* Division of Water Resources, Bulletin No. 35, *Permissible Economic Rate of Irrigation Development in California*, State Printing Office, Sacramento, 1930
David Weeks, A. E. Wieslander, H. R. Josephson and C. L. Hill, *Land Utilization in the Northern Sierra Nevada*, Special Publication of the Giannini Foundation of Agricultural Economics, University of California, Berkeley, 1943
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Lassen County____ Nadene Wemple, County Clerk
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Irma Laird, County Historian

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E. B. Bond, County Agricultural Commissioner
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Siskiyou County__ Joe G. Allen, Chairman, Board of Supervisors
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PART ONE

PROBABLE ULTIMATE POPULATION AND ECONOMIC DEVELOPMENT IN CALIFORNIA'S NORTHEASTERN COUNTIES, PREDICATED UPON FULL DEVELOPMENT OF NATURAL RESOURCES

Prepared in co-operation with
VAN BEUREN STANBERY
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NORTHEASTERN COUNTIES INVESTIGATION

PROJECTIONS OF POPULATION AND ECONOMIC DEVELOPMENT

I. SCOPE AND PURPOSE OF REPORT

To assist in determining ultimate water needs of the counties of Butte, Colusa, Glenn, Lake, Lassen, Modoc, Plumas, Shasta, Sierra, Siskiyou, Sutter, Tehama, Trinity, Yolo and Yuba, studies and projections have been made of present and probable ultimate population and economic development in those counties. These studies are intended to be of direct use in estimating consumptive water use in urban, suburban, rural-farm, and rural-nonfarm areas, according to methods described in State Water Resources Board *Bulletin No. 2* (June 1955).

Additional demand for water for personal consumption will be created by development of potential recreation areas. The classification and measurement of such areas are discussed in a companion report which follows this monograph.

II. SUMMARY OF FINDINGS

1. California's northeastern counties are still in the primary stages of economic development, with high dependence on agriculture and the manufacture of lumber and wood products from local natural resources. Their populations are relatively small and predominantly rural, with no large urban concentrations.

The patterns of population and economic development of the northeastern county area in 1950 were strikingly similar to those of the state of California in the year 1870.

2. The northeastern counties have great resources of agricultural, forest and recreational lands, water and hydro-electric power, that can be more intensively developed and used. The area has a large potential for future growth through increased irrigation of its agricultural lands, expanded utilization of its forest products, and development of its recreation attractions. Full development of the agricultural, forest, recreational, water and power resources of the northeastern counties is a basic requirement for achievement of the ultimate economic and population growth projected in this study.

3. In addition, technological advances and the huge expected increases of population in the United States and California will eventually lead to a concommitant development and growth in the northeastern counties. The natural advantages of the northeastern counties for outdoor recreation, for human habitation, and for new types of industry and services will inevitably draw thousands of part-time and full-time residents from other parts of the nation and state. The greater part of the future population increase in the area as a whole is expected to be supported by activities other than the production and marketing of commodities derived from local natural resources.

At the same time, agriculture and the utilization of forest products will continue to provide substantially larger proportions of total employment for the northeastern county area than for the state as a whole.

4. At the time of ultimate development of the natural resources of the area (years 2020-2050), it is estimated that:

Population will have increased to
375,000,000 in the United States;
45,000,000 in California; and
1,750,000 in the northeastern county area.

Irrigated lands in the northeastern county area will have increased to 3,803,900 acres, about three times the acreage in 1954 and three and one-half times that in 1949.

Number of farms and **farm population** in the area will be approximately twice those in 1950. **Agricultural employment** (as of April 1) will also be about double that of 1950.

Employment in lumber and wood products industries (as of April 1) in the area will be about twice that of 1950. In addition, a substantial number of persons will be employed in pulp and paper products industries of which the area had none in 1950.

Total manufacturing employment (April 1) in the area will approximate 639,000 compared with 116,000 in April 1950.

Mining (excluding petroleum extraction) and forestry will continue to provide a somewhat higher proportion of total employment in the area than will be true in the rest of the state, but the volume of such employment will be relatively small.

Other employment (construction, distribution and service activities) will account for a majority of the jobs in the area. The proportion of total employment accounted for by this category will rise from 61 percent in 1950 to an estimated 74 percent in 2020-2050.

Anticipated development of recreation areas will provide substantial employment in trade and service activities and will induce settlement of many permanent non-farm residents therein.

Urban residents will comprise the bulk of the area's population. Urban population will rise to about 69 percent of the area's population, compared with 35 percent in 1950.

Rural farm population and **rural non-farm population** will both increase in numbers, but will decline in percent of total population.

Gross population densities will approximate 48 persons per square mile, a little more than the state average in 1940.

The geographical locations and patterns of ultimate growth in the area will generally follow those of present development. The largest concentrations of urban population and industrial and commercial activities are expected in those counties which now have the largest urban populations: Butte, Shasta, Yolo and Yuba, and also Sutter. Although some counties will grow more rapidly than others, the ranking of the counties in total population and total employment at time of ultimate development will be approximately the same as now.

PLATE A-1

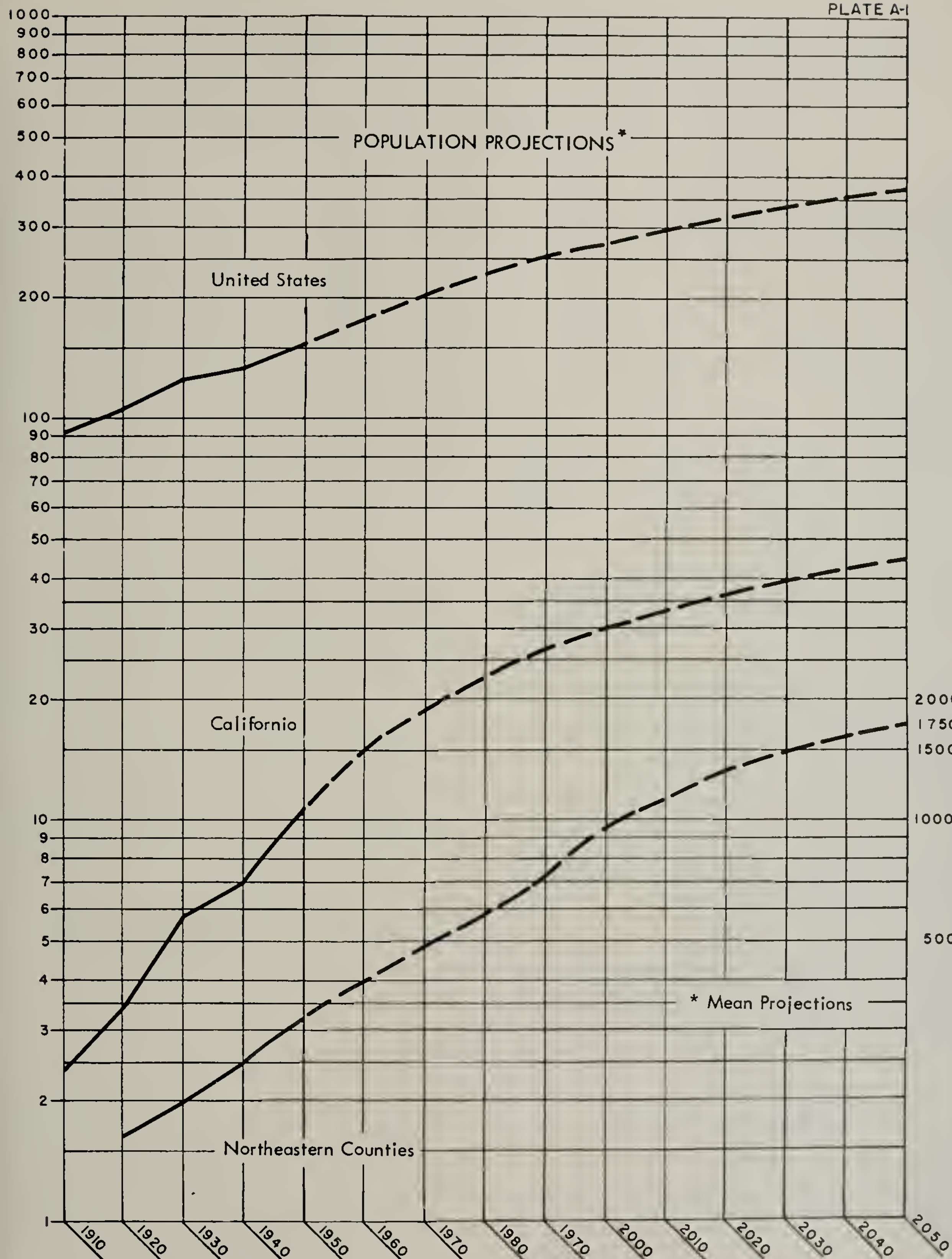
POPULATION PROJECTIONS*
United States
California
Northeastern Counties
* Mean Projections
POPULATION OF CALIFORNIA AND THE UNITED STATES IN MILLIONS
POPULATION OF NORTHEASTERN COUNTIES IN THOUSANDS
1000
900
800
700
600
500
400
300
200
100
90
80
70
60
50
40
30
20
10
9
8
7
6
5
4
3
2
1
2000
1750
1500
1000
500
1910
1920
1930
1940
1950
1960
1970
1980
1970
2000
2010
2020
2030
2040
2050

TABLE 1

POPULATION OF 15 NORTHEASTERN CALIFORNIA COUNTIES 1920-1956
AND PROBABLE ULTIMATE POPULATION 2020-2050

	Jan. 1, 1920	Apr. 1, 1930	Apr. 1, 1940	Apr. 1, 1950	July 1, 1956	Probable ultimate 2020-2050
Butte	30,030	34,093	42,840	64,930	69,300	284,000
Colusa	9,290	10,258	9,788	11,651	11,400	68,000
Glenn	11,853	10,935	12,195	15,448	16,300	85,000
Lake	5,402	7,166	8,069	11,481	11,000	65,000
Lassen	8,507	12,589	14,479	18,474	16,900	67,500
Modoc	5,425	8,038	8,713	9,678	9,500	51,100
Plumas	5,681	7,913	11,548	13,519	11,800	44,700
Shasta	13,361	13,927	28,800	36,413	45,000	195,000
Sierra	1,783	2,422	3,025	2,410	2,200	16,000
Siskiyou	18,545	25,480	28,598	30,733	32,200	127,200
Sutter	10,115	14,618	18,680	26,239	28,500	121,800
Tehama	12,882	13,866	14,316	19,276	20,300	105,100
Trinity	2,551	2,809	3,970	5,087	6,500	22,000
Yolo	17,105	23,644	27,243	40,640	53,100	390,000
Yuba	10,375	11,331	17,034	24,420	28,100	105,000
15-county total	162,905	199,089	249,298	330,399	362,100	1,747,400
Percent of state	4.75	3.51	3.61	3.12	2.66	3.9
State total	3,426,861	5,677,251	6,907,387	10,586,223	13,600,000	45,000,000

III. ANALYSIS OF TRENDS AND PATTERNS OF ECONOMIC DEVELOPMENT AND POPULATION GROWTH IN THE NORTHEASTERN COUNTY AREA

In terms of economic geography, the northeastern counties fall into two, or possibly three, economic areas. The counties of Butte, Colusa, Glenn, Sutter, Tehama, Yolo and Yuba constitute State Economic Area No. 4, as defined by the Bureau of the Census. These are predominantly valley counties. The counties of Lassen, Modoc, Plumas, Shasta, Sierra, Siskiyou, and Trinity are part of State Economic Area No. 9. These are predominantly mountain counties. Lake County lies in State Economic Area No. 1 comprising north-coastal counties which are predominantly mountainous.

State economic areas are groups of counties having similar agricultural, demographic, climatic, physiographic, and cultural characteristics.

PRESENT DEVELOPMENT

Taken as a whole, the northeastern county area has 23.0 percent of the state's land area, but in 1956 had only 2.7 percent of its civilian population (Table 1). Average gross density of population was ten persons per square mile compared with the state average of 85 persons per square mile.

The 15-county area today has a little more than one percent of the state's urban population, and about 11 percent of its farm population (Table 2).

The economy of the 15-county area has been built historically on agriculture, lumbering, and mining. Agriculture is a major activity in all the counties, and is the foundation of the economies of the valley counties. Lumber production is the leading industry in the mountain counties, excluding Lake.

TABLE 2

POPULATION AND EMPLOYMENT IN 15 NORTHEASTERN COUNTIES AS PERCENTAGE OF CALIFORNIA STATE TOTALS

(All Data as of April 1)

	1930	1940	1950	Probable ultimate
Total population	3.51	3.61	3.12	3.9
Urban population	0.89	0.90	1.34	3.0
Rural non-farm population	10.29	10.03	10.48	10.7
Rural farm population	11.35	10.70	10.73	12.0
Total employment	3.58	3.41	2.98	3.8
Farm employment	9.99	8.92	8.87	11.5
Wood products employment (excl. pulp and paper)	15.20	22.52	19.58	20.0
Mining employment—total	7.28	10.61	3.55	2.7
Excl. oil and gas	19.57	22.67		

SOURCE (1930-1950 data): U.S. Bureau of the Census.

TABLE 3

RELATION BETWEEN URBAN POPULATION AND EMPLOYMENT IN AGRICULTURE AND LUMBER AND WOOD PRODUCTS INDUSTRIES

	United States			California		
	Percent urban population	Percent employment in two industries	Sum of percentages	Percent urban population	Percent employment in two industries	Sum of percentages
1870	25.7	55.9	81.6	37.2	33.9	71.1
1880	28.2	52.9	81.1	42.9	33.4	76.3
1890	35.1	44.5	79.6	48.6	32.5	81.1
1900	39.7	40.7	80.4	52.3	28.1	80.4
1910	45.7	34.6	80.3	61.8	21.1	82.9
1920	51.2	29.6	80.8	67.9	20.0	87.9
1930	56.2	27.3	83.5	73.3	15.5	88.8
1940	56.5	20.7	77.2	71.0	12.3	83.3
1950	64.0	14.3	78.3	80.7	9.1	89.8

SOURCE: U.S. Bureau of the Census; Margaret S. Gordon, "Employment Expansion and Population Growth, The California Experience 1900-1950," University of California Press 1954.

Approximately two-thirds of the population of the northeastern county area is now supported directly and indirectly by agriculture and the timber industry. Likewise, two-thirds of the area's population today is rural.

The area presently accounts for about 11 percent of annual state agricultural production (by value), and 34 percent of California's timber products output (measured in board feet of sawlogs).

Mining, once the leading industry in the mountain counties, has dropped to a relatively minor role in recent years. In 1954, value of mineral production in the 15 counties was only 0.9 percent of the state total. In minerals other than oil and gas, the 15-county share was somewhat larger.

PROBABLE FUTURE ECONOMIC DEVELOPMENT

The 15-county area has about one-fifth of the state's farm land, and more than half of its commercial forest land. These resources will continue to support a substantial but declining proportion of the area's population.

Known mineral reserves indicate a potential for long-term sustained economic activity, but the proportion of population supported by mining is expected to remain relatively small.

In the years to come, it is expected that "footloose" industries, not dependent on agricultural, timber or mineral resources in the counties, will play an increasing part in their economies.

Trade and service industries are expected to increase greatly in proportion to other economic activities. Economic activities based on development and use of recreation resources are expected to become a major economic support of the 15-county area, and in some counties will rank as the "No. 1 industry". These activities will be predominantly in services to tourists and to persons residing in the area because of its scenic, climatic and other natural attractions.

Development of the northeastern county area has been held back to a considerable degree by inadequate transportation. The central valley portion of the area is traversed by major rail and highway routes; but there are relatively few rail and highway routes "off the main line". In the mountain counties, most roads are elementary and some areas cannot be reached by roads. Nevertheless the area has the framework for an improved transportation system built around such transfer points as Redding, Red Bluff, Chico, Marysville, and Davis.

GROWTH PATTERNS

This forecast of development trends in the northeastern counties has been guided by studies in the field of economic geography which show that as a large rural region such as the northeastern county area becomes more highly developed and populated, its pattern of economic and population growth follows certain definite trends. Among these are:

1. The proportion of total employment in the region provided by extractive activities (agriculture, forestry, and mining) and in manufacture of products from local natural resources (e.g. lumbering) steadily declines.

2. Employment and population in urban communities of the region grow more rapidly than employment and population in rural sections, with consequent increases in the proportion of urban population in the region.*

A remarkably constant relationship has been noted between the *decline* of the percent of total employment provided by agriculture and lumbering and the *rise* in the percentage of urban population. This is shown by the trends of these percentages in the United States and the State of California from 1870 to 1950 presented in Table 3.

In view of the large expected rise of population, economic activity and income levels in the United States and California from 1950 to the time of probable ultimate development of the natural resources of the 15-county area (years 2020-2050) and the pressure and potentials for economic development and population growth in the northeastern counties, it can be expected that the proportion of total employment in the area provided by agriculture and lumbering in the period 2020-2050 will range between 10 and 15 percent. Consequently it is estimated that the urban population of the area will then comprise about 70 percent of the total population.

The projections of employment and population in the 15-county area in the period 2020-2050, stated below, have been derived from detailed studies of potential development of natural resources in the individual counties and from established trends of economic development and population growth in the nation, state and area.

PROBABLE ULTIMATE POPULATION AND EMPLOYMENT

At ultimate development, in the period 2020-2050, the northeastern counties will have a total population of approximately 1,750,000. This is about 5.3 times the 1950 population of the area, and 4.8 times the estimated 1956 population.

It is estimated that about 36.6 percent of this population, on the average, will be employed, indicating a total employment of approximately 639,000. Construction, distribution, trade and service activities will provide nearly three-fourths of this employment; in 1950 they already accounted for 60 percent of employment in the northeastern county area.

Extractive industries, which accounted for nearly one-fourth of employment as of April 1, 1950, will ultimately account for slightly less than ten percent. Manufacturing will increase its share from 15.8 percent in April 1950 to around 17 percent.

The area's dependence on agriculture and lumbering will be greatly reduced. In 1950 these industries accounted for 33.5 percent of direct employment in the 15-county area as of April 1. Ultimately it is anticipated that this proportion will decline to about 12.8 percent (14.2 percent if pulp and paper products are included). This decline in relative importance will occur despite an anticipated increase in the absolute numbers of persons employed both in agriculture and in the lumber and wood products industries.

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* The term "urban population" in this report refers to the classification used by the Bureau of the Census. Before 1950, urban population referred to persons living in incorporated places of 2,500 or more. In 1950 the definition was broadened to include unincorporated places of 2,500 or more. The classification also includes the densely settled "urban fringe", including both incorporated and unincorporated places, around cities of 50,000 or more.

The Department of Water Resources employs a definition of urban lands which takes in much of what the Bureau of the Census classifies as "rural-non farm." In the 1940 and earlier Censuses, persons living in the suburbs of cities constituted a large proportion of the rural-non farm population. Under the new definition, a considerable number of such persons are transferred to the urban population. The rural-non farm population still includes villages and hamlets of less than 2,500 inhabitants, and some of the fringe areas surrounding smaller cities, which come under the Department of Water Resources classification of "urban" or "suburban" lands.

Employment in agriculture is expected to more than double—from the 25,416 reported by the Census Bureau for April 1, 1950, to approximately 55,000 as of April 1 at ultimate development. This will be made possible primarily by an increase in irrigated acreage from 1,085,000 in 1950 to an estimated 3,803,900 at ultimate development. Total acreage in farms is expected to remain about the same as in 1954, though slightly higher than in 1950.

Employment in lumber and wood products industries, excluding pulp, paper and paper products, is expected to double—from 13,543 reported by the 1950 census, to an estimated 27,000. In addition, an estimated 8,900 jobs will be provided in pulp, paper and paperboard manufacture, which is just now beginning in the area. This projected increase in employment in the timber industry assumes a sustained yield cutting program, maximum recovery of tree products in the forest, and full utilization of these products at the mills.

Mining is not presently an important source of employment in the northeastern county area. Some resumption of mining activity, on a sustained basis, is anticipated in the employment projections of this report.

In keeping with the decline in importance of extractive industries, the proportion of population living in rural areas is expected to decline from 65 percent as reported in the 1950 census, to about 31 percent. Conversely, the proportion of population residing in urban areas will just about double—from 35 percent in 1950 to about 69 percent.

The relative position of each county in the area with respect to population and population density will remain about the same as it is now. The geographical pattern of ultimate population and economic development in the northeastern county area appears to be generally established by the present relative degrees of development among counties.

Butte, Yolo, Shasta, Siskiyou and Sutter counties, in that order, presently rank highest in population and account for about 63 percent of the population of the area. At ultimate development, Yolo will be first in population but otherwise the positions are expected to be unchanged; the five counties together will account for an estimated 64 percent of total population in the northeastern county area.

POPULATION DENSITY

The ratio of population density in the 15 counties to that in the state will be about the same as in 1940—approximately one-sixth the state average. In 1940, the average gross population density of California was 44.1 persons per square mile. Density was 6.9 persons per square mile in the 15-county area. Thus, the state density was 6.3 times the area density in 1940.

With ultimate total population of 1,750,000 in the 15-county area, the average gross population density would be approximately 48.5 persons per square mile. Average gross population density of California at ultimate development, with a population of 45,000,000 will be 288.5 persons per square mile. This is approximately six times the density expected in the 15-county area.

Average gross population density is presently highest in Yolo, Sutter, Yuba, and Butte counties, in that order. At ultimate development these counties will continue to have substantially greater gross population density than the other northeastern counties (Table 4).

Gross population density is not to be confused with concentration of urban population. However, as indicated on an earlier page, these counties, plus Shasta County, are also those which are expected to have the largest urban populations at ultimate development, reflecting the generally close relationship between economic development, urban growth and total population.

With suitable controls over development, gross population density in urban areas might average about eight persons per acre (5,120 persons per square mile). This assumes an average of 8.5 persons per urban acre in Yolo, Sutter, Shasta and Siskiyou counties; 8.0 per acre in Butte and Yuba counties; and 7.0 per acre in all other counties. If these densities seem low, it may be noted that a density standard of 150 persons per square mile—0.23 persons per acre—is used by the Bureau of the Census as one of the criteria of metropolitan character.

With the urban population estimated in this report—1,203,500—an average density of 8.0 persons per acre would permit the northeastern counties to meet their needs for urban land, including urban industrial sites, with slightly more than 150,000 acres.

TABLE 4

POPULATION DENSITY IN 15 NORTHEASTERN COUNTIES

County	Population per square mile	
	1956	Ultimate (2020-2050)
Yolo	51.4	377
Sutter	47.0	201
Yuba	44.0	165
Butte	41.7	171
Glenn	12.4	65
Shasta	11.8	51
Colusa	9.9	59
Lake	8.8	52
Tehama	6.8	35
Siskiyou	5.1	20
Plumas	4.6	17
Lassen	3.7	15
Modoc	2.3	12
Sierra	2.3	17
Trinity	2.0	7
Average	10.0	48

COMPARISON WITH STATE AND NATIONAL DEVELOPMENT

1. *Proportion of Employment Provided by Agriculture*

The proportion of total employment in agriculture has been declining since 1920 and will continue to decline, in the nation, the state and each of the 15 counties.

Because California is now a highly urbanized state, the proportion of all California employment provided by agriculture in April 1950 was only 7.3 percent (Table 12). Hence, the extent of further decline in this percentage (and in the percentage of farm population) will be relatively small in the state as a whole.

From study of the potential ultimate development of irrigated land and accompanying shifts in crop patterns and the projected growth of the total population, it is estimated that about 2.8 percent of total employment in California at time of ultimate developments of its land resources (years 2020–2050) will be provided by agriculture. Although both agricultural employment and rural farm population in California at time of ultimate development, are estimated to be about 2¼ times the April 1950 figures, the rural farm population will decline from 5.4 percent of state population in 1950 to about 2.4 percent at ultimate development (see Table 5).

Each of the 15 counties is less developed economically and its population is now more rural and less urban than is the case for the state as a whole. For the 15-county area as a whole the percentage of employment provided by agriculture April 1, 1950 (21.9 percent) was three times the state figure of 7.3 percent (Tables 6 and 38). The area's proportion of rural farm population in April 1950 (18.5 percent) was 3.6 times the state figure of 5.4 percent (Table 5 and Table 54).

TABLE 5

POPULATION DATA AND PROJECTIONS

State of California

	Jan. 1, 1920	Apr. 1, 1930	Apr. 1, 1940	Apr. 1, 1950	Ultimate
Total population	3,426,861	5,677,251	6,907,387	10,586,223	45,000,000
Urban*	2,331,729	4,160,596	4,902,265	8,539,420	40,050,000
Rural farm	493,513	579,350	635,389	568,231	1,070,000
Rural non-farm	601,619	937,305	1,369,733	1,478,572	3,880,000
Percent distribution	100.0	100.0	100.0	100.0	100.0
Urban*	68.0	73.3	71.0	80.7	89.0
Rural farm	14.4	10.2	9.2	5.4	2.4
Rural non-farm	17.6	16.5	19.8	13.9	8.6

* 1950 urban population includes unincorporated places having 2,500 inhabitants or more. In previous years, only incorporated places of 2,500 inhabitants or more were considered "urban."
Population data and projections for the 15 counties are presented in Tables 22-37.

Hence, the proportion of total employment provided by agriculture (and the percent of rural farm population) will decline to a greater extent in these counties that in the state as they become more highly developed and more densely populated. Conversely, their percentages of urban population and of employment in non-agricultural activities (which were much below the state percentages in April 1950) will rise to a greater degree than the state percentages and will be closer to the state percentages at ultimate development than they were in 1950.

The decline in agriculture's relative importance will, of course, be greatest in the counties in which urban population and non-agricultural employment are expected to show the largest increases from 1950 to ultimate development, such as Butte, Shasta, Yolo and Yuba counties.

The analysis of agricultural development presented here implies continued net out-migration of population from farm areas in both the state and the 15-county area. In other words, if no future net out-migration of farm residents should occur between now and 2050, the expected natural increase of the farm population in the state and also in the 15-county area as a whole would produce larger ultimate farm populations than those estimated herein.

2. *Proportion of Employment Provided by Manufacturing*

In the United States as a whole the proportion of total employment provided by manufacturing rose from 19.4 percent in 1900 to 25.9 percent in 1950 (Table 11). It should be noted, however, that the rise in this percentage was influenced by the large decline in the percentage of agricultural employment. In view of expected continued increases in automation and in average productivity per man-hour of labor in manufacturing, it is estimated that the proportion of total employment provided by manufacturing in the nation in the period 2020-2050 will be about the same as in 1950 and will probably range between 24 and 26 percent.

Because manufacturing has been relatively less developed in California than in the nation as a whole, the proportion of total state employment provided by manufacturing was below the national proportion in each census year 1870-1950 (Table 11 and Table 12). The rapid growth of manufacturing industries in California since 1940, however, is tending to raise the state's percentage of manufacturing employment closer to the national percentage.

In the period 2020-2050, it is expected that manufacturing in California will have nearly the same degree of development relative to other economic activities as in the nation, and that the proportion of employment then provided by manufacturing will be about 22.5 percent, or about the same as estimated for April 1956.

TABLE 6

EMPLOYMENT DATA AND PROJECTIONS

State of California

(Employment as of April 1)

Industry group	1940 Number employed	1940 %	1950 Number employed	1950 %	Ultimate Number employed	Ultimate %
Total	2,475,581	100.0	3,902,278	100.0	16,965,000	100.0
Extractive	319,380	12.9	328,427	8.4	576,800	3.4
Agriculture	265,871	10.7	286,642	7.3	480,000	2.8
Forestry and fisheries	7,617	0.3	11,477	0.3	12,000	0.1
Mining	45,892	1.9	30,308	0.8	84,800	0.5
Manufacturing	415,721	16.8	763,680	19.6	3,817,100	22.5
Lumber and wood products*	40,195	1.6	69,167	1.8	135,000	0.8
Other manufacturing	375,526	15.2	694,513	17.8	3,682,100	21.7
All other	1,740,480	70.3	2,810,171	72.0	12,571,100	74.1
Sum of percentages, agriculture plus lumber and wood products	---------	12.3	---------	9.1	---------	3.6

* As defined in Standard Industrial Classification Groups 24 and 25. Pulp, paper and allied products (S.I.C. Group 26) are included in "other manufacturing" according to Census Bureau practice. Employment in pulp, paper and allied products at ultimate development is estimated at 18,000.
Employment data and projections for the 15 counties are presented in Tables 38-53.

Because of its relatively small development of manufacturing industries (except for lumber and wood products manufacture in the mountain counties), its high proportion of rural population and large dependence on agriculture, the proportion of total employment provided by manufacturing in the 15-county area as a whole has been well below the state and national percentages. In April 1950 manufacturing in the northeast counties provided only 15.8 percent of total employment there and accounted for only 2.4 percent of all manufacturing employment in the state. The lumber and wood products industries provided more than 70 percent of all April 1950 manufacturing employment in the 15 counties, and most of this was in the mountain counties.

As California's population and economy expand, population and manufacturing industries also will expand in the 15-county area, and the pattern of economic and industrial development of the area should become more like that of the state and nation. The area has a number of strategic economic transfer points for land, water and air transport and centers of potential industrial development, particularly in Shasta, Tehama, Butte, Yuba and Yolo counties.

If the population of California approaches or exceeds the mean projection of 26,750,000 in the year 1990 shown in Table 8, it can reasonably be expected that the pressures for further economic and population growth, plus the large natural resources, potential economic advantages and attractions of these areas for human living, will induce a relatively large development of manufacturing and other economic activities in the northeastern county area during the years 1990-2050. Manufacturing is expected to account then for about 17 percent of total employment.

3. *Proportion of Employment Provided by Agriculture and Lumbering*

As noted before, approximately two-thirds of the population of the 15-county area today is supported, *directly and indirectly*, by agriculture and the timber industry. Likewise, two-thirds of the population today is rural. This stage of development is comparable to that of the state in 1870 (Table 3).

(This analysis assumes conservatively that for every person employed in agriculture and lumbering there is at least one person employed in distribution and service activities related to the handling of farm and timber products and the provision of food, clothing, shelter and services to the population engaged in producing these commodities. This is a multiplier effect of 2:1. Generally, in the state and national economy, the employment in distribution and services generated by a given volume of employment in basic commodity producing industries is seldom less than 1.5 times the latter, or a multiplier effect of 2.5:1).

By 1950 the economic development of the State of California had progressed to the point where only about one-sixth (17.4 percent) of its 10,586,223 population was economically dependent on agriculture and the manufacture of lumber and wood products. The other five-sixths were supported by other sources of employment and income. Eighty percent of the 1950 state population was classed as urban.

By the time of ultimate development (years 2020-2050) it is estimated that the state will have a population of 45,000,000 of which only about one-fourteenth (7.2 percent) will be dependent (either directly or indirectly) on agriculture and the manufacture of lumber and wood products.

For the northeastern county area as a whole, however, the estimates of employment and population at time of ultimate development (years 2020-2050) show that about one-fourth of the area's 1,750,000 population will still be economically dependent on agriculture and the manufacture of lumber and wood products and that about 30 percent of the population will still be classed as rural.

In effect, the pattern of economic development and urbanization of the population of the 15-county area as a whole at time of ultimate development of its natural resources is estimated to be somewhat similar to that of the State of California in 1910 when 25 percent of state population was dependent directly or *indirectly on agriculture and the manufacture of lumber and wood products, and 29 percent of state population was still rural.* (In the 15-county area the estimated percent of ultimate total employment in agriculture and wood products manufacture combined is 12.8 percent, while the corresponding 1940 percent for California was 12.3).

In the 60 years 1880 to 1940, employment in the resource-based industries of agriculture and the manufacture of lumber and wood products in California increased by 143 percent—from an estimated 126,000 in 1880 to 306,000 in 1940. The proportion of total California employment provided by these two industry groups, however, declined from 33.4 percent in 1880 to 12.3 percent in 1940 (Table 3).

During the same period the total population of California increased by 699 percent—from 864,694 in 1880 to 6,907,387 in 1940. Thus, the rate of total population growth was 4.9 times the rate of increase of employment in the two resource-based industries.

In April 1940 the proportion of total civilian employment in the 15-county area provided by these two industry groups was 38.6 percent. By April 1950 it had declined to 33.5 percent, practically the same proportion as that for the State in 1880.

Also during the 10 years April 1940-April 1950, employment in the two industry groups in the area increased 17.4 percent while the total population of the area increased 32.5 percent, or 1.87 times as fast.

The sum of the estimates of employment in agriculture and in the manufacture of lumber and wood products (excluding pulp and paper) in the individual counties of the 15-county area at time of ultimate development equals 82,190, an increase of 111 percent over the April 1950 employment in these industries.

The estimated total population of the individual counties of the 15-county area at time of ultimate development is 1,750,000. This is an increase of 430 percent over the 1950 population. It also represents 3.9 times the estimated rate of the increase (from 1950 to ultimate development) of employment in agriculture and the manufacture of lumber and wood products in the area.

A rate of population increase equal to 3.9 times the rate of increase of employment in the two resource-based industries may appear high, but examination shows that:

(a) It is less than the population growth rate of 4.9 times the rate of employment increase in these two industries in California during the 60 years 1880-1940 cited above.

(b) It is below the rate of 4.45 times the rate of employment increase in the same two industries estimated for the growth of California population from 1950 to the same date of ultimate employment. *

(c) Continuation of the relative growth rates of population and of employment in the two industries for the period 1940-1950 would alone produce a population increase of 200 percent in the area from 1950 to ultimate development.

4. Relation of 15-county Population Growth to that of United States

Population in the 15 counties has in recent decades grown relatively faster than population in the United States as a whole. If the trend of relative growth shown in the period 1920-1950 is projected to year 2050, it yields population figures for the 15 counties which closely support the 1,750,000 estimate made by quite independent methods, which are explained in the following section of the report.

On the low side, the trend for 1920-1950 may be used. (This is low because of the relatively small population increase in the 15 counties during the 1920's). Over the three decades, 15-county population increased from 0.154 percent of U.S. population to 0.219 percent, an average increase per decade of 0.0217 percentage points.

If this average increase is projected over 10 decades to year 2050, the 15-county population would be 0.436 percent of U.S. population. The latter is estimated at 375,000,000 (Table 7). The resulting estimate for the 15 counties is 1,635,000.

On the high side, the faster growth trend of 1930-1950 shows an average increase of 15-county population, as a percent of U. S. population, of 0.0285 percentage points per decade. Projecting this increase over 10 decades to year 2050 indicates that 15-county population would then be 0.504 percent of U. S. population. This indicates a 15-county population of 1,890,000.

The average of the low and high estimates is 1,762,500.

Extent of in-migration. A population of 1,750,000 in the 15-county area in year 2050 implies an average net in-migration of approximately 5,000 per year during the years 1950-2050. This would be about the same as annual net in-migration into the area during 1940-1950, which is indicated below:

Total population increase, 1940-1950	81,100
Total natural population increase, 1940-1950 (60,866 births minus 30,940 deaths)† approx.	30,000
Total net in-migration, 1940-1950	51,100
Total net in-migration per year, 1940-1950	5,100

* State population increase: $\frac{45,000,000}{10,586,000}$ or 325 percent

State employment increase in agriculture and lumber and wood products $\frac{615,000}{355,800}$ or 73 percent

$\frac{325}{73}$ or 4.45 times

† State Department of Public Health

IV. METHOD OF ESTIMATING ULTIMATE EMPLOYMENT AND POPULATION IN NORTHEASTERN COUNTIES

A. SUMMARY

Basically, the estimates of employment and population in the northeast counties at ultimate development were developed from detailed study of present and potential ultimate development of agricultural lands and water, mineral, forest, and recreation resources of each county (and of the northeastern county area as a whole) similar to the analysis in State Water Resources Board *Bulletin No. 2* and the State Division of Water Resources *Report on Upper Feather River Service Area*. However, statistical techniques used in translating estimates of ultimate development of natural resources into estimates of population and employment differ from those in the foregoing reports.

Trends and patterns of economic development and population growth of the 15-county area as a whole were analyzed and projected to the period of ultimate development (years 2020-2050) based on potential development of the natural resources of the area, the projected growth of the state and national populations, and expected changes in employment patterns of the state and the 15-county area in light of established long term trends.

Estimates of major land uses, employment and population were then prepared for each county on the basis of its physical and economic characteristics, potential development of its natural resources, and past and expected patterns and trends of its growth and development in relation to those of the 15-county area and the state as a whole.

The aggregates of the estimates for the individual counties are consistent with the magnitudes of population and employment projected separately for the entire area.

Framework of Estimates

The estimates for the northeast counties were developed within a framework of population projections for the United States (375,000,000) and California (45,000,000) in the year 2050. These projections were developed as described in Section C of this chapter, entitled "Projections of the Populations of the United States and California to the year 2050".

The county projections are also based on certain assumptions about the probable relation between population and employment expected to prevail in the state and in the 15 northeastern counties at ultimate development. The determination of this relationship (i.e., the ratio of employed population to total population) is an essential step in estimating population growth based on development of local resources. The data and assumptions used in computing this ratio for the state and 15 counties are discussed in Section D entitled "Estimation of Ratio of Total Employment to Total Population at Time of Ultimate Development".

Estimates of the distribution of employment of county residents among various industries at ultimate development were guided by long-term trends of changes in employment patterns in the United States and California described in Section E entitled "Distribution of Employment, United States and California, 1870—1950, with Projections."

Estimates of ultimate agricultural development and ultimate April 1 employment in agriculture and the timber industry in each of the 15 counties were developed from estimates of potential ultimate irrigable acreage and sustained timber yields in each county, provided by the Department of Water Resources and the U. S. Forest Service respectively (Sections F and G).

All estimates and projections as to ultimate development presented in this report are predicated on the assumptions concerning future technologic, economic and demographic conditions and trends described under "Assumptions about Living Conditions in 2050" (Section B).

County Factors Considered in Preparing Estimates

The county estimates at ultimate development also are based on study and appraisal of the following specific factors and conditions for each county:

1. **Physical Factors**
   a. *Land Use*
      Present and estimated ultimate acreages of land in each of the following categories:
      - Total gross area
      - Water surface area
      - Barren and wasteland
      - Forest land
      - Agricultural land—total and irrigated
      - Institutional and public use
      - Urban areas

   b. *Physiography*
      Approximate area of:
      - Flat or relatively level land
      - Rolling or foothill land suitable for human habitation and scattered rural population

Steep or mountainous terrain with little or no permanent population

Recreation areas suitable for permanent settlement

Number and locations of present and potential urban communities, approximate acreage available at each location for future urban development (if such acreage would impose limitations on size of urban population), including consideration of:

Railroads and highways serving each such area, especially junction points for rail and highway transport.

Proximity or distance of such communities from other urban communities and from large recreation areas.

Favorable or adverse climatic conditions in different sections of county, and other physical conditions for living in various parts of county.

2. **Economic and Demographic Factors.** General nature and pattern of economic and population growth expected to be realized at ultimate development of county resources based on appraisal of:

Extent and inter-relationships of the various types of ultimate land use and of the established pattern of land ownership.

The geographical location of the county and its present and probable ultimate function and economic position in the 15-county area and the state as a whole.

The direction, rate, and nature of trends in economic development and population growth in the county, the 15-county area and the state.

The relative desirability and attractions of the county and various areas within it for human living and for particular types of economic and recreational activity at ultimate development, including its industrial location factors and advantages.

Locations of principal industrial, distribution and service centers (present and probable ultimate), including consideration of ultimate gross habitable area tributary to such economic foci and trading centers. This was useful in estimating ultimate amount and percent of distribution and service employment ('Other Employment' in the tables) based on size of population served from trading centers in county (or contrariwise from other centers outside the county).

Probable degrees of concentration and dispersion of lumber and wood products industries in the county. (The greater the expected concentration of such industries in one or two localities, the greater the probable development of supplier and related industries and of other types of manufacturing).

Present and probable ultimate percentage distribution and relative densities of rural farm, urban and rural non-farm populations of the county derived from analysis of the previously described physical factors and the trends of these percentages and densities in the 15-county area and the state.

Estimates of the numbers and percentages of county residents employed as of April 1 at ultimate development in agriculture and in the manufacture of lumber and wood products were then established from detailed studies of ultimate development of agricultural and forest resources and the previously determined pattern and trends of economic growth.

B. ASSUMPTIONS ABOUT LIVING CONDITIONS IN 2050

The projections of population and employment presented in this report have been developed in a framework of assumptions about conditions of human living in the United States and California in the year 2050 (selected to represent probable "ultimate" or full development of the northeastern counties' resources). These assumptions are:

1. Disparities in income levels among the regions and areas of the United States will have been largely eliminated by 2050 and median incomes of the population will be approximately the same among the regions and states.

2. Median family income of the populations of the United States and of California will be more than double the current median (in equivalent purchasing power of 1956 dollars).

3. New sources and applications of energy will be developed and widely used along with new and unpredictable types of materials, products, distribution methods and services, including transportation facilities and communication media.

4. Automation will have greatly reduced the amount of human effort required for production of materials and tangible goods. The average week of gainful labor at scheduled tasks will be about 24 or 25 hours (compared to about 38 hours in 1956).

5. *The location of population and economic activity will be determined to a greater extent by the economic advantages of various localities, including the relative desirability and attractiveness of physical environments for human living and working, than by the local availability of natural resources and the currently used natural sources of energy.*

6. Population and economic activity in the U. S. and California, therefore, will be much more widely diffused than they are in 1956. Maximum gross resi-

dential densities in cities and metropolitan areas will be substantially reduced below the current (1956) maximum densities, but average gross residential densities for the state and nation will be greatly increased.

7. Through progress in science and medicine, the average life span will be lengthened, and the proportion of the population ages 60 and over will be substantially larger than in 1950. Practically all people aged 60 years and over will have acquired life incomes *permitting them to select and live in environments most attractive to them.*

Applying these assumptions to the northeastern counties, it is expected that technological developments in transportation and communication will increase the accessibility of the area to all parts of the state and nation, and will make it feasible for many persons to reside in the area while carrying on their business elsewhere. These developments will also induce the establishment of many types of specialized activities not dependent on natural resources of the area.

The recreation resources of the area, together with increased leisure time for the population generally, will draw to it many outside visitors, and a substantial number of persons will live in the area solely because of its facilities for "good living" and leisure-time activities. Hence, the northeastern county area will contain a relatively large part-time or vacation population not dependent on employment in the area. The proportion of retired people in the 15-county area also may be somewhat higher than for the state as a whole.

In view of these prospects the potential population of the area at ultimate development is much larger than the present economy and developed resources of the area would indicate.

All estimates and projections at time of ultimate development assume that no major disaster, such as a devastating war, epidemic or other catastrophe, will occur during the period of the projection.

C. PROJECTIONS OF THE POPULATIONS OF THE UNITED STATES AND CALIFORNIA TO THE YEAR 2050

Need for the Population Projections

The levels of population and economic development in California are influenced by and closely related to those of the nation. In turn the size of the population and the extent and nature of economic development in the 15 counties are affected by and related to the size of the state and national populations.

Hence, the first step was to determine the probable size of the populations of the United States and of California at the time of ultimate development of the natural resources of the 15 counties. For reasons presented elsewhere in this report, the year 2050 has been taken as the approximate date of such ultimate development.

Assumptions and Procedures in Projecting Populations of the United States and California to the Year 2050

The sizes of the populations of the United States and of California in the year 2050 are subject to wide variations because of the many factors that may accelerate or retard population growth. The most logical approach to the problem was judged to be (a) determination of the range within which the population can be expected to vary in the year 2050 and (b) adoption of a figure near the middle of this range.

Probable high and probable low projections of the total populations of the United States and California in the year 2050, therefore, were developed as described below and shown in Tables 7 and 8.

Assumptions with respect to future economic and social trends and conditions on which the projections have been based are set forth in the preceding section of this report.

1. Projections of the Population of the United States

High Projections. For 1960, 1965, 1970 and 1975, the high projections in Table 7 are the highest of a series of projections of the total population (including armed forces overseas) for those dates published by the Bureau of the Census in its current Population Reports, Series P-25, No. 123, October 20, 1955. The low projections in Table 7 for those dates are the lowest of the Bureau of the Census projections in the same report.

For 1990, the high projection of 270,000,000 developed in 1954 by the engineering firm of Parsons, Brinckerhoff, Hall and Macdonald in a study of population growth in the nation, California, and the San Francisco Bay Area was adopted. This 1990 high projection is 60,620,000 more than the 1970 high projection of 209,380,000 by the Bureau of the Census. It represents an average increase of 3,031,000 per year for that 20 year period, or 30,310,000 per decade.

The high projections for the census years 2000 to 2050 are straight line arithmetical projections based on an assumed average increase of 3,000,000 per year over the entire 60 pear period, 1990-2050. The assumption of an average population growth of 3,000,000 per year appears conservative for a high projection of the national population for the following reasons:

(a) It represents a gradual decline in the average crude rate of natural increase from approximately 14.9 per thousand population during the five years 1950-55 to approximately 9.8 per thousand population for the five years 1990-95 and approximately 6.7 per thousand population in the five years 2045-50. These future crude rates of natural increase and the population projections based thereon might be exceeded if age-specific fertility rates and mortality rates were maintained at about their current levels, despite the larger proportions of older people in the projected future populations.

(b) A report published in November 1952 by the Federal Security Agency * shows a high projection of 392,289,000 for the population of the entire United States (including territorial possessions) in 2050. This projection, however, does not reflect the large population increase which has already occurred during 1950-56. The high projection in that report for 1975 is 200,923,000 which is about 28,000,000 less than the more recent 1975 high projection by the Bureau of the Census shown in Table 7. Moreover, the high projections by the Federal Security Agency assume a large reduction in age-specific fertility rates after 1960.

(c) The potentialities for continuous advancement in medical science, in productivity per man-hour of labor and in the general plane of living, with consequent lowering of mortality rates, make a high projection of 450,000,000 population for the United States in the year 2050 seem not excessive.

Low Projections. The low projections for 1960, 1965, 1970 and 1975 in Table 7 are the lowest of the series of projections by the Bureau of the Census in the report previously cited.

The 1980 projection of 215,000,000 was obtained by adding an assumed increase of 8,093,000 to the Census Bureau's 1975 low projection of 206,907,000. This represents an average increase, 1975-80, of 1,618,000 per year—which is less than the average increase of 2,107,400 per year for the five years 1970-75 and the 2,030,300 average annual increase for the 15 years 1960-75, shown by the Census Bureau's low projections.

The low projections for the census years 1990 to 2050 were obtained by adding gradually decreasing annual increments of population growth, based on an assumed gradual decline in age-specific fertility rates to the prewar level of 1940 and practically no change in age-specific mortality rates.

It may be argued that the low projection of 300,000,000 is too low a figure for the population of the United States in the year 2050. However, the Federal Security Agency report cited before shows a low projection of only 225,525,000 population in 2050.

* *Illustrative United States Population Projections 1952*, Robert J. Myers and E. A. Razor, Actuarial Study No. 33, Federal Security Agency, November 1952.

As an aid in determining the population of California in 2050, the potential range for the national population in that year shown in Table 7 appears reasonable.

2. **Projections of the Population of California.** High and low projections showing the expected size range of the population of California in the year 2050 (Table 8) were developed by:

(a) Extending to the year 2050 the high and low projections of the state's population published by the State Department of Finance for 1960 and 1965 and the high projection for 1990 made by the firm of Parsons, Brinckerhoff, Hall and Macdonald.

(b) Computing the percentages of the high, low and mean population projections for the United States represented by the corresponding projections of the California population (as developed by procedure (a) above) in each census year 2000 to 2050 to determine whether the trends and amounts of these future percentages were consistent and reasonable in light of past relationships of population growth in the two areas.

The *high* projections for the population of California in the census years 2000 to 2050 assume a gradual decrease in annual growth from 500,000 per year during 1990-2010 to 400,000 per year during 2040-2050. These average annual increases are less than the estimated average during the five years 1950-55 and also well below the 560,000 annual average for the 20 years 1970-90 shown by the Parsons, Brinckerhoff, Hall and Macdonald high projections.

If future age-specific fertility and mortality rates are approximately the same as those assumed for the high projections of the national population (which appears to be a reasonable assumption for the high projections of the California population), the high projections in Table 8 represent a gradual decline of the average annual net migration into California from about 300,000 during 1950-60 to about 40,000 during 2040-50. Consequently, the high projections in Tables 7 and 8 represent a consistent and reasonable decline in the differential between rates of population growth in the nation and in California. This is shown by the trend of the percentages of U. S. population represented by the high projections of California population for the census years 1950-2050 in Table 8.

The *low* projections of the population of California in the census years 2000-2050 assume a gradual decline in both the rate and amount of population increase in each decade after 1990. The low projections are based on the assumption that net migration will steadily decline from about 125,000 per year during 1990-2000 to zero during 2040-50 and also that age-specific fertility rates will decline at approximately the same rate in California as that previously assumed for the low projections of the national population in the decades 2000-2050.

Average crude rates of natural increase during the five years 2045-50 for the low projections of the national and state populations are both approximately 3.5 per thousand population.

Conclusion

In effect, the high and low projections in Tables 7 and 8 represent reasonable upper and lower limits for the populations of the United States and California in the year 2050. Because it is impossible to predict whether the population of California in 2050 will be closer to the upper or to the lower limit of the indicated potential range, the figure adopted for this study is the mean of 45,000,000 between the high of 58,000,000 and the low of 32,000,000.

On the basis of the foregoing analysis, it is estimated that California will have a population of approximately 45,000,000 at the time of "ultimate" or full development of natural resources in the northeastern counties. It also appears possible that this population figure might be reached at any time after the year 2020.

Comparability With Other Estimates

The 45,000,000 estimate derived by the foregoing analysis is only 2,590,000 larger than the estimate of 42,410,000 for probable ultimate state population developed by a different method by the State Division of Water Resources and published in State Water Resources Board *Bulletin No. 2*, Volume 1, June 1955, page 220.

The projection is quite close to the 45,800,000 estimate for California population in 2050 developed by the Bureau of Reclamation, Region 2, and published in its "Guide for Forecasting Population Growth," October 1954, page 9. The Bureau estimate for U. S. population in 2050 is 381,700,000 compared with 375,000,000 in Table 7.

Also in Table 7, the estimate of 272,500,000 for United States population in year 2000 compared with an estimate of 273,000,000 for that year prepared by Stanford Research Institute in its 1954 report to Weyerhauser Timber Company, "America's Demand for Wood 1929-1975."

TABLE 7

POPULATION OF THE UNITED STATES 1900-1950 WITH ESTIMATES AND PROJECTIONS TO 2050

Year	Population
1900	75,994,575
1910	91,972,266
1920	105,710,620
1930	122,775,046
1940	131,669,275
April 1, 1950	151,132,000 (incl. armed forces overseas)
July 1, 1955[a]	165,271,000 (incl. armed forces overseas)
July 1, 1956[a]	168,091,000 (incl. armed forces overseas)

Projections	High	Mean	Low
July 1			
1960[b]	179,358,000	177,905,000	176,452,000
1965[b]	193,346,000	189,818,500	186,291,000
1970[b]	209,380,000	202,875,000	196,370,000
1975[b]	228,463,000	217,685,000	206,907,000
1980	239,000,000	227,000,000	215,000,000
1990	[c]270,000,000	250,500,000	231,000,000
2000	300,000,000	272,500,000	245,000,000
2010	330,000,000	293,750,000	257,500,000
2020	360,000,000	314,500,000	269,000,000
2030	390,000,000	335,000,000	280,000,000
2040	420,000,000	355,000,000	290,000,000
2050	450,000,000	375,000,000	300,000,000

[a] Estimated by the Bureau of the Census, Current Population Reports, Series P-25, No. 141, August 10, 1956.

[b] High and low projections from Bureau of the Census, Current Population Reports, Series P-25, No. 123, October 20, 1955. Mean projections are the arithmetical means between the high and low projections and are not those of the Bureau of the Census.

[c] 1990 high projection by Parsons, Brinckerhoff, Hall and Macdonald.

TABLE 8

POPULATION OF CALIFORNIA 1900-1950 WITH ESTIMATES AND PROJECTIONS TO 2050

Year	Population	California percent of United States
1900	1,485,053	1.95
1910	2,377,549	2.59
1920	3,426,861	3.24
1930	5,677,251	4.62
1940	6,907,387	5.25
April 1, 1950	10,586,223	7.00
July 1, 1955[a]	13,035,000	7.89
July 1, 1956[a]	13,600,000	8.09

Projections	High	Mean	Low	California percent of United States		
				High	Mean	Low
July 1						
1960[b]	15,413,000	15,011,000	14,609,000	8.59	8.44	8.28
1965[b]	17,781,000	17,100,000	16,419,000	9.20	9.01	8.81
1970	[c]20,000,000	18,800,000	17,600,000	9.55	9.27	8.96
1980	25,600,000	22,900,000	20,200,000	10.71	10.09	9.40
1990	[c]31,200,000	26,750,000	[c]22,300,000	11.56	10.68	9.65
2000	36,200,000	30,200,000	24,200,000	12.07	11.08	9.88
2010	41,000,000	33,500,000	26,000,000	12.42	11.40	10.10
2020	45,500,000	36,650,000	27,800,000	12.64	11.65	10.33
2030	49,800,000	39,600,000	29,400,000	12.77	11.82	10.50
2040	54,000,000	42,400,000	30,800,000	12.86	11.94	10.62
2050	58,000,000	45,000,000	32,000,000	12.89	12.00	10.67

[a] From "California's Population in 1956," State Department of Finance, July 1956.

[b] High and low projections are from Projected Population of California by Broad Age Groups, 1956-1966, State Department of Finance, September 1955.

[c] High projection for 1970 and the high and low projections for 1990 are those developed by Parsons, Brinckerhoff, Hall and Macdonald for their report, Regional Rapid Transit, to the San Francisco Bay Area Rapid Transit Commission, January 1956.

D. ESTIMATION OF RATIO OF TOTAL EMPLOYMENT TO TOTAL POPULATION AT TIME OF ULTIMATE DEVELOPMENT

The proportion of the population of an area that is gainfully employed on a particular date is determined by:

1. The percentage of that population which is in the working age group 14 years and older.
2. The percentage of that working age population which is in the labor force (i.e., persons actually employed or seeking work. This percentage is known as the labor force participation rate).
3. The percentage of the labor force that is gainfully employed.

The ratio of total employment to total population therefore is equal to percentage 1. multiplied by percentage 2. multiplied by percentage 3.

Assumptions Concerning Future Characteristics of County Populations

In the past, the populations of most of the 15 northeast California counties have shown:

1. A higher sex ratio (i.e., number of males per 100 females) than for the nation and state.
2. Larger proportions of children ages 0-14 years than the averages for the nation and state.

The long-term trends of the sex ratios and age distribution in the 15 counties, however, have been to diminish their differentials in these respects from the national and state averages.

Hence by the time of ultimate development (2020-2050) it can reasonably be expected that the age distribution and sex composition of the populations of most of the 15 northeast counties will have become about the same as the age-distribution and sex composition of the national and state populations at that future date.

Some of the 15 northeast counties, for example, the counties of Lake, Plumas, Lassen, and Sierra, because of their potential attractions for retired elderly persons, may have relatively high proportions in the age group 65 and over with consequently smaller percentages of their working populations in their labor forces. The effects of these two deviations from the average for the nation, state and other northeast counties would tend to be offsetting. The larger percentage in the age group 65 years and over would increase percentage 1. but the greater proportion of retired persons would tend to reduce percentage 2. Hence, in computing the overall ratio of employment to population, it has been assumed that the age distribution and sex composition for each of the 15 counties at ultimate development will approximate the averages for the national and state populations.

Estimation of Percentage 1 At Ultimate Development

The percentages of the civilian populations of the United States, California and the 15 northeast counties in the working age group 14 years and over in the years 2020-2050 should be larger than in April 1950 because there will then be smaller percentages in the child age groups and higher percentages in the older age groups 65 years and over. A series of population projections for the entire United States by the Federal Security Agency to 2050 shows a probable decline of 2½ to 4 percentage points from 1950 to 2050 for children ages 14 and younger and a rise of 4½ to 7 percentage points for the age group 65 years and over.[1]

On the other hand, the active working age group 20-64 years which contains most of the gainfully employed will probably decline from 57.5 percent of the total U. S. population in 1950 to 56 or 55 percent by 2050.

Again, these changes in the age distribution of the population may have offsetting effects on the ratio of total employment to total population. The decline of the proportion of the population in the most active working ages will tend to lower the ratio, while the larger proportion in the elderly ages may tend to raise it.

In view of the population projections to 2050 by the Federal Security Agency, cited above, the expected range of the age distribution of the populations of California and the 15 northeast counties in 2020-2050 is as follows:

PROBABLE RANGE OF AGE DISTRIBUTION OF THE POPULATION OF CALIFORNIA AND THE 15 COUNTIES IN 2020-2050[2]

Age Group	*Probable Range*
0-14 years	23- 25 percent
15-19 years	7- 8 percent
20-64 years	56- 55 percent
65 years and over	14- 12 percent
	100-100 percent

Another prospect of significance for this study is that the current downtrend of the sex ratio of the national population may be halted and begin to reverse itself between 1975 and 2000 with the result that the sex ratio will be higher in 2020 and 2050 than it was in 1950. The four series of population projections for the entire United States to 2050 published by the Federal Security Agency in 1952 each assumes that the current relative superiority of female over male mortality will decrease in the future (although absolute improvement is shown for both sexes). It is recognized that in the past the gap has been widening so that this assumption is contrary to a projection of

[1] "*Illustrative United States Population Projections 1952,*" by Robert J. Myers and E. A. Razor, Actuarial Study No. 33, Federal Security Agency, November 1952. Population figures in this report include the populations of Alaska, Hawaii, Puerto Rico, Virgin Islands and U. S. armed forces and civilians overseas.

[2] Based on projected age distributions of United States population in Federal Security Agency study cited above.

past trends but is thought to be the most reasonable assumption.[1]

Hence, it seems likely that the sex ratios of the populations of the United States, California and the 15 northeast counties will be close to unity by the years 2020-2050. In other words the number of males will then be approximately equal to the number of females.

Estimation of Percentage 2 At Ultimate Development

The next question is: In what direction and to what extent will changes occur in percentage 2, i.e., the rate of labor force participation of the working age population? Will the anticipated higher income level and assured lifetime income of the elderly reduce their propensity to seek gainful employment, or will their improved health and increased vitality and longevity (through expected advancements in medical science) together with the expected greater opportunities for non-arduous labor and a desire of the aged to perform such remunerative service to society raise their labor force participation rate?

On this point, a recent report by the Bureau of the Census[2] projects a decline in the labor force participation rate of males ages 65 and over in the national population from 44.7 percent in 1950 to 36.5 percent in 1975. This is a drop of 8.2 percentage points for those 25 years. The same report, however, projects a slight increase from 8.9 percent in 1950 to 9.5 percent in 1975 in the labor force participation rate for females ages 65 and over in the national population.

The same Census Bureau report also projects an increase from 57.3 percent in 1950 to 59.1 in 1975 in the labor force participation rate of the whole national population ages 14 years and over. The projected rate for males ages 14 years and over drops from 83.3 percent in 1950 to 80.6 percent in 1975, but the rate for females ages 14 years and over rises from 31.3 percent in 1950 to 37.5 percent in 1975.

A writer on California employment trends has noted:

> "In the past there has been a close relationship between the working age population (assumed here for convenience to be 15-64 years) and civilian employment in California. However, the employed portion of California's population has been declining gradually with time, as it has been in the nation as a whole. In 1880, about 60 percent of California's working age population was employed; by 1950, this ratio had dropped to about 55 percent. If this trend continues, the ratio will be about 53 percent in 1970."[3]

In view of the much higher level of the population, assured life incomes for most of the elderly group, and the smaller percentages of total employment in extractive activities expected during 2020-2050, it seems likely that current definitions and statistical relationships between population, labor force, and employment will have become outmoded by those dates and new concepts, definitions and relationships will have emerged. Especially it seems probable that the labor force will then be divided into two groups,

TABLE 9

COMPUTATION OF PERCENTAGES OF TOTAL POPULATION IN THE LABOR FORCE AND EMPLOYED IN CALIFORNIA 2020-2050

A. Percent of population 14 years old and over in April 1 labor force, United States and California

	United States[1]		California	
	1950	1975	1950[2]	2020-2050
Males:				
14-19 years	48.9	43.7	39.0	25.0 21.0[3]
20-64 years	93.8	93.2	89.2	87.0-85.0
65 years and over	44.7	36.5	32.4	28.0-25.0
14 years and over, total	83.3	80.6	78.2	70.7-68.6
Females:				
14-19 years	27.4	26.3	19.7	12.0-10.0[3]
20-64 years	35.7	45.8	35.9	44.0-40.0
65 years and over	8.9	9.5	7.4	10.0- 8.0
14 years and over, total	31.3	37.5	31.0	34.9-34.6
Average, male and female	57.3	59.1	54.1	52.8-51.6

B. Proportion of total population in April 1 labor force, California, 2020-2050

		High	Low
Males:			
15-19 years	=	.25 × .07 = .0175	.21 × .08 = .0168
20-64 years	=	.87 × .56 = .4872	.85 × .55 = .4675
65 years and over	=	.28 × .14 = .0392	.25 × .12 = .0300
		.5439 (= 54.39%)	.5143 (= 51.43%)
Females:			
15-19 years	=	.12 × .07 = .0084	.10 × .08 = .0080
20-64 years	=	.44 × .56 = .2464	.40 × .55 = .2420
65 years and over	=	.10 × .14 = .0140	.08 × .12 = .0096
		.2688 (= 26.88%)	.2596 (= 25.96%)
Average, male and female:		40.64 percent (high)	38.70 percent (low)

C. Percent of total population employed April 1, California. 2020-2050

	High	Low
Percent in labor force	40.64 percent	38.70 percent
Percent employed	.96	.94
Percent of whole population employed	39.01	36.38

Average equals $\frac{39.01 + 36.38}{2}$ = 37.7 percent

[1] Data from Bureau of the Census, Current Population Reports, Labor Force, Series P-50, No. 42, December 10, 1952, Table 1 (includes persons in military service).
[2] Data from 1950 Census of Population, Part 5, California, Table 69, page 5-269.
[3] Age group 15-19 years in 2020-2050.

[1] Quoted from Federal Security Agency study, pages 32 and 33.
[2] Bureau of the Census, Current Population Reports, Labor Force, Series P-50, No. 42, December 10, 1952, Table 1 (A Projected Growth of the Labor Force in the United States under Conditions of High Employment: 1950-1975).
[3] Richard C. Singleton in *Growth and Changes in California's Population*, by Warren S. Thompson, The Haynes Foundation, Los Angeles, 1955, page 296.

one representing persons engaged in or seeking regular full time employment and the other representing those who desire and will accept only intermittent or part-time employment, devoting the rest of their time to non-remunerative activities.

But since it is necessary to estimate future employment, labor force and population on the basis of current definitions and relationships, the following assumptions appear logical and reasonable for the purposes of this study. It is therefore assumed that by 2020-2050:

1. The proportions of youths ages 14-19 in the labor forces of California and the nation will be much smaller than in 1950 because their educational period should then be materially lengthened. The minimum age for gainful employment will almost certainly be raised from 14 to 16 years and the labor force participation rates in the 15-19 year age bracket will probably not exceed 25 percent for males and 12 percent for females (see Table 9, Section A).

2. The labor force participation rates for males ages 20-64 years in California and the nation will have declined to 87-85 percent; for females ages 20-64 years it will range between 44 and 40 percent.

3. The labor force participation rate of males ages 65 years and over will have declined to 28-25 percent and the rate for females will range from 10 to 8 percent.

These assumptions then were applied to the projected range of the age distribution of the population in 2020-2050 as shown in the statistical analysis in Table 9, Section B.

In accordance with the previously described trend in sex ratios, it is also assumed that the sex ratio of the California population in 2020-2050 will be unity (i.e., equal numbers of males and females).

With these assumptions, the labor force participation rate of the population of California ages 15 years and over in 2020-2050 will range between 70.7-68.6 percent for males and between 34.9-34.6 percent for females. For males and females together the range is 52.8-51.6 percent (Table 9, Section A).

For the total population of California in 2020-2050 the projected range is 54.4-51.4 percent for males and 26.9-26.0 percent for females.

Estimation of Percentage 3 At Ultimate Development

It is impossible of course to predict exact levels of employment and unemployment in 2020-2050. It may reasonably be assumed, however, that periods of economic recession will then be relatively short and of relatively small depth because of the advances that will doubtless be made in controlling fluctuations of economic activity in the future.

Since unemployment on April 1 (as now defined generally averages about 4 percent in prosperous peacetime years, it seems reasonable to assume that unemployment in the nation and California in the period 2020-2050 will probably fluctuate between 4-6 percent. Hence it is assumed that from 96 to 94 percent of the labor force will be employed at the time of ultimate development.

Summary: Percentage 1 x Percentage 2 x Percentage 3

Finally, therefore, the estimated range of the ratio of total April 1 employment to total April 1 population in California in 2020-2050 is as follows:

Estimated Range of Percentages in 2020-2050

	High	*Low*
Percent of total population ages 15 years and over (Percentage 1)	77.0	75.0
Percent of population ages 15 years and over in the labor force (Percentage 2)	52.8	51.6
Percent of the labor force employed (Percentage 3)	96.0	94.0
Ratio of total employment to total population	39.0	36.4
	(mean = 37.7)	

Employment Ratio for 15 Northeastern Counties

The ratio of total employment to total population in the 15 northeastern counties at time of ultimate development will probably be slightly below the 37.7 percent average developed above for California as a whole. Reasons for this belief are:

1. The larger proportions of rural non-farm population and smaller proportions of urban population expected in the 15 counties than for the state as a whole.

2. The proportions of employment in extractive activities and in wood products manufacture are expected to be relatively larger in the 15 counties than the average for the state.

Labor force participation rates of the rural non-farm population in California are substantially lower for both males and females than the corresponding rates for the State's urban population. Comparative rates for April 1, 1950 are shown in the following table:

Percent of State Population April 1, 1950		*Percent of Population Ages 14 Years and Over in Civilian Labor Force California, April 1,1950* Total	Males	Females
80.7	Urban	53.3	75.2	32.6
5.4	Rural Farm	54.7	83.0	19.8
13.9	Rural Non-Farm	45.2	64.2	22.0
100.0	Whole Population	52.3	74.0	30.7

SOURCE: U. S. Census of Population: 1950, Volume II, Part 5, Chapter B, Table 25.

Since it seems likely that the rural non-farm population of the 15 northeastern counties at the time of ultimate development will comprise a considerably larger percent of their total population than the average percent for the state population; and because the rural non-farm population tends to have a relatively low labor force participation rate, it may be expected that the labor force participation rate for the 15 counties in 2020-2050 will be slightly below that for the state as a whole at that time.

Furthermore, larger proportions of total employment in the 15 northeastern counties are in the extractive activities and in wood products manufacture than the corresponding proportions for California as a whole, and male employment in these activities is relatively high while female employment in them is relatively low. Nine of the 15 northeastern counties had slightly higher labor force participation rates for males in 1950 than the California average of 78.2 percent.[1] These nine counties were Colusa, Glenn, Lassen, Modoc, Plumas, Shasta, Siskiyou, Sutter and Tehama. Only one of the 15 counties (Plumas), however, equalled the *national* labor force participation rate of 83.3 per cent for males in 1950; all the other counties had lower rates for their males of working age.

All 15 counties, however, had much lower labor force participation rates for their females of working age in 1950 than the 30.8 percent for the state and the 31.3 percent for the nation.

Hence, the labor force participation rate for the whole population of working age (males and females together) in the 15 counties generally was below the corresponding state and national rates in 1950. It should be noted also that the California rates for both males and females were slightly below the corresponding national rates in 1950. Part of this difference probably was due to the higher median income level of the California population, which freed relatively more of the state's population of working age from the necessity of gainful employment.

Another clue to the probable labor force participation rates of the northeastern counties in 2020-2050 may be found by examining the rates for Lake County in 1950. These rates were only 71.3 percent for the county's male population ages 14 and over and 24.1 percent for the female population of working age. For males and females together the rate was only *48.3* percent. The unusually low rates for Lake County in 1950 appear to have been due largely to the age distribution of the county's 1950 population, especially the very high proportion (14.7 percent) of persons ages 65 and over.

The sex ratio of the population of Lake County in 1950 was approximately 106 and the age distribution of the population was:

0–14 years	23.3 percent
15–64 years	62.0 percent
65 years and over	14.7 percent
Whole population	100.0

[1] 1950 Census of Population, Vol. II, Part 5, Chapter B, Tables 10 and 12.

The foregoing analysis indicates that the age distribution and labor force participation rate of the populations of the northeastern counties in 2020-2050 may approach that of Lake County in 1950. Hence, it may logically be reasoned that the labor force participation rate for the population ages 15 years and over in the 15 counties in 2020-2050 probably will not exceed 50 percent, and may be below that figure. This is below the estimated state average rate of $\frac{(52.8 + 51.6)}{2} = 52.2$ percent in 2020-2050 (data from Table 9).

Assuming an average labor force participation rate of 50 percent of the population ages 15 years and over in 2020-2050, the ratio of total employment to total population in the 15 northeastern counties would be as follows:

Percentage 1.—76 $\frac{(77 + 75)}{2}$

Percentage 2.—50

Percentage 3.—95 $\frac{(96 + 94)}{2}$

Total Employment—36.1 percent of total population

Hence, in making the population projections for the northeastern counties the ratio of April 1 employment to population at time of ultimate development has been generally assumed to be 36 percent. In applying this assumption to computations for individual counties, however, the percentage has been varied to meet local differences. For Yolo County, which is expected to have a relatively high degree of urban and industrial development, the percentage is assumed to be 37.5 percent. In a number of other counties, especially Colusa, Glenn and Sutter, where farm employ-

TABLE 10

EMPLOYMENT (APRIL 1) AS PERCENT OF POPULATION IN 15 NORTHEASTERN COUNTIES: ESTIMATES FOR ULTIMATE DEVELOPMENT, YEARS 2020-2050

	Population	Employment	Employment as percent of population
Butte	284,000	102,200	36.0
Colusa	68,000	26,500	39.0
Glenn	85,000	32,080	37.7
Lake	65,000	21,000	32.3
Lassen	67,500	24,930	36.9
Modoc	51,100	18,510	36.2
Plumas	44,700	16,080	36.0
Shasta	195,000	70,200	36.0
Sierra	16,000	5,750	35.9
Siskiyou	127,200	46,180	36.3
Sutter	121,800	47,180	38.7
Tehama	105,100	36,800	35.0
Trinity	22,000	7,925	36.0
Yolo	390,000	146,250	37.5
Yuba	105,000	37,750	36.0
Total	1,747,400	639,335	36.6

ment is a relatively high proportion of total employment or is relatively high in comparison with farm population, the employment to population ratio of .36 was applied only to non-farm employment instead of to total employment. Lake County is assumed to have a relatively low ratio of employment to population.

For the 15 counties as a group, this procedure results in an average ratio of estimated April 1 employment to population at ultimate development of 36.6 percent. In the case of some counties, the difference between 36 percent and the figure shown in Table 10 is due to rounding of population estimates or employment estimates or both.

E. DISTRIBUTION OF EMPLOYMENT, UNITED STATES AND CALIFORNIA 1870-1950 WITH PROJECTIONS

Purposes and Uses of Data in Tables 11 and 12

Tables 11 and 12 were prepared to show the directions and rates of shifts in the functional distribution of employment in the United States and California, by decades, 1870-1950.

These tables show clearly the continuous decline in both the United States and California of the proportions of employment provided by the extractive activities and the continuous rise in the proportions employed in "Other Employment" (i. e., in construction, distribution and service activities). Similar analyses for other states show the same general trends.

The universality of these long term trends in employment patterns provides the basis for projections of the distribution of employment in the northeastern California counties and for projections of total employment therein at the stage of probable ultimate development, including full utilization of their natural resources.

Sources of Data in Tables 11 and 12

Percentage distribution of employment 1870-1950, was computed from data in *Employment Expansion and Population Growth, The California Experience 1900-1950* by Margaret S. Gordon, University of California Press, 1954, especially Tables A-13, A-14, A-17, A-18, and A-19.

TABLE 11

TRENDS IN FUNCTIONAL DISTRIBUTION OF EMPLOYMENT IN THE UNITED STATES

	1870	1880	1890	1900	1910	1920	1930	1940	1950
Total Employment	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Extraction	54.2	51.6	43.8	40.7	34.3	30.2	24.9	20.9	14.1
Agriculture	52.3	49.4	41.2	37.6	31.1	27.0	22.1	18.7	12.2
Forestry and Fishing	0.4	0.5	0.7	0.7	0.6	0.6	0.5	0.2	0.2
Mining	1.5	1.7	1.9	2.4	2.6	2.6	2.3	2.0	1.7
Manufacturing	16.2	17.7	18.3	19.4	22.4	25.1	22.6	23.5	25.9
Lumber and wood products	3.6	3.5	3.3	3.1	3.5	2.6	2.4	2.0	2.1
Other manufacturing	12.6	14.2	15.0	16.3	18.9	22.5	20.2	21.5	23.8
Other Employment	29.6	30.7	37.9	39.9	43.3	44.7	52.5	55.6	60.0

TABLE 12

TRENDS IN FUNCTIONAL DISTRIBUTION OF EMPLOYMENT IN CALIFORNIA

Industry Group	1870	1880	1890	1900	1910	1920	1930	1940	1950	Estimated April 1956	(Tentative) Ultimate Development 2020-2050
Total Employment	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Extraction	46.5	41.0	35.3	31.1	21.9	19.7	16.4	12.9	8.4	8.9	3.4
Agriculture	29.3	28.6	29.0	25.0	17.9	17.2	13.7	10.7	7.3	7.8	2.8 Estimated
Forestry and fishing	1.7	2.1	1.7	1.4	1.2	0.8	0.6	0.3	0.3	0 3	0.1 Assumed
Mining	15.5	10.3	4.6	4.7	2.8	1.7	2.1	1.9	0.8	0.8	0.5 Assumed
Manufacturing	14.2	17.5	16.7	17.7	17.9	21.0	17.0	16.8	19.6	22.3	22.5 Assumed
Lumber and wood products	4.6	4.8	3.5	3.1	3.2	2.8	1.8	1.6	1.8	--	0.8 Assumed
Other manufacturing	9.6	12.7	13.2	14.6	14.7	18.2	15.2	15.2	17.8	--	21.7 Assumed
Other Employment	39.3	41.5	48.0	51.2	60.2	59.3	66.6	70.3	72.0	68.8	74.1

Percent of total employment in lumber and wood products manufacture was computed by multiplying percentages of total manufacturing production workers employed in lumber and wood products by the percentage of total employment engaged in manufacturing in the nearest census year (Tables A-18 and A-19 in Gordon report).

Percentage distribution in Table 12 for April 1956 was computed from data in *Monthly Report on Employment and Unemployment in California*, published by the State Departments of Employment and Industrial Relations.

F. ESTIMATION OF FARM POPULATION AND EMPLOYMENT

Farms, Farm Population and Employment

According to the projections made for this study, the number of farms in the northeastern counties at time of ultimate development will be approximately twice the present number. These farms will support roughly twice the farm population and farm employment reported in the 1950 Census of Population.

Increase in Irrigated Acreage

This expansion is predicated upon full development of irrigation through the California Water Plan. The State Department of Water Resources estimates total net irrigable acres in the northeastern counties at 3,803,900. This is 3.5 times the irrigated acreage reported by the 1950 Census of Agriculture and 3.0 times that reported by the 1954 Census of Agriculture.

Total land in farms is not expected to change much from the present acreage; land in irrigated farms will be greatly increased while land in non-irrigated farms will be greatly decreased. Average size of farm will be reduced to about half the present figure.

Expansion of irrigated acreage will take place in part through additions to the irrigated acreage of existing irrigated farms, and in part through creation of entirely new farms on land made useful for cropland or pasture by irrigation.

Reversal of Trend Toward Larger Farms

The projected increase in number of farms and in farm population and employment presumes a reversal of the present state-wide trend. In recent decades, increases in irrigated acreage have resulted largely in an increase in the average size of farms, rather than an increase in number of farms and farm population. For example, between 1930 and 1950 irrigated acreage in the state increased from 4.7 million to 6.4 million; farm population declined slightly from 620,000 to 617,000; and average size of farm increased from 224 acres to 307 acres. The increase in size of farm was almost entirely accounted for by an increase in the size of irrigated farms. Development in the northeastern counties has followed a similar pattern.

Assumptions Underlying the Projections

In presuming that there will be a reversal of the present trend, this study bases its projections on the following assumptions:

1. Estimates of agricultural development in the northeastern counties should indicate the *maximum* development possible with full use of water resources.
2. Population pressure will require higher ratios of people to land, and every productive acre of farm land will be called upon to support a maximum share of population.
3. To achieve a maximum ratio of people to farm land, farm land will be shifted generally into the most intensive use of which it is capable. This process will be aided by technological improvements which cannot now be predicted.
4. Farms will attract a large number of people as desirable places to live and make a living in the highly urbanized nation of the future.

State-wide Increase in Irrigated Acreage

The State Division of Water Resources has estimated that a gross area of 19,050,000 acres is suitable for irrigated agriculture and that "under ultimate conditions of development in the State a net area averaging about 16,250,000 acres will actually be irrigated" (State Water Resources Board *Bulletin No. 2*, page 222).

This estimate is very close to that of Varden Fuller of the Giannini Foundation for Agricultural Economics, who has written:

> "In combination, the various accelerating forces may approximately offset the growing resistances to the development of water resources and the achievements from their use. If so, the decades immediately ahead may see irrigation expansion at near the average of the past half century, namely, at an average of a million acres per decade. If development were to be at that rate, the estimated ultimate development of 17 million acres will be achieved by about 2050. If the accelerated rate of 1940-1950 were to be maintained, the ultimate would be reached by 2020" (from Chapter XVIII of *Growth and Changes in California's Population*, by Warren S. Thompson, the Haynes Foundation, Los Angeles 1955, pp. 288-289).

Basis for Population Increase

It has been noted that increases in irrigated land in California provide a basis for increased population. In studies for the Central Valley Project, the Bureau of Reclamation stated:

> "The development of water and power affords new economic opportunities in agriculture and industry which can support an increased population. This factor is of prime importance in California

where the population has expanded and probably will continue to expand much more rapidly than in the rest of the United States'' (Report of U. S. Department of Interior, Bureau of Reclamation, *Central Valley Basin*, August 1949; printed as Senate Document 113, 81st Congress, 1st Session, page 63).

Ratio of New Irrigated Acreage to New Farms

The Bureau of Reclamation report estimated that an increase of 3,860,000 in irrigated acreage in the Central Valley basin would provide a basis for creation of some 51,000 new farms—a ratio of 75.7 new irrigated acres per new farm (Report, page 198).

The projections presented in this report indicate that for the state as a whole, the increase in irrigated acreage from 7,048,049 in 1954 to 16,250,000 in 2050 will result in an increase in number of farms from 123,074 in 1954 to 220,000 in 2050—a ratio of 94.9 new irrigated acres per new farm created.

For the 15 northeastern counties, the indicated increases are 2,525,837 irrigated acres and 15,639 farms—a ratio of 161.5 new irrigated acres per new farm created.

It is clear that the ratio for the 15 counties results in a conservative estimate of the increase in number of farms compared with increases indicated by the state and Central Valley ratios.

The ration of new irrigated acres to estimated new farms in each of the northeastern counties is shown in Table 13.

TABLE 13

AVERAGE NUMBER OF NEW IRRIGATED ACRES PER NEW FARM IN 15 NE. COUNTIES FROM 1954 TO 2050

	Additional irrigated acres	New farms	Ratio of new acres to new farms
Butte	196,872	1,112	177.0
Colusa	236,971	1,834	129.2
Glenn	196,889	2,462	80.0
Lake	60,102	304	197.7
Lassen	388,282	1,348	288.0
Modoc	227,328	1,101	206.5
Plumas	85,899	249	345.0
Shasta	162,939	971	167.8
Sierra	34,899	214	163.1
Siskiyou	249,648	1,375	181.6
Sutter	99,266	808	122.9
Tehama	246,434	1,053	234.0
Trinity	13,036	15	869.1
Yolo	215,582	2,272	94.9
Yuba	111,690	521	214.4
Total	2,525,837	15,639	161.5
State	9,201,951	96,926	94.9

Procedure for Estimating Farm Population and Employment

Most of the figures presented in Table 14 and Tables 54-69 are historical data from the Census of Agriculture for 1930, 1940, 1950 and 1954. These data have been used to indicate current trends in agricultural development, and to provide a benchmark for estimates of ultimate development (2020-2050). Key determinations for ultimate development are the following:

Irrigated land in farms is the estimate of net irrigable acreage made by the State Department of Water Resources from its 1956 land classification survey. To obtain *number of irrigated farms,* this figure has been divided by an assumed *average of irrigated acres per irrigated farm.* The latter is a judgment figure based on the historical Census data, on probable ultimate crop patterns, and on opinions of agricultural experts interviewed in the various counties. Much assistance was obtained from Circular 173 of the California Agricultural Extension Service, *Farming in California*, May 1951.

It should be noted that the assumed figures of irrigated acreage per farm are generally higher than those indicated in Circular 173. Effort was made to have the assumed average reflect local conditions, including length of growing season and the probable ultimate crop pattern of each county.

In general, average irrigated acreage per farm is assumed to be greater where farming is expected to be predominantly extensive—livestock and pasture—and smaller where the dominant type of cultivation will be more intensive—field crops, truck crops, and orchards.

Average size of farm represents a judgment as to the minimum economic unit required to support a farm family. It is based on the same factors as the estimate for irrigated land in farms, namely, past trends, the judgment of local farm experts, and considerations set forth in Circular 173. The estimates for average size of farm used in the projections are considerably larger than the estimates of minimum economic unit made by expert sources.

Total land in farms is an estimate based largely on recent Census data, and on consideration of the expansion believed likely to take place in other land uses such as urban and recreational. A precise estimate of total land in farms in each county is not now available because the Census Bureau reports land in farms according to the county in which the farm headquarters is located. This means that some farm land credited to a specific county is located outside it; and some farm land in the county is not credited to it. Unless these acreages happen to balance, the reported Census figure overstates or understates actual land in farms in the county.

Average population per farm equals total farm population divided by number of farms as reported by the Census Bureau. Estimates of average population per farm at time of ultimate development are based on projected changes in average size of farms and employment required per farm. The figures represent all persons living on farms, and not solely members of the primary farm household.

TABLE 14

RURAL FARM POPULATION AND EMPLOYMENT DATA AND PROJECTIONS
STATE OF CALIFORNIA

	1930	1940	1950	1954	Ultimate
1. Number of farms—total	135,676	132,658	137,168	123,074	220,000
2. Irrigated farms	85,784	84,310	90,755	84,502	203,500
3. Non-irrigated farms	49,892	43,348	46,413	38,572	16,500
4. Land in farms—total (acres)	30,442,581	30,524,324	36,613,291	37,800,380	37,500,000
5. Irrigated farms	12,018,864	14,071,222	20,562,873	22,967,240	32,500,000
6. Non-irrigated farms	18,423,717	16,453,102	16,050,418	14,833,140	5,000,000
7. Irrigated land in farms (acres)	4,746,632	4,276,554	6,438,324	7,018,049	*16,250,000
8. % of land in farms	15.6	14.0	17.6	18.6	43.3
9. % land in irrigated farms	39.5	30.4	31.3	30.7	50.0
10. Avg. per irrigated farm (acres)	55.3	50.7	70.9	83.4	80.0
11. Average size of farm (acres)	224.4	230.1	266.9	307.1	170.0
12. Irrigated farms	140.1	166.9	226.6	271.8	160.0
13. Non-irrigated farms	369.3	340.3	345.8	384.6	300.0
14. Farm population April 1—total	620,506	670,426	617,367	--	1,070,000
15. Urban farm	41,156	35,037	[1] 49,136	--	--
16. Rural farm—total	579,350	635,389	[1] 568,231	--	1,070,000
17. Rural farm; average per farm	4.57	5.05	4.50	--	4.9
18. % state population	10.9	9.71	5.83	--	2.4
19. No. per 1,000 acres	20.38	21.96	16.86	--	28.5
20. Farm employment, April 1, total	334,241	265,871	286,642	--	480,000
21. % rural farm population	57.7	41.8	50.4	--	44.9
22. % civilian employment	13.36	10.74	7.35	--	2.8
23. No. per 1,000 acres	10.98	8.71	7.83	--	12.8
24. Average per farm	2.46	2.00	2.09	--	2.2

[1] New definition. Old: Urban farm—32,204. Rural farm—585,163.
NOTE: 1930 employment is per old definition: "persons 10 years old and over engaged in gainful occupations."
* SWRB Bulletin No. 2, page 222.

Average employment per farm is also estimated primarily from the Census data. Consideration was given also to ultimate crop patterns and to farm labor requirements, as estimated by the Agricultural Extension Service. Average employment per farm is estimated as of April 1, and therefore tends to represent the permanent farm labor force. It is assumed that seasonal farm requirements will be supplied both by migratory labor and by residents who are not in the labor force on a year-around basis.

All other figures shown in the "ultimate" column of the tables on farm population and employment are derived from the foregoing key determinations.

G. ESTIMATION OF APRIL 1 EMPLOYMENT IN LUMBER AND WOOD PRODUCTS INDUSTRIES IN 15 NORTHEASTERN CALIFORNIA COUNTIES UNDER CONDITIONS OF PROBABLE ULTIMATE SUSTAINED YIELD

The employment estimates for lumber and wood products industries shown in Table 15 are derived essentially from sustained yield capacity estimates supplied by the U. S. Forest Service, California Region, and employment factors published by Ralph W. Marquis, Forest Economist, U. S. Forest Service, in the *Journal of Forestry*, May 1948.

Sustained Yield

The estimates of sustained yield capacity are provided in a letter from B. H. Payne, Assistant Regional Forester, Division of Timber Management, U. S. Forest Service, California Region, to California State Division of Water Resources, dated March 13, 1956, reference "S-PLANS—Timber Management."

The estimates, according to W. R. Howden of the Timber Management section, are sustained yield capacities of timber areas and working circles in the 15 northeast counties, allocated as precisely as possible to individual counties. Both public and private forest lands are included.

The "ultimate sustained yield capacity" for the commercial forest land in each county is based upon the assumption that all lands capable of growing commercial forest stands would be used for that purpose, and that an average stocking capacity of 80 percent would be obtained. The acreages in commercial forest stands used in these estimates are those shown by the California Forest and Range Experiment Station of the U. S. Forest Service in *Forest Survey Release No. 25*, December 1954, Table 12.

Sustained yield capacity is compared with estimates of current production of saw timber in Table 16.

Employment Factors

The employment factors for logging, rough lumber (sawmills) and "all other" wood products manufacture in Standard Industrial Classification Groups 24 and 25 are taken from the article by Ralph W. Marquis entitled "Employment Opportunities in Full Forest Utilization," *Journal of Forestry*, May 1948. These factors are presented in Tables 17 and 18.

Marquis estimates the employment which might result from full utilization of the timber resources of a typical area in the Douglas fir region of Oregon and Washington. The labor requirement factors used in his estimates, though not tested against specific experience in the California pine, fir and Douglas fir regions, appear to be in general agreement with employment ratios of timber operators in the northeast counties.

For example, Marquis shows that under present utilization there are approximately 10.0 men per million board feet of sawtimber cut, employed in logging, primary manufacture including rough lumber and plywood, and remanufacture including planing mill products, box and shook. These are the principal lumber industry operations now found in the northeastern counties. The ratios reported by timber operators during a survey of the northeastern counties in July-August 1956 ranged from 6.0 to 12.0 men per million board feet of sawtimber cut, depending on the range of operations performed. For comparison, statewide employment in 1952 in lumber and wood products industries (excluding pulp and paper products) averaged 12 persons per million board feet of sawtimber cut that year. This ratio included furniture production which is not presently a factor in the northeastern counties.

Full Utilization

The concept of full utilization used by Marquis is based on the historical trend, demonstrated in timber areas of the East and Pacific Northwest, that "with the diminishing availability of an area's accessible timber resource, that area will shift to the production of more final and less primary products from its modified resource base—the net result of such a shift shows that greater employment may be obtained from a given resource input" (Walter J. Mead, "The Forest Products Economy of the Pacific Northwest," *Land Economics,* University of Wisconsin, May 1956).

California's forest industry is now based primarily on the single product of lumber. In 1952, employment in the industry averaged 68,097 persons, or 11.9 per-

TABLE 15

EMPLOYMENT (APRIL 1) IN TIMBER INDUSTRY 15 NORTHEASTERN COUNTIES 1940, 1950 AND ULTIMATE

	1940	1950	At ultimate sustained timber yield		
			Lumber and wood products (SIC Gps. 24, 25)	Pulp and paper (SIC Gp. 26)	Total
Butte	964	1,761	2,073	1,978	4,051
Colusa	11	27	74	--	74
Glenn	10	25	332	--	332
Lake	56	145	517	--	517
Lassen	2,540	1,894	1,636	--	1,636
Modoc	671	664	1,156	--	1,156
Plumas	1,129	1,527	3,215	--	3,215
Shasta	499	2,323	4,531	3,487	8,018
Sierra	295	170	1,380	--	1,380
Siskiyou	3,027	3,201	6,863	856	7,719
Sutter	9	100	--	--	--
Tehama	42	451	2,542	1,721	4,263
Trinity	24	644	1,902	--	1,902
Yolo	47	68	--	--	--
Yuba	54	543	859	837	1,696
Total	9,378	13,543	27,080	8,879	35,959

TABLE 16

CURRENT TIMBER PRODUCTION AND SUSTAINED YIELD CAPACITY OF COMMERCIAL FOREST LAND IN 15 NORTHEASTERN COUNTIES

(Production in millions of board feet of saw timber per year)

	Current (1952-45 average[1])	Ultimate sustained yield capacity[2]
Butte	147	135
Colusa	--	6
Glenn	37	27
Lake	24	42
Lassen	202	133
Modoc	104	94
Plumas	366	295
Shasta	377	303
Sierra	95	138
Siskiyou	378	558
Sutter	--	--
Tehama	92	166
Trinity	262	326
Yolo	--	--
Yuba	43	44
Total	2,127	2,267

[1] California State Department of Natural Resources, Division of Forestry, annual reports on commodity production of forest products.
[2] U.S. Department of Agriculture, Forest Service, California Region, letter from B. H. Payne to California State Division of Water Resources, March 13, 1956.

TABLE 17

LABOR REQUIREMENTS PER UNIT OF PRODUCTION IN LUMBER AND WOOD PRODUCTS INDUSTRIES

(Present Utilization)

	Unit	Number employed	
		Marquis[1]	Forest service[2]
Logging	MM bd. ft. saw timber	3.40	3.35
Thinning	M cords	5.00	--
Rough lumber	MM bd. ft.	3.25	3.25
Dressed lumber	MM bd. ft. lumber used	1.75	1.75
Mill work	MM bd. ft. lumber used	15.00	15.00
Box	MM bd. ft. lumber used	7.50	7.50
Furniture	MM bd. ft. lumber used	80.00	--
Caskets	MM bd. ft. lumber used	10.00	--
Shingles	M squares	0.63	0.63
Plywood	MM sq. ft.	5.44	5.40
Pulp	M tons	3.65	3.25
Paper and board	M tons	7.25	6.50
Molasses	Ton	--	4.50
Alcohol	M gal.	--	6.00

[1] Ralph W. Marquis, "Employment Opportunities in Full Forest Utilization," "Journal of Forestry," May 1948.
[2] U.S. Forest Service, Report on Timber and Range Resources of the Upper Klamath Basin, in departmental report entitled "Upper Klamath River Basin," U.S. Bureau of Reclamation, June 1954.

TABLE 18

EMPLOYMENT RATIOS IN LUMBER AND WOOD PRODUCTS INDUSTRIES WITH FULL UTILIZATION

Expressed as persons employed per MM bd. ft. of saw timber cut

	Marquis[1]	Used for this report[2]
Logging	7.07	7.0
Rough lumber	3.34	3.3
Plywood, shingles and cooperage, planing, furniture, mill work, box shook, etc.	4.89	4.8
Pulp	2.30	1.8
Paper board	2.97	2.4
Converted paper products	0.66	0.5
Use of sawmill waste	1.50	--
Total	22.73	19.8

[1] See footnote 1, Table 17.
[2] Derived from Marquis, adjusted according to labor requirements shown in Forest Service report (Table 17).

sons per million board feet of sawtimber cut that year. Marquis' typical Douglas-fir area shows under present utilization 11.6 persons employed per million board feet of saw timber cut; under full utilization, the same area has a potential for employment of 22.7 persons per million board feet. The increased employment is accounted for by salvage of cull timber and logging residues in the forest, by greater remanufacture of rough lumber, and by fuller use of logging and milling residues suitable for production of pulp, paper, hardboard and softboard, and other converted paper products.

The current rate of cutting in California forests is roughly double the current rate of growth of sawtimber. Some excess of growth over cut is reasonable and necessary because of the dominance of recent old-growth timber which makes little contribution to net growth.

"However, there is substantial evidence to indicate that the cut from California forests has reached a plateau level and that further significant increases in the volume of cut are not likely. Further expansion of the forest industries to contribute to the support of the expanding population and to add to the supply of needed forest products in the state must come primarily from increased use of the timber cut rather than from increases in the volume cut" (from draft report of the Cooperative Study on Waste Treatment and Disposal Aspects of Development of Pulp and Paper Resources of California, by the State Water Pollution Control Board and cooperating agencies, June 21, 1956).

April 1 Employment

Estimates of annual employment in lumber and wood products industries have been adjusted to an April 1 level for consistency with present methods of reporting population and employment used by the U. S. Bureau of the Census. Data of the California State Department of Employment and Department of Industrial Relations were used to formulate seasonal adjustment factors based on current experience.

A special tabulation of employment in logging camps, sawmills and planing mills in the 15 northeastern counties, prepared by the State Department of Employment for this study, shows the following April 1 employment levels (average of March and April):

April 1 employment, 15 counties, as percent of year average:	*1950*	*1951*
Logging camps and contractors	57.3	78.5
Sawmills and planing mills	84.4	92.4

For the state as a whole in 1950, the April 1 level of logging employment was 65 percent of the year average; the level of employment in sawmills and planing mills was 84 percent.

For the state as a whole, State Department of Employment data show April 1 employment in the lumber and wood products industry (excluding furniture) has averaged 91 percent of the annual average in recent years (Table 19).

TABLE 19

EMPLOYMENT IN CALIFORNIA LUMBER AND WOOD PRODUCTS INDUSTRIES AS OF APRIL 1 AS PERCENT OF ANNUAL AVERAGE EMPLOYMENT

Year	Lumber and wood products, excluding furniture	Furniture and fixtures	Paper and allied products
1950	84.1	95.8	92.2
1951	94.1	104.6	99.7
1952	89.9	96.0	96.0
1953	95.6	104.9	96.4
1954	91.3	98.5	97.4
1955	91.9	98.5	96.9
Average	91.2	99.7	96.4

SOURCE: State Department of Employment—"California Employment & Payrolls 1950"; State Department of Industrial Relations—"Handbook of California Labor Statistics," 1951-1952 and 1953-1954; "Estimated Number of Wage and Salary Workers in Non-Agricultural Establishments, by Industry, California 1939-1955" (March 1956).

Pulp, Paper and Board

The estimates of employment in wood pulp, paper and paper board manufacture in Table 15 are based on the following assumptions:

1. Annual production of pulp material in the 15 northeastern California counties, with a sustained yield of 2,267 million board feet of saw timber per year, will approximate 220,000,000 cubic feet of solid wood residues (forest residue plus coarse mill residue). This is the framework of the assumption by the California Forest and Range Experiment Station that total material available for pulp production in the State, with a sustained yield of 4,000 million board feet per year, will approximate 385,000,000 cubic feet per year.

2. The 220,000,000 cubic feet of pulp material will yield about 550,000,000 cubic feet of wood chips (@ 80 cubic feet solid wood *equals* 200 cubic feet of chips).

3. The 550,000,000 cubic feet of chips will produce approximately 1,375,000 tons of pulp (@ 400 cubic feet of chips per ton of pulp). To allow for some diversion of pulp material to other uses, this estimate is reduced to 1,285,000 tons of pulp per year for employment estimate purposes.

The latter figure is selected because it is consistent with the pulp production estimate resulting from the Cooperative Study on Waste Treatment and Disposal Aspects of Development of Pulp and Paper Resources of California, by the State Water Pollution Control Board and cooperating agencies, July 31, 1956. The Cooperative Study estimated that under sustained yield conditions (4,000 million board feet per year) and with *minimum* diversion of sawlogs from existing wood processing industries (only about 10 percent of sawlogs would go to the pulp mills), there would be sufficient pulp material to support mills with a daily capacity of 6,445 tons, including the existing mills at Antioch and Ukiah.

On a proportional basis, the 15 counties would produce sufficient material to support mills with a daily capacity of approximately 3,675 tons (@ 350 working days per year). The 15 counties, with 57 percent of the state's sustained yield of saw timber, would presumably have at least 57 percent of its pulp material. However, it is estimated that only about 85 percent of this pulp material would be processed in the 15-county area.

4. Employment in pulp mills would be on the order of 3.25 men per 1,000 tons produced, per year. This ratio is used by the U. S. Forest Service in its report on timber and range resources of the Upper Klamath Basin (published as part of report by U. S. Bureau of Reclamation, *Upper Klamath River Basin,* June 1954).

It is somewhat below the ratio of 3.65 men per 1,000 tons used by Marquis in his *Journal of Forestry* article, May 1948.

5. Employment in paper and board production would be on the order of 6.50 men per 1,000 tons of paper and board production. The latter is assumed to be two-thirds of pulp tonnage, as indicated by Marquis. The ratio of 6.50 men per 1,000 tons is used by the Forest Service in the Upper Klamath Basin report. It is somewhat lower than the ratio of 7.25 men per 1,000 tons used by Marquis.

Use of the foregoing assumption results in a range of estimates of total employment generated by the area's pulp material output of 9,700 to 10,300 employed per year (Table 20). The total of county estimates shown in Table 15 is somewhat below this range, due to adjustment to an April 1 basis and allowance for pulp material processing outside the 15-county area.

6. It is assumed that the location of mills producing pulp, paper and board will be confined generally

TABLE 20

TOTAL YEARLY EMPLOYMENT IN PULP, PAPER AND BOARD PRODUCTION RESULTING FROM SUSTAINED YIELD CUTTING PROGRAM AND FULL FOREST UTILIZATION IN 15 NORTHEASTERN COUNTIES

Estimate No. 1

(1) State output of pulp material assuming sustained yield of 4,000 million board feet saw timber	= 385,000,000 cu. ft.
(2) 15-county output of solid pulp material assuming sustained yield of 2,267 million board feet saw timber (56.7% of state total)	= 218,295,000 cu. ft.
(3) 218,295,000 cu. ft. solid pulp material (@ 80 cu. ft. solid wood = 200 cu. ft. chips)	= 545,737,500 cu. ft. chips
(4) 545,737,500 cu. ft. chips (@ 400 cu. ft. chips = 1 ton pulp)	= 1,364,340 tons pulp (= 602 tons pulp/MM bd. ft. logs)
(5) Daily capacity @ 350 days/year	3,898 tons
(6) 1,364,340 tons pulp = employment of (@ 3.25 men/M tons pulp)	4,434 in pulp 5,912 in paper and board
(@ 6.50 men/M tons paper and board) (1 ton pulp = ⅔ ton paper and board)	
Total	10,346

Estimate No. 2

(1) State sustained yield of 4,000 million bd. ft. saw timber will provide enough pulp material for 6,445 tons daily capacity of mills. (State Water Pollution Control Board, Cooperative Study)

(2) 15 northeastern counties, with 2,267 million bd. ft. of saw timber (56.7% of state total) will provide enough material for 3,650 tons daily capacity of mills.

(3) 3,650 × 350 days = 1,277,500 tons/year

(4) 1,277,500 × 3.25 = 4,152 men in pulp (= 1.83 men/MM bd. ft. saw logs)
852,000 × 6.50 = 5,538 men in paper and board (= 2.44 men/MM ft. saw logs)

Total 9,690

Note: These estimates represent total yearly employment provided by all pulp material produced in the 15 counties. The estimate used for the 15 counties—8,879—represents April 1 employment, from approximately 85 percent of the pulp material produced in the area.

TABLE 21

ESTIMATED ANNUAL PRODUCTION OF MAJOR TIMBER PRODUCTS IN 15 NORTHEASTERN COUNTIES AT SUSTAINED YIELD

County	Lumber (MM bd. ft.)	Plywood (M sq. ft.)	Pulp (M tons)	Paper and paperboard (M tons)
Butte	286	21,840	244	156
Colusa	6	985	--	--
Glenn	27	4,360	--	--
Lake	42	6,790	--	--
Lassen	134	21,520	--	--
Modoc	95	15,195	--	--
Plumas	149	47,730	--	--
Shasta	417	66,610	431	276
Sierra	140	11,150	--	--
Siskiyou	566	90,285	106	68
Tehama	168	44,440	213	135
Trinity	111	8,000	--	--
Yuba	45	18,290	103	66
Total	2,186	357,200	1,097	701

to central valley counties such as Shasta, Tehama, Butte, Yuba, and perhaps Siskiyou. These counties will process pulp materials received from their own forests and sawmills, plus those of Modoc, Lassen, Plumas, Sierra, Glenn and Colusa. It is assumed further that Trinity County's pulp material will be processed in Shasta and Tehama counties and the north coastal area, one-third share each; and that Lake County's pulp material will be processed entirely in the north coastal area. These assumptions are based in the main on the findings of the Cooperative Study and in part on judgment factors resulting from interviews and observations in the various counties.

Output of Major Timber Products

As a final step, estimates of annual production of major timber products in each of the 15 northeastern counties, under conditions of sustained yield and full forest utilization, have been made and are presented in Table 21. These estimates are derived from the data, estimates and assumptions presented in this section, including the sustained yield estimates provided by the Forest Service, the analysis of full utilization by Marquis, the pulp production estimates of the State Water Pollution Control Board Cooperative Study, and the assumptions as to location of pulp mills made by the authors of this report.

V. BASIC DATA AND PROJECTIONS

The tables which follow (Tables 22-69) comprise the basic statistical data and projections of the report. The first group of tables (Tables 22-37) deals with population; the second group (Tables 38-53) with employment; and the third group (Tables 54-69) with farm population and farm employment.

Sources of data are as follows:

Population

Population data for 1920-1950 are from the Census of Population for those years. The 1920 Census was taken as of January 1; others were taken as of April 1.

The projections of ultimate population are based on estimates of future employment and on relationships of population growth in the northeastern counties to that in the state and nation.

Employment

Employment data for 1940 and 1950 are from the Census of Population for those years.

Projections of ultimate employment are based on estimates of employment in local resource-based industries, agriculture and lumbering and wood products manufacture. The proportions of total employment provided by these industries and other economic activities have been projected on the basis of long-term trends observed from historical data for the United States and California.

A remarkable consistency has been found in the historical relationship between the proportion of employment in agriculture and lumber and wood products manufacture and the proportion of population residing in urban places. This relationship has been used as a check on the consistency and reasonableness of the projections.

Farm Population and Employment

Data for 1930, 1940 and 1950 and 1954 are from the Census of Agriculture.

Projections shown in the "ultimate" column are based on the key figure of irrigated land in farms, as estimated by the State Department of Water Resources from its 1956 land classification survey. All other figures in the column represent direct or derived judgments, based on consideration of the census data for past years, and on information, judgments and opinions obtained from experts in the field of agriculture. These include farm advisors, agricultural commissioners and representative farmers interviewed in each county; soil classification experts of the Department of Water Resources; and agricultural economists of the California Agricultural Extension Service.

TABLES 22-37

POPULATION DATA AND PROJECTIONS NORTHEASTERN CALIFORNIA COUNTIES

County	1920	1930	1940	1950	Ultimate
16 counties total					
Total population	162,905	199,089	249,298	330,339	1,747,400
Urban	30,881	36,884	43,892	114,465	1,203,980
Rural farm	132,024	65,778	67,965	60,993	128,550
Rural non-farm		96,427	137,441	154,941	414,870
Percent distribution	100.0	100.0	100.0	100.0	100.0
Urban	19.0	18.5	17.6	34.6	68.9
Rural farm	81.0	33.0	27.3	18.5	7.4
Rural non-farm		48.5	55.1	46.9	23.7
Butte					
Total population	30,030	34,093	42,840	64,930	284,000
Urban	12,679	11,659	13,708	27,225	210,160
Rural farm	17,351	9,144	10,465	9,408	15,820
Rural non-farm		13,290	18,667	28,297	58,020
Percent distribution	100.0	100.0	100.0	100.0	100.0
Urban	42.2	34.2	32.0	41.9	74.0
Rural farm	57.8	26.8	24.4	14.5	5.6
Rural non-farm		39.0	43.6	43.6	20.4
Colusa					
Total population	9,290	10,258	9,788	11,651	68,000
Urban	--	--	--	3,031	40,120
Rural farm	9,290	4,394	3,781	2,907	10,650
Rural non-farm		5,864	6,007	5,713	17,230
Percent distribution	100.0	100.0	100.0	100.0	100.0
Urban	--	--	--	26.0	59.0
Rural farm	100.0	42.8	38.6	25.0	15.7
Rural non-farm		57.2	61.4	49.0	25.3
Glenn					
Total population	11,853	10,935	12,195	15,448	85,000
Urban	--	--	--	3,019	48,450
Rural farm	11,853	6,110	5,978	6,286	16,000
Rural non-farm		4,825	6,217	6,143	20,550
Percent distribution	100.0	100.0	100.0	100.0	100.0
Urban	--	--	--	19.5	57.0
Rural farm	100.0	55.9	49.0	40.7	18.8
Rural non-farm		44.1	51.0	39.8	24.2
Lake					
Total population	5,402	7,166	8,069	11,481	65,600
Urban	--	--	--	--	29,250
Rural farm	5,402	3,027	2,997	2,824	4,300
Rural non-farm		4,139	5,072	8,657	31,450
Percent distribution	100.0	100.0	100.0	100.0	100.0
Urban	--	--	--	--	45.0
Rural farm	100.0	42.2	37.1	24.6	6.6
Rural non-farm		57.8	62.9	75.4	48.4
Lassen					
Total population	8,507	12,589	14,479	18,474	67,500
Urban	--	--	--	8,956	40,500
Rural farm	8,507	2,199	2,115	1,659	7,850
Rural non-farm		10,390	12,364	7,859	19,150
Percent distribution	100.0	100.0	100.0	100.0	100.0
Urban	--	--	--	48.5	60.0
Rural farm	100.0	17.5	14.6	9.0	11.6
Rural non-farm		82.5	85.4	42.5	28.4
Modoc					
Total population	5,425	8,038	8,713	9,678	51,100
Urban	--	--	--	2,819	29,640
Rural farm	5,425	2,762	3,048	3,066	7,400
Rural non-farm		5,276	5,665	3,793	14,060
Percent distribution	100.0	100.0	100.0	100.0	100.0
Urban	--	--	--	29.1	58.0
Rural farm	100.0	34.4	35.0	31.7	14.5
Rural non-farm		65.6	65.0	39.2	27.5
Plumas					
Total population	5,681	7,913	11,548	13,519	*44,700
Urban	--	--	--	--	22,350
Rural farm	5,681	908	700	536	1,500
Rural non-farm		7,005	10,848	12,983	20,850
Percent distribution	100.0	100.0	100.0	100.0	100.0
Urban	--	--	--	--	50.0
Rural farm	100.0	11.5	6.1	4.0	3.4
Rural non-farm		88.5	93.9	96.0	46.6
Shasta					
Total population	13,361	13,927	28,800	36,413	195,000
Urban	2,962	4,188	8,109	10,256	140,400
Rural farm	10,399	4,394	5,140	4,100	8,200
Rural non-farm		5,345	15,551	22,057	46,400
Percent distribution	100.0	100.0	100.0	100.0	100.0
Urban	22.2	30.1	28.2	28.2	72.0
Rural farm	77.8	31.5	17.8	11.2	4.2
Rural non-farm		38.4	54.0	60.6	23.8
Sierra					
Total population	1,783	2,422	3,025	2,410	16,000
Urban	--	--	--	-	7,200
Rural farm	1,783	265	306	205	850
Rural non-farm		2,157	2,719	2,205	7,950
Percent distribution	100.0	100.0	100.0	100.0	100.0
Urban	--	--	--	--	45.0
Rural farm	100.0	10.9	10.1	8.5	5.3
Rural non-farm		89.1	89.9	91.5	49.7
Siskiyou					
Total population	18,545	25,480	28,598	30,733	127,200
Urban	2,528	2,610	--	5,966	76,320
Rural farm	16,017	5,355	5,463	4,359	9,870
Rural non-farm		17,515	23,135	20,408	41,010
Percent distribution	100.0	100.0	100.0	100.0	100.0
Urban	13.6	10.2	--	19.4	60.0
Rural farm	86.4	21.0	19.1	14.2	7.8
Rural non-farm		68.8	80.9	66.4	32.2
Sutter					
Total population	10,115	14,618	18,680	26,239	121,800
Urban	--	3,605	4,968	7,861	90,130
Rural farm	10,115	8,088	8,134	8,724	12,450
Rural non-farm		2,925	5,578	9,654	19,220
Percent distribution	100.0	100.0	100.0	100.0	100.0
Urban	--	24.7	26.6	30.0	74.0
Rural farm	100.0	55.3	43.5	33.2	10.2
Rural non-farm		20.0	29.9	36.8	15.8
Tehama					
Total population	12,882	13,866	14,316	19,276	105,100
Urban	3,104	3,517	3,824	7,442	71,500
Rural farm	9,778	6,764	6,835	6,313	11,000
Rural non-farm		3,585	3,657	5,521	22,600
Percent distribution	100.0	100.0	100.0	100.0	100.0
Urban	24.1	25.4	26.7	38.6	68.0
Rural farm	75.9	48.8	47.8	32.8	10.5
Rural non-farm		25.8	25.5	28.6	21.5
Trinity					
Total population	2,551	2,809	3,970	5,087	22,000
Urban	--	--	--	--	9,900
Rural farm	2,551	1,191	1,175	688	700
Rural non-farm		1,618	2,795	4,399	11,400
Percent distribution	100.0	100.0	100.0	100.0	100.0
Urban	--	--	--	--	45.0
Rural farm	100.0	42.4	29.6	13.5	3.0
Rural non-farm		57.6	70.4	86.5	52.0
Yolo					
Total population	17,105	23,644	27,243	40,640	390,000
Urban	4,147	5,542	6,637	21,986	312,000
Rural farm	12,958	8,720	9,082	6,779	16,000
Rural non-farm		9,382	11,524	11,875	62,000
Percent distribution	100.0	100.0	100.0	100.0	100.0
Urban	24.2	23.4	24.4	54.1	80.0
Rural farm	75.8	36.9	33.3	16.7	4.1
Rural non-farm		39.7	42.3	29.2	15.9

* SDWR estimate in "Report on Upper Feather River Service Area" is: Total: 41,200; urban: 24,500; rural: 16,700.

TABLES 22-37—Continued

POPULATION DATA AND PROJECTIONS NORTHEASTERN CALIFORNIA COUNTIES

County	1920	1930	1940	1950	Ultimate	County	1920	1930	1940	1950	Ultimate
Yuba											
Total population	10,375	11,331	17,034	24,420	105,000	Percent distribution	100.0	100.0	100.0	100.0	100.0
Urban	5,461	5,763	6,646	15,904	75,600	Urban	52.6	50.9	39.0	65.1	72.0
Rural farm	4,914	2,457	2,746	3,139	5,960	Rural farm	47.4	21.7	16.1	12.9	5.7
Rural non-farm		3,111	7,642	5,377	23,440	Rural non-farm		27.4	44.9	22.0	22.3

NOTE: 1950 urban population includes cities and unincorporated places having 2,500 inhabitants or more. In previous census years, only incorporated places of 2,500 inhabitants or more were considered "urban."

TABLES 38-53

NORTHEASTERN CALIFORNIA COUNTIES EMPLOYMENT DATA AND PROJECTIONS

(Employment as of April 1)

Industry group	1940		1950		Ultimate	
	No.	%	No.	%	No.	%
15 N. E. Counties						
Total	86,074	100.0	116,254	100.0	639,335	100.0
Extractive	29,074	33.8	27,362	23.5	59,258	9.3
Agriculture	23,705	27.6	25,416	21.9	55,113	8.6
Forestry and fisheries	525	0.6	869	0.7	4,145	0.6
Mining	4,804	5.6	1,077	0.9		
Manufacturing	12,042	14.0	18,397	15.8	108,993	17.0
Lbr. and wood prod.	9,478	11.0	13,543	11.6	27,080	4.2
Other mannfacturing	2,564	3.0	4,854	4.2	81,913	12.8
All other	44,958	52.2	70,495	60.7	471,084	73.7
Butte						
Total	12,896	100.0	21,366	100.0	102,200	100.0
Extractive	3,816	29.59	3,841	17.98	6,330	6.2
Agriculture	3,052	23.67	3,582	16.77	5,930	5.8
Forestry and fisheries	40	.31	83	.39	100	0.4
Mining	724	5.61	176	.82	300	
Manufacturing	1,599	12.40	3,226	15.10	18,400	18.0
Lbr. and wood prod.	964	7.48	1,761	8.24	2,073	2.0
Other manufacturing	635	4.92	1,465	6.86	16,327	16.0
All other	7,481	58.01	14,299	66.92	77,470	75.8
Colusa						
Total	3,482	100.0	4,268	100.0	26,500	100.0
Extractive	1,682	48.30	1,892	44.33	5,900	22.3
Agriculture	1,664	47.79	1,878	44.00	5,830	22.0
Forestry and fisheries	4	.11	8	.19	70	.3
Mining	14	.40	6	.14		
Manufacturing	87	2.50	156	3.66	2,120	8.0
Lbr. and wood prod.	11	.32	27	.63	74	.3
Other manufacturing	76	2.18	129	3.03	2,046	7.7
All other	1,713	49.20	2,220	52.01	18,480	69.7
Glenn						
Total	4,209	100.0	5,858	100.0	32,080	100.0
Extractive	2,170	51.56	2,543	43.41	8,080	25.2
Agriculture	2,144	50.94	2,517	42.97	8,000	25.0
Forestry and fisheries	17	.40	23	.39	80	.2
Miniog	9	.22	3	.05		
Manufacturing	170	4.04	320	5.46	2,570	8.0
Lbr. and wood prod.	10	.24	25	.43	332	1.0
Other manufactnring	160	3.80	295	5.03	2,238	7.0
All other	1,869	44.40	2,995	51.13	21,430	66.8
Lake						
Total	2,573	100.0	3,946	100.0	21,000	100.0
Extractive	1,064	41.35	1,185	30.03	1,700	8.1
Agriculture	915	35.56	1,125	28.51	1,680	8.0
Forestry and fisheries	21	.82	40	1.01	120	.1
Mining	128	4.97	20	.51		
Manufacturing	123	4.78	258	6.54	1,678	8.0
Lbr. and wood prod.	56	2.18	145	3.68	517	2.5
Other manufacturing	67	2.60	113	2.86	1,161	5.5
All other	1,386	53.87	2,503	63.43	17,622	83.9
Lassen						
Total	5,476	100.0	6,569	100.0	24,930	100.0
Extractive	830	15.16	706	10.75	3,700	14.8
Agriculture	760	13.89	644	9.80	3,490	14.0
Forestry and fisheries	49	.89	61	.93	210	0.8
Mining	21	.38	1	.02		
Manufacturing	2,738	50.0	1,997	30.40	2,500	10.0
Lbr. and wood prod.	2,640	48.21	1,894	28.83	1,636	6.6
Other manufacturing	98	1.79	103	1.57	864	3.4
All other	1,908	34.84	3,866	58.85	18,730	75.2
Modoc						
Total	3,328	100.0	3,735	100.0	18,510	100.0
Extractive	1,237	37.17	1,203	32.21	2,945	15.9
Agriculture	1,161	34.89	1,128	30.20	2,775	15.0
Forestry and fisheries	35	1.05	66	1.77	120	.9
Mining	41	1.23	9	.24	50	
Manufacturing	720	21.63	739	19.79	1,700	9.2
Lbr. and wood prod.	671	20.16	664	17.78	1,156	6.3
Other manufacturing	49	1.47	75	2.01	544	2.9
All other	1,371	41.20	1,793	48.00	13,865	74.9
Plumas						
Total	4,475	100.0	5,028	100.0	16,080	100.0
Extractive	1,176	26.28	320	6.36	700	4.3
Agriculture	281	6.28	187	3.72	500	3.1
Forestry and fisheries	60	1.34	61	1.21	100	.6
Mining	835	18.66	72	1.43	100	.6
Manufacturing	1,171	26.17	1,601	31.84	3,375	21.0
Lbr. and wood prod.	1,129	25.23	1,527	30.37	3,215	20.0
Other manufacturing	42	.94	74	1.47	160	1.0
All other	2,128	47.55	3,107	61.80	12,005	74.7
Shasta						
Total	10,042	100.0	12,743	100.0	70,200	100.0
Extractive	1,882	18.74	1,487	11.67	3,060	4.3
Agriculture	1,254	12.49	1,161	9.11	2,460	3.5
Forestry and fisheries	70	.70	174	1.37	300	.4
Mining	558	5.55	152	1.19	300	.4
Manufacturing	758	7.55	2,650	20.80	14,740	21.0
Lbr. and wood prod.	499	4.97	2,323	18.23	4,530	6.5
Other manufacturing	259	2.58	327	2.57	10,210	14.5
All other	7,402	73.71	8,606	67.53	52,400	74.6
Sierra						
Total	1,289	100.0	795	100.0	5,750	100.0
Extractive	562	43.60	148	18.62	500	8.7
Agriculture	110	8.53	67	8.43	300	5.2
Forestry and fisheries	9	.70	8	1.01	50	.9
Mining	443	34.37	73	9.18	150	2.6
Manufacturing	310	24.05	204	25.66	1,500	26.1
Lbr. and wood prod.	295	22.89	170	21.38	1,380	24.0
Other manufacturing	15	1.16	34	4.28	120	2.1
All other	417	32.35	443	55.72	3,750	65.2
Siskiyou						
Total	11,204	100.0	11,662	100.0	46,180	100.0
Extractive	2,917	26.04	1,869	16.03	4,650	10.1
Agriculture	1,900	16.97	1,484	12.73	3,925	8.5
Forestry and fisheries	118	1.05	187	1.60	350	.8
Mining	899	8.02	198	1.70	375	.8
Manulacturing	3,192	28.49	3,429	29.40	9,220	20.0
Lbr. and wood prod.	3,027	27.02	3,201	27.45	6,864	14.9
Other manufacturing	165	1.47	228	1.95	2,356	5.1
All other	5,095	45.47	6,364	54.57	32,310	69.9
Sutter						
Total	5,729	100.0	8,942	100.0	47,180	100.0
Extractive	2,909	50.78	3,497	39.11	5,290	11.2
Agriculture	2,848	49.71	3,457	38.66	5,190	11.0
Forestry and fisheries	3	.06	4	.04	100	0.2
Mining	58	1.01	36	.41		
Manufacturing	213	3.72	503	5.62	7,550	16.0
Lbr. and wood prod.	9	.16	100	1.12		
Other manufacturing	204	3.56	403	4.50	7,550	16.0
All other	2,607	45.50	4,942	55.27	34,340	72.8

TABLES 38-53—Continued

NORTHEASTERN CALIFORNIA COUNTIES EMPLOYMENT DATA AND PROJECTIONS

(Employment as of April 1)

Industry group	1940		1950		Ultimate		Industry group	1940		1950		Ultimate	
	No.	%	No.	%	No.	%		No.	%	No.	%	No.	%
Tehama							**Yolo**						
Total	4,800	100.0	6,941	100.0	36,800	100.0	Total	9,747	100.0	15,072	100.0	146,250	100.0
Extractive	2,008	41.83	2,024	29.16	3,560	9.7	Extractive	4,260	43.70	4,772	31.66	9,450	6.4
Agriculture	1,963	40.90	1,967	28.34	3,310	9.0	Agriculture	4,224	43.33	4,728	31.37	9,250	6.3
Forestry and fisheries	30	.62	49	.71	150	0.7	Forestry and fisheries	11	.11	24	.16	200	0.1
Mining	15	.31	8	.11	100		Mining	25	.26	20	.13		
Manufacturing	200	4.17	759	10.94	6,630	18.0	Manufacturing	525	5.39	1,064	7.06	29,250	20.0
Lbr. and wood prod.	42	.88	451	6.50	2,540	6.9	Lbr. and wood prod.	47	.48	68	.45		
Other manufacturing	158	3.29	308	4.44	4,090	11.1	Other manufacturing	478	4.91	996	6.61	29,250	20.0
All other	2,592	54.00	4,158	59.90	26,610	72.3	All other	4,962	50.91	9,236	61.28	107,550	73.5
Trinity							**Yuba**						
Total	1,388	100.0	1,764	100.0	7,925	100.0	Total	5,436	100.0	7,565	100.0	37,750	100.0
Extractive	864	62.25	369	20.92	508	6.4	Extractive	1,697	31.22	1,506	19.91	2,885	7.3
Agriculture	303	21.83	227	12.87	208	2.6	Agriculture	1,126	20.71	1,264	16.71	2,265	6.0
Forestry and fisheries	50	3.60	52	2.95	120	1.5	Forestry and fisheries	8	.15	29	.38	100	1.3
Mining	511	36.82	90	5.10	180	2.3	Mining	563	10.36	213	2.82	400	
Manufacturing	33	2.38	651	36.90	2,100	26.5	Manufacturing	203	3.73	840	11.10	5,660	15.0
Lbr. and wood prod.	24	1.73	644	36.50	1,902	24.0	Lbr. and wood prod.	54	.99	543	7.18	859	2.3
Other manufacturing	9	.65	7	.40	198	2.5	Other manufacturing	149	2.74	297	3.92	4,801	12.7
All other	491	35.37	744	42.18	5,317	67.1	All other	3,536	65.05	5,219	68.99	29,205	77.7

NOTE: Lumber and wood products include industries in Standard Industrial Classification Groups 24 and 25. Pulp, paper and allied products (S.I.C. Group 26) are included in "Other Manufacturing," which is in accordance with present Census Bureau practice.

TABLE 54

RURAL FARM POPULATION AND EMPLOYMENT NORTHEASTERN CALIFORNIA COUNTIES

1930-54 and Ultimate

15 NE. Counties

	1930	1940	1950	1954	Ultimate
1. Number of farms—total	15,825	14,827	15,375	15,248	30,887
2. Irrigated farms	8,854	9,432	10,518	10,985	28,062
3. Non-irrigated farms	6,971	5,395	4,857	4,263	2,825
4. Land in farms—total (acres)	6,846,424	6,856,600	7,715,014	8,107,983	8,155,000
5. Irrigated farms	3,178,360	4,087,248	4,972,678	5,701,561	7,024,850
6. Non-irrigated farms	3,668,064	2,769,352	2,742,336	2,406,422	1,130,150
7. Irrigated land in farms (acres)	674,501	869,283	1,085,368	1,278,063	3,803,900
8. % of land in farms	9.9	12.7	14.1	15.8	46.6
9. % land in irrigated farms	21.2	21.3	21.8	22.4	54.1
10. Average per irrigated farm (acres)	76.2	92.2	103.2	116.3	135.5
11. Average size of farm (acres)	432.6	462.4	501.8	531.7	264
12. Irrigated farms	359.0	433.3	472.8	519.0	250
13. Non-irrigated farms	526.2	513.3	564.6	564.5	400
14. Farm population—total	66,158	68,088	61,592	--	128,550
15. Urban farm	380	123	599	--	--
16. Rural farm—total	65,778	67,965	60,993	--	128,550
17. Rural farm, average per farm	4.16	4.58	3.97	--	4.2
18. % county population	33.0	27.3	18.5	--	7.4
19. No. per 1,000 acres	9.61	9.91	7.91	--	15.8
20. Farm employment, April 1, total	33,374	23,705	25,416	--	55,113
21. % rural farm population	50.7	34.9	41.7	--	42.9
22. % civilian employment	37.2	27.5	21.9	--	8.6
23. No. per 1,000 acres	4.87	3.46	3.29	--	6.8
24. Average per farm	2.11	1.60	1.65	--	1.8

NOTE: 1930 employment is per old definition: "persons 10 years old and over engaged in gainful occupations."

TABLE 55

RURAL FARM POPULATION AND EMPLOYMENT NORTHEASTERN CALIFORNIA COUNTIES

1930-54 and Ultimate

Butte County

	1930	1940	1950	1954	Ultimate
1. Number of farms—total	2,603	2,584	2,680	2,843	3,955
2. Irrigated farms	1,445	1,500	1,835	2,026	3,770
3. Non-irrigated farms	1,158	1,084	845	817	185
4. Land in farms—total (acres)	619,584	582,779	676,109	672,802	600,000
5. Irrigated farms	264,379	310,846	436,385	521,309	555,000
6. Non-irrigated farms	355,205	271,933	239,724	151,493	45,000
7. Irrigated land in farms (acres)	67,038	79,885	125,209	161,628	358,500
8. % of land in farms	10.8	13.7	18.5	24.0	59.8
9. % land in irrigated farms	25.4	25.7	28.7	31.0	64.6
10. Average per irrigated farm (acres)	46.4	53.3	68.2	79.8	95.1
11. Average size of farm (acres)	238.0	225.5	252.3	236.7	152
12. Irrigated farms	183.0	207.2	237.8	257.3	147
13. Non-irrigated farms	306.7	250.9	283.7	185.4	243
14. Farm population—total	9,173	10,491	9,565	--	15,820
15. Urban farm	29	26	157	--	--
16. Rural farm—total	9,144	10,465	9,408	--	15,820
17. Rural farm, average per farm	3.51	4.05	3.51	--	4.0
18. % county population	26.8	24.4	14.5	--	5.6
19. No. per 1,000 acres	14.76	17.96	13.91	--	26.4
20. Farm employment, April 1, total	4,451	3,052	3,582	--	5,930
21. % rural farm population	48.7	29.2	38.1	--	37.5
22. % civilian employment	31.57	27.3	16.8	--	5.8
23. No. per 1,000 acres	7.18	5.23	5.30	--	9.9
24. Average per farm	1.71	1.18	1.34	--	1.5

NOTE: 1930 employment is per old definition: "persons 10 years old and over engaged in gainful occupations."

TABLE 56

RURAL FARM POPULATION AND EMPLOYMENT NORTHEASTERN CALIFORNIA COUNTIES

1930-54 and Ultimate

Colusa County

	1930	1940	1950	1954	Ultimate
1. Number of farms—total	894	730	813	746	2,580
2. Irrigated farms	359	400	530	533	2,350
3. Non-irrigated farms	535	330	283	213	230
4. Land in farms—total (acres)	481,604	437,030	532,915	597,968	600,000
5. Irrigated farms	120,004	196,771	346,489	443,732	530,000
6. Non-irrigated farms	361,600	240,259	186,426	154,236	70,000
7. Irrigated land in farms (acres)	58,369	82,890	97,347	138,929	375,900
8. % of land in farms	12.1	19.0	18.3	23.2	62.7
9. % land in irrigated farms	48.6	42.1	28.1	31.3	70.9
10. Average per irrigated farm (acres)	162.6	207.2	183.7	260.7	160.0
11. Average size of farm (acres)	538.7	598.7	655.5	801.6	235
12. Irrigated farms	334.3	492.0	653.8	832.5	225
13. Non-irrigated farms	675.9	728.1	658.7	724.1	300
14. Farm population—total	4,394	3,781	2,919	--	10,650
15. Urban farm	--	--	12	--	--
16. Rural farm—total	4,394	3,781	2,907	--	10,650
17. Rural farm, average per farm	4.91	5.18	3.58	--	4.1
18. % county population	42.8	38.6	25.0	--	15.7
19. No. per 1,000 acres	9.12	8.65	5.45	--	17.7
20. Farm employment, April 1, total	2,712	1,664	1,878	--	5,830
21. % rural farm population	61.7	44.0	64.6	--	54.7
22. % civilian employment	57.3	47.8	44.0	--	22.0
23. No. per 1,000 acres	5.63	3.81	3.52	--	9.7
24. Average per farm	3.03	2.28	2.31	--	2.3

NOTE: 1930 employment is per old definition: "persons 10 years old and over engaged in gainful occupations."

TABLE 57

RURAL FARM POPULATION AND EMPLOYMENT NORTHEASTERN CALIFORNIA COUNTIES

1930-54 and Ultimate

Glenn County

	1930	1940	1950	1954	Ultimate
1. Number of farms—total	1,463	1,376	1,527	1,538	4,000
2. Irrigated farms	997	1,061	1,292	1,318	3,700
3. Non-irrigated farms	466	315	235	220	300
4. Land in farms—total (acres)	586,411	541,555	611,865	703,043	620,000
5. Irrigated farms	185,392	258,807	387,450	411,049	515,000
6. Non-irrigated farms	401,019	282,748	224,415	291,994	105,000
7. Irrigated land in farms (acres)	60,306	101,557	102,557	136,511	333,400
8. % of land in farms	10.3	18.8	16.8	19.4	53.8
9. % land in irrigated farms	32.5	39.2	26.5	33.2	64.7
10. Average per irrigated farm (acres)	60.5	95.7	79.4	103.6	90.1
11. Average size of farm (acres)	400.8	393.6	400.7	457.1	155
12. Irrigated farms	185.9	243.9	299.9	311.9	140
13. Non-irrigated farms	860.6	897.6	955	1,327.22	350
14. Farm population—total	6,110	5,978	6,286	--	16,000
15. Urban farm	--	--	--	--	--
16. Rural farm—total	6,110	5,978	6,286	--	16,000
17. Rural farm: average per farm	4.18	4.34	4.12	--	4.00
18. % county population	55.9	49.0	40.7	--	18.8
19. No. per 1,000 acres	10.42	11.04	10.27	--	25.8
20. Farm employment, April 1, total	2,573	2,144	2,517	--	8,000
21. % rural farm population	42.1	35.9	40.0	--	50.0
22. % civilian employment	55.3	50.9	43.0	--	24.9
23. No. per 1,000 acrea	4.39	3.96	4.11	--	12.9
24. Average per farm	1.76	1.56	1.65	--	2.0

NOTE: 1930 employment is per old definition: "persons 10 years old and over engaged in gainful occupations."

TABLE 58

RURAL FARM POPULATION AND EMPLOYMENT NORTHEASTERN CALIFORNIA COUNTIES

1930-54 and Ultimate

Lake County

	1930	1940	1950	1954	Ultimate
1. Number of farms—total	1,057	876	1,058	1,038	1,342
2. Irrigated farms	110	141	314	359	854
3. Non-irrigated farms	947	735	744	679	488
4. Land in farms—total (acres)	240,445	229,854	252,923	247,810	200,000
5. Irrigated farms	52,476	56,802	110,261	112,489	102,450
6. Non-irrigated farms	187,969	173,052	142,662	135,321	97,550
7. Irrigated land in farms (acres)	1,916	3,281	9,174	12,498	72,600
8. % of land in farms	0.7	1.4	3.6	5.0	36.3
9. % land in irrigated farms	3.7	5.8	8.3	11.1	70.9
10. Average per irrigated farm (acres)	17.4	23.3	29.2	34.8	85.0
11. Average size of farm (acres)	227.5	262.4	239.1	238.7	149
12. Irrigated farms	477.1	402.9	351.1	313.3	120
13. Non-irrigated farms	198.5	235.4	191.8	199.3	200
14. Farm population—total	3,027	2,997	2,824	--	4,300
15. Urban farm	--	--	--	--	--
16. Rural farm—total	3,027	2,997	2,824	--	4,300
17. Rural farm: average per farm	2.86	3.42	2.67	--	3.2
18. % county population	42.2	37.1	24.6	--	6.6
19. No. per 1,000 acres	12.59	13.04	11.16	--	21.5
20. Farm employment, April 1, total	1,352	915	1,125	--	1,680
21. % rural farm population	44.7	30.5	39.8	--	39.1
22. % civilian employment	46.2	35.6	28.5	--	8.0
23. No. per 1,000 acres	5.62	3.98	4.45	--	8.4
24. Average per farm	1.28	1.04	1.06	--	1.25

NOTE: 1930 employment is per old definition: "persons 10 years old and over engaged in gainful occupations."

TABLE 59

RURAL FARM POPULATION AND EMPLOYMENT
NORTHEASTERN CALIFORNIA COUNTIES

1930-54 and Ultimate

Lassen County

	1930	1940	1950	1954	Ultimate
1. Number of farms—total	472	486	420	397	1,745
2. Irrigated farms	241	301	211	232	1,545
3. Non-irrigated farms	231	185	209	165	200
4. Land in farms—total (acres)	473,268	606,335	682,086	672,795	1,000,000
5. Irrigated farms	303,248	511,973	528,863	494,988	800,000
6. Non-irrigated farms	170,020	94,362	153,223	177,807	200,000
7. Irrigated land in farms (acres)	39,893	62,243	48,662	53,018	441,300
8. % of land in farms	8.4	10.3	7.1	7.9	44.1
9. % land in irrigated farms	13.2	12.2	9.2	10.7	55.2
10. average per irrigated farm (acres)	165.5	206.8	230.6	228.5	285.6
11. Average size of farm (acres)	1,002.7	1,247.6	1,624.0	1,694.7	573
12. Irrigated farms	1,258.3	1,700.9	2,506.5	2,133.6	518
13. Non-irrigated farms	736.0	510.1	733.1	1,077.6	1,000
14. Farm population—total	2,199	2,115	1,665	--	7,850
15. Urban farm	--	--	6	--	--
16. Rural farm—total	2,199	2,115	1,659	--	7,850
17. Rural farm: average per farm	4.66	4.35	3.95	--	4.5
18. % county population	17.5	14.6	9.0	--	11.6
19. No. per 1,000 acres	4.65	3.49	2.43	--	7.8
20. Farm employment, April 1, total	987	760	644	--	3,490
21. % rural farm population	44.9	35.9	38.8	--	44.5
22. % civilian employment	16.2	13.9	9.8	--	14.0
23. No. per 1,000 acres	2.08	1.25	.94	--	3.5
24. Average per farm	2.09	1.56	1.53	--	2.0

NOTE: 1930 employment is per old definition: "persons 10 years old and over engaged in gainful occupations."

TABLE 60

RURAL FARM POPULATION AND EMPLOYMENT
NORTHEASTERN CALIFORNIA COUNTIES

1930-54 and Ultimate

Modoc County

	1930	1940	1950	1954	Ultimate
1. Number of farms—total	621	686	823	749	1,850
2. Irrigated farms	418	532	655	569	1,756
3. Non-irrigated farms	203	154	168	180	94
4. Land in farms—total (acres)	450,139	583,189	680,694	673,897	750,000
5. Irrigated farms	310,471	471,868	597,095	595,917	702,400
6. Non-irrigated farms	139,668	111,321	83,599	77,980	47,600
7. Irrigated land in farms (acres)	70,025	92,419	133,869	124,772	352,100
8. % of land in farms	15.6	15.8	19.7	18.5	46.9
9. % land in irrigated farms	22.6	19.6	22.4	20.9	50.1
10. Average per irrigated farm (acres)	167.5	173.7	204.4	219.3	200.5
11. Average size of farm (acres)	724.9	850.1	827.1	899.7	405.2
12. Irrigated farms	742.8	887.0	911.6	1,047.3	400
13. Non-irrigated farms	688.0	722.9	497.6	433.2	500
14. Farm population—total	2,762	3,048	3,068	--	7,400
15. Urban farm	--	--	2	--	--
16. Rural farm—total	2,762	3,048	3,066	--	7,400
17. Rural farm: average per farm	4.45	4.44	3.72	--	4.0
18. % county population	34.4	35.0	31.7	--	14.5
19. No. per 1,000 acres	6.14	5.23	4.50	--	9.9
20. Farm employment, April 1, total	1,320	1,161	1,128	--	2,775
21. % rural farm population	47.8	38.1	36.8	--	37.5
22. % civilian employment	35.6	34.9	30.2	--	15.0
23. No. per 1,000 acres	2.93	1.99	1.66	--	3.7
24. Average per farm	2.13	1.69	1.37	--	1.5

NOTE: 1930 employment is per old definition: "persons 10 years old and over engaged in gainful occupations."

TABLE 61

RURAL FARM POPULATION AND EMPLOYMENT NORTHEASTERN CALIFORNIA COUNTIES

1930-54 and Ultimate

Plumas County

	1930	1940	1950	1954	Ultimate
1. Number of farms—total	178	167	159	151	400
2. Irrigated farms	119	130	100	95	375
3. Non-irrigated farms	59	37	59	56	25
4. Land in farms—total (acres)	167,446	160,513	150,621	164,004	200,000
5. Irrigated farms	98,666	145,510	114,822	127,000	180,000
6. Non-irrigated farms	68,780	15,003	35,799	37,004	20,000
7. Irrigated land in farms (acres)	16,774	29,481	24,516	22,001	107,900
8. % of land in farms	10.0	18.4	16.3	13.4	54.0
9. % land in irrigated farms	17.0	20.3	21.3	17.3	59.9
10. Average per irrigated farm (acres)	141.0	226.8	245.2	231.6	287.7
11. Average size of farm (acres)	940.7	961.2	947.3	1,086.1	500
12. Irrigated farms	829.1	1,119.3	1,148.2	1,336.8	480
13. Non-irrigated farms	1,165.7	405.5	606.8	660.8	800
14. Farm population—total	908	700	536	--	1,500
15. Urban farm	--	--	--	--	--
16. Rural farm—total	908	700	536	--	1,500
17. Rural farm: average per farm	5.10	4.19	3.37	--	3.75
18. % county population	11.5	6.7	4.0	--	3.4
19. No. per 1,000 acres	5.42	4.36	3.56	--	7.5
20. Farm employment, April 1, total	385	281	187	--	500
21. % rural farm population	42.4	40.1	34.9	--	33.3
22. % civilian employment	8.8	6.3	3.7	--	3.1
23. No. per 1,000 acres	2.30	1.75	1.24	--	2.5
24. Average per farm	2.16	1.68	1.18	--	1.25

NOTE: 1930 employment is per old definition: "persons 10 years old and over engaged in gainful occupations."

TABLE 62

RURAL FARM POPULATION AND EMPLOYMENT NORTHEASTERN CALIFORNIA COUNTIES

1930-54 and Ultimate

Shasta County

	1930	1940	1950	1954	Ultimate
1. Number of farms—total	1,213	1,229	1,108	1,079	2,050
2. Irrigated farms	809	885	753	773	1,800
3. Non-irrigated farms	404	344	355	306	250
4. Land in farms—total (acres)	607,833	534,671	723,752	768,818	750,000
5. Irrigated farms	386,847	395,201	504,234	469,446	625,000
6. Non-irrigated farms	220,986	139,490	219,518	299,372	125,000
7. Irrigated land in farms (acres)	41,173	37,273	39,992	44,961	207,900
8. % of land in farms	6.8	7.0	5.5	5.8	27.7
9. % land in irrigated farms	10.6	9.4	7.9	9.6	33.3
10. Average per irrigated farm (acres)	50.9	42.1	53.1	58.2	115.5
11. Average size of farm (acres)	501.1	435.1	653.2	712.5	366
12. Irrigated farms	478.2	446.6	669.6	607.3	347
13. Non-irrigated farms	547.0	405.4	618.4	978.3	500
14. Farm population—total	4,447	5,163	4,116	--	8,200
15. Urban farm	53	23	16	--	--
16. Rural farm—total	4,394	5,140	4,100	--	8,200
17. Rural farm: average per farm	3.62	4.18	3.70	--	4.0
18. % county population	31.6	17.8	11.3	--	4.2
19. No. per 1,000 acres	7.23	9.61	5.66	--	10.9
20. Farm employment, April 1, total	1,826	1,254	1,161	--	2,460
21. % rural farm population	41.6	24.4	28.3	--	30.0
22. % civilian employment	29.3	12.5	9.1	--	3.5
23. No. per 1,000 acres	3.00	2.34	1.60	--	3.3
24. Average per farm	1.50	1.02	1.05	--	1.2

NOTE: 1930 employment is per old definition: "persons 10 years old and over engaged in gainful occupations."

TABLE 63

RURAL FARM POPULATION AND EMPLOYMENT
NORTHEASTERN CALIFORNIA COUNTIES

1930-54 and Ultimate

Sierra County

	1930	1940	1950	1954	Ultimate
1. Number of farms—total	92	86	69	66	280
2. Irrigated farms	54	65	49	44	250
3. Non-irrigated farms	38	21	20	22	30
4. Land in farms—total (acres)	119,579	60,105	83,535	92,477	100,000
5. Irrigated farms	53,340	46,872	54,924	77,199	83,000
6. Non-irrigated farms	66,239	13,233	28,611	15,278	17,000
7. Irrigated land in farms (acres)	9,104	7,307	16,682	14,201	49,100
8. % of land in farms	7.6	12.2	20.0	15.3	49.1
9. % land in irrigated farms	17.1	15.6	30.4	18.4	59.2
10. Average per irrigated farm (acres)	168.6	112.4	340.4	1,322.7	196.4
11. Average size of farm (acres)	1,299.8	698.9	1,210.7	1,401.2	357
12. Irrigated farms	987.8	721.1	1,120.9	1,754.5	333
13. Non-irrigated farms	1,743.1	630.1	1,430.6	694.4	550
14. Farm population—total	265	306	205	--	850
15. Urban farm	--	--	--	--	--
16. Rural farm—total	265	306	205	--	850
17. Rural farm: average per farm	2.88	3.56	2.97	--	3.0
18. % county population	10.9	10.1	8.4	--	5.3
19. No. per 1,000 acres	2.22	5.09	2.45	--	8.5
20. Farm employment, April 1, total	136	110	67	--	300
21. % rural farm population	51.3	35.9	32.7	--	35.3
22. % civilian employment	10.7	8.5	8.4	--	5.2
23. No. per 1,000 acres	1.14	1.83	.80	--	3.0
24. Average per farm	1.48	1.28	.97	--	1.1

NOTE: 1930 employment is per old definition: "persons 10 years old and over engaged in gainful occupations."

TABLE 64

RURAL FARM POPULATION AND EMPLOYMENT
NORTHEASTERN CALIFORNIA COUNTIES

1930-54 and Ultimate

Siskiyou County

	1930	1940	1950	1954	Ultimate
1. Number of farms—total	1,155	1,208	1,000	970	2,345
2. Irrigated farms	744	915	681	698	2,145
3. Non-irrigated farms	411	293	319	272	200
4. Land in farms—total (acres)	627,704	699,496	879,904	961,344	950,000
5. Irrigated farms	415,855	589,742	653,121	735,577	850,000
6. Non-irrigated farms	211,849	109,754	226,783	225,767	100,000
7. Irrigated land in farms (acres)	58,655	91,783	100,525	93,552	343,200
8. % of land in farms	9.3	13.1	11.4	9.7	36.1
9. % land in irrigated farms	14.1	15.6	15.4	12.7	40.4
10. Average per irrigated farm (acres)	78.8	100.3	147.6	134.0	160.0
11. Average size of farm (acres)	543.5	579.1	879.9	991.1	405
12. Irrigated farms	558.9	644.5	959.1	1,053.8	400
13. Non-irrigated farma	515.4	374.6	710.9	830.0	500
14. Farm population—total	5,355	5,463	4,371	--	9,870
15. Urban farm	--	--	12	--	--
16. Rural farm—total	5,355	5,463	4,359	--	9,870
17. Rural farm: average per farm	4.64	4.52	4.36	--	4.2
18. % county population	21.0	19.1	14.2	--	7.8
19. No. per 1,000 acres	8.53	7.81	4.95	--	10.4
20. Farm employment, April 1, total	2,190	1,900	1,484	--	3,925
21. % rural farm population	40.9	34.8	34.0	--	39.8
22. % civilian employment	19.3	17.0	12.7	--	8.5
23. No. per 1,000 acres	3.49	2.72	1.69	--	4.1
24. Average per farm	1.90	1.57	1.48	--	1.7

NOTE: 1930 employment is per old definition: "persons 10 years old and over engaged in gainful occupations."

TABLE 65

RURAL FARM POPULATION AND EMPLOYMENT NORTHEASTERN CALIFORNIA COUNTIES

1930-54 and Ultimate

Sutter County

	1930	1940	1950	1954	Ultimate
1. Number of farms—total	1,758	1,425	1,807	1,787	2,595
2. Irrigated farms	1,257	1,084	1,527	1,532	2,570
3. Non-irrigated farms	501	341	280	255	25
4. Land in farms—total (acres)	343,654	317,113	372,192	369,349	365,000
5. Irrigated farms	185,410	230,610	312,236	321,420	360,000
6. Non-irrigated farms	158,244	86,503	59,956	47,929	5,000
7. Irrigated land in farms (acres)	98,771	102,119	168,868	192,534	291,800
8. % of land in farms	28.7	32.2	45.4	52.1	79.9
9. % land in irrigated farms	53.3	44.3	54.1	59.9	81.1
10. Average per irrigated farm (acres)	78.6	94.2	110.6	125.7	113.5
11. Average size of farm (acres)	195.5	222.5	206.0	206.7	141
12. Irrigated farms	147.5	212.7	204.5	209.8	140
13. Non-irrigated farms	315.9	253.7	214.1	188.0	200
14. Farm population—total	8,158	8,179	8,735	--	12,450
15. Urban farm	70	45	11	--	--
16. Rural farm—total	8,088	8,134	8,724	--	12,450
17. Rural farm: average per farm	4.60	5.71	4.83	--	4.8
18. % county population	55.3	43.5	33.2	--	10.2
19. No. per 1,000 acres	23.53	25.65	23.44	--	34.1
20. Farm employment, April 1, total	4,285	2,848	3,457	--	5,190
21. % rural farm population	53.0	35.0	39.6	--	41.7
22. % civilian employment	65.3	49.7	38.7	--	11.0
23. No. per 1,000 acres	12.47	8.98	9.29	--	14.2
24. Average per farm	2.44	2.00	1.91	--	2.0

NOTE: 1930 employment is per old definition: "persons 10 years old and over engaged in gainful occupations."

TABLE 66

RURAL FARM POPULATION AND EMPLOYMENT NORTHEASTERN CALIFORNIA COUNTIES

1930-54 and Ultimate

Tehama County

	1930	1940	1950	1954	Ultimate
1. Number of farms—total	1,805	1,744	1,718	1,707	2,760
2. Irrigated farms	953	981	1,141	1,280	2,560
3. Non-irrigated farms	852	763	577	427	200
4. Land in farms—total (acres)	1,195,796	1,227,205	1,131,660	1,161,699	1,100,000
5. Irrigated farms	394,095	447,830	323,606	598,908	920,000
6. Non-irrigated farms	801,701	779,375	808,054	562,791	180,000
7. Irrigated land in farms (acres)	32,110	34,453	38,440	50,766	297,200
8. % of land in farms	2.7	2.8	3.4	4.4	27.0
9. % land in irrigated farms	8.1	7.7	11.9	8.5	32.3
10. Average per irrigated farm (acres)	33.7	35.1	33.7	39.7	116.1
11. Average size of farm (acres)	662.5	703.7	658.7	680.6	399
12. Irrigated farms	413.5	456.5	283.6	467.9	359
13. Non-irrigated farms	941.0	1,021.5	1,400.4	1,318.0	900
14. Farm population—total	6,764	6,843	6,433	--	11,000
15. Urban farm	--	8	120	--	--
16. Rural farm—total	6,764	6,835	6,313	--	11,000
17. Rural farm: average per farm	3.75	3.92	3.67	--	4.0
18. % county population	48.8	47.7	32.7	--	10.5
19. No. per 1,000 acres	5.66	5.57	5.58	--	10.0
20. Farm employment, April 1, total	2,746	1,963	1,967	--	3,310
21. % rural farm population	40.6	28.7	31.1	--	30.1
22. % civilian employment	48.0	40.9	28.3	--	9.0
23. No. per 1,000 acres	2.30	1.60	1.74	--	3.0
24. Average per farm	1.52	1.12	1.14	--	1.2

NOTE: 1930 employment is per old definition: "persons 10 years old and over engaged in gainful occupations."

TABLE 67

RURAL FARM POPULATION AND EMPLOYMENT NORTHEASTERN CALIFORNIA COUNTIES

1930-54 and Ultimate

Trinity County

	1930	1940	1950	1954	Ultimate
1. Number of farms—total	325	329	238	215	230
2. Irrigated farms	193	199	104	119	180
3. Non-irrigated farms	132	130	134	96	50
4. Land in farms—total (acres)	184,523	186,445	195,862	186,898	125,000
5. Irrigated farms	46,553	57,688	92,691	106,677	90,000
6. Non-irrigated farms	137,970	128,757	103,171	80,221	35,000
7. Irrigated land in farms (acres)	5,263	4,753	3,734	3,664	16,700
8. % of land in farms	2.9	2.5	1.9	2.0	13.4
9. % land in irrigated farms	11.3	8.2	4.0	3.4	18.6
10. Average per irrigated farm (acres)	27.3	23.9	35.9	30.8	92.8
11. Average size of farm (acres)	567.8	566.7	822.9	869.3	544
12. Irrigated farms	241.2	289.9	891.3	896.4	500
13. Non-irrigated farms	1,045.2	990.4	769.9	835.6	700
14. Farm population—total	1,191	1,175	688	--	700
15. Urban farm	--	--	--	--	--
16. Rural farm—total	1,191	1,175	688	--	700
17. Rural farm: average per farm	3.66	3.57	2.89	--	3.0
18. % county population	42.4	29.6	13.5	--	3.2
19. No. per 1,000 acres	6.45	6.30	3.51	--	5.6
20. Farm employment, April 1, total	452	303	227	--	208
21. % rural farm population	38.0	25.8	33.0	--	29.7
22. % civilian employment	40.3	21.8	12.9	--	2.6
23. No. per 1,000 acres	2.45	1.62	1.16	--	1.7
24. Average per farm	1.39	.92	.95	--	.9

NOTE: 1930 employment is per old definition: "persons 10 years old and over engaged in gainful occupations."

TABLE 68

RURAL FARM POPULATION AND EMPLOYMENT NORTHEASTERN CALIFORNIA COUNTIES

1930-54 and Ultimate

Yolo County

	1930	1940	1950	1954	Ultimate
1. Number of farms—total	1,641	1,339	1,263	1,158	3,430
2. Irrigated farms	820	868	860	825	3,200
3. Non-irrigated farms	821	471	403	333	230
4. Land in farms—total (acres)	488,252	477,258	509,630	580,153	580,000
5. Irrigated farms	214,548	268,521	356,038	467,764	512,000
6. Non-irrigated farms	273,704	208,737	153,592	112,389	68,000
7. Irrigated land in farms (acres)	84,856	115,301	139,483	172,218	387,800
8. % of land in farms	17.4	24.2	27.4	29.7	66.9
9. % land in irrigated farms	39.6	42.9	39.2	36.8	75.7
10. Average per irrigated farm (acres)	103.5	132.8	162.1	208.7	121.2
11. Average size of farm (acres)	297.5	356.4	403.5	501.0	169
12. Irrigated farms	261.6	309.4	414	567.0	160
13. Non-irrigated farms	333.4	443.2	381.1	337.5	296
14. Farm population—total	8,814	9,100	6,861	--	16,000
15. Urban farm	94	18	82	--	--
16. Rural farm—total	8,720	9,082	6,779	--	16,000
17. Rural farm: average per farm	5.31	6.78	5.37	--	4.7
18. % county population	36.9	33.3	16.7	--	4.1
19. No. per 1,000 acres	17.86	19.03	13.30	--	27.6
20. Farm employment, April 1, total	6,061	4,224	4,728	--	9,250
21. % rural farm population	69.5	46.5	69.7	--	57.8
22. % civilian employment	54.5	43.3	31.4	--	6.3
23. No. per 1,000 acres	12.41	8.85	9.28	--	15.9
24. Average per farm	3.69	3.15	3.74	--	2.7

NOTE: 1930 employment is per old definition: "persons 10 years old and over engaged in gainful occupations."

TABLE 69

RURAL FARM POPULATION AND EMPLOYMENT NORTHEASTERN CALIFORNIA COUNTIES

1930-54 and Ultimate

Yuba County

	1930	1940	1950	1954	Ultimate
1. Number of farms—total	548	562	692	804	1,325
2. Irrigated farms	335	370	466	582	1,250
3. Non-irrigated farms	213	192	226	222	75
4. Land in farms—total (acres)	260,186	213,032	231,266	254,926	215,000
5. Irrigated farms	147,076	98,207	154,463	218,086	200,000
6. Non-irrigated farms	113,110	114,825	76,803	36,840	15,000
7. Irrigated land in farms (acres)	30,248	24,538	36,310	56,810	168,500
8. % of land in farms	11.6	11.5	15.7	22.3	78.4
9. % land in irrigated farms	20.6	25.0	23.5	26.0	84.3
10. Average per irrigated farm (acres)	90.3	66.3	77.9	97.6	134.8
11. Average size of farm (acres)	474.8	379.1	334.2	317.1	162
12. Irrigated farms	439.0	265.4	331.5	374.7	160
13. Non-irrigated farms	531.0	598.0	339.8	165.9	200
14. Farm population—total	2,591	2,749	3,320	--	5,960
15. Urban farm	134	3	181	--	--
16. Rural farm—total	2,457	2,746	3,139	--	5,960
17. Rural farm: average per farm	4.48	4.89	4.54	--	4.5
18. % county population	21.7	16.1	12.8	--	5.7
19. No. per 1,000 acres	9.44	12.89	13.57	--	27.7
20. Farm employment, April 1, total	1,898	1,126	1,264	--	2,265
21. % rural farm population	77.2	41.0	40.2	--	38.0
22. % civilian employment	35.2	20.8	16.7	--	6.0
23. No. per 1,000 acres	7.29	5.28	5.47	--	10.5
24. Average per farm	3.46	2.00	1.83	--	1.7

NOTE: 1930 employment is per old definition: "persons 10 years old and over engaged in gainful occupations."

PART TWO

POTENTIAL ULTIMATE RECREATION DEVELOPMENT IN CALIFORNIA'S NORTHEASTERN COUNTIES, PREDICATED UPON FULL DEVELOPMENT OF NATURAL RESOURCES

I. INTRODUCTION

The northeastern part of the State of California has an exceedingly colorful history woven from its streams and rivers, gold and silver mines and vast stands of pine and fir. Indians, Chinese, and Yankees, miners, woodsmen, trappers and cattlemen all have played a part in the fascinating drama of "Superior" California. The Chinese temple in Weaverville, the lava trenches of the Modoc War, Susanville's Fort Defiance, are historic reminders of this not so distant past.

Historical romance intrigues the historian and the tourist, but the modern-day resident of the area—the farmer, the lumber mill worker, the government employee, the small entrepreneur cannot live on the memories of the past. The economic life of individuals and business operations depends upon a stable, prosperous future. Declining economies in a number of the counties within this area indicate a need to evaluate the potential return from full development of the natural resources of the area.

RECREATION: A NEW "INDUSTRY"

Historically, the economic life of the northern mountain counties has consisted of timber, mining and agricultural operations and related service industries. In recent years, however, recreation activity has increased rapidly to a position of major importance in the region's economy. There is now every reason to believe that its future volume will surpass the visions of the far-sighted men who some time ago formed the Shasta-Cascade Wonderland Association to inform the world of the resources of the northeastern mountain counties.

It appears evident the northeastern counties are on the threshold of enormous growth in the development and use of their recreation resources. These counties have some of the finest mountain country in the state. All or parts of eight national forests are included in their boundaries, plus one national park and one national monument. The pressure of population upon the older, more developed recreation areas of the state is sending more people into the northeastern counties already each year in search of recreation opportunities.

RECENT INCREASES IN RECREATION USE

Forest Service records show that in 1955 there were 8,351,600 visitor-days use of national forest recreation areas in the northeastern counties, compared with 2,958,500 only five years earlier. This increase of 182 percent in recreation use occurred during a period when state population was increasing 23 percent, and population of the northeastern county area increased only 10 percent. Thus it is clear that *per capita* use was increasing substantially.

This increase in recreation use reflects an increasing national propensity to spend more time in leisure and recreation activities. It has been estimated by the National Association of Travel Organizations that tourists in the United States in 1955 spent $24,000,000,000 for recreation purposes, or about 7½ percent of the national income. Recreation visits to the national parks and national forests in 1955 totalled 96,000,000, an increase of 140 percent over 1946. On a *per capita* basis, recreation visits more than doubled between 1946 and 1955 (U. S. Forest Service, *Operation Outdoors*, 1957).

In California, visitor-days use of the national parks and national forests increased from 23,085,000 in 1946 to 35,614,000 in 1955, an increase of 54 percent. State population increased 36 percent during this period.

PROSPECT OF ACCELERATED DEVELOPMENT

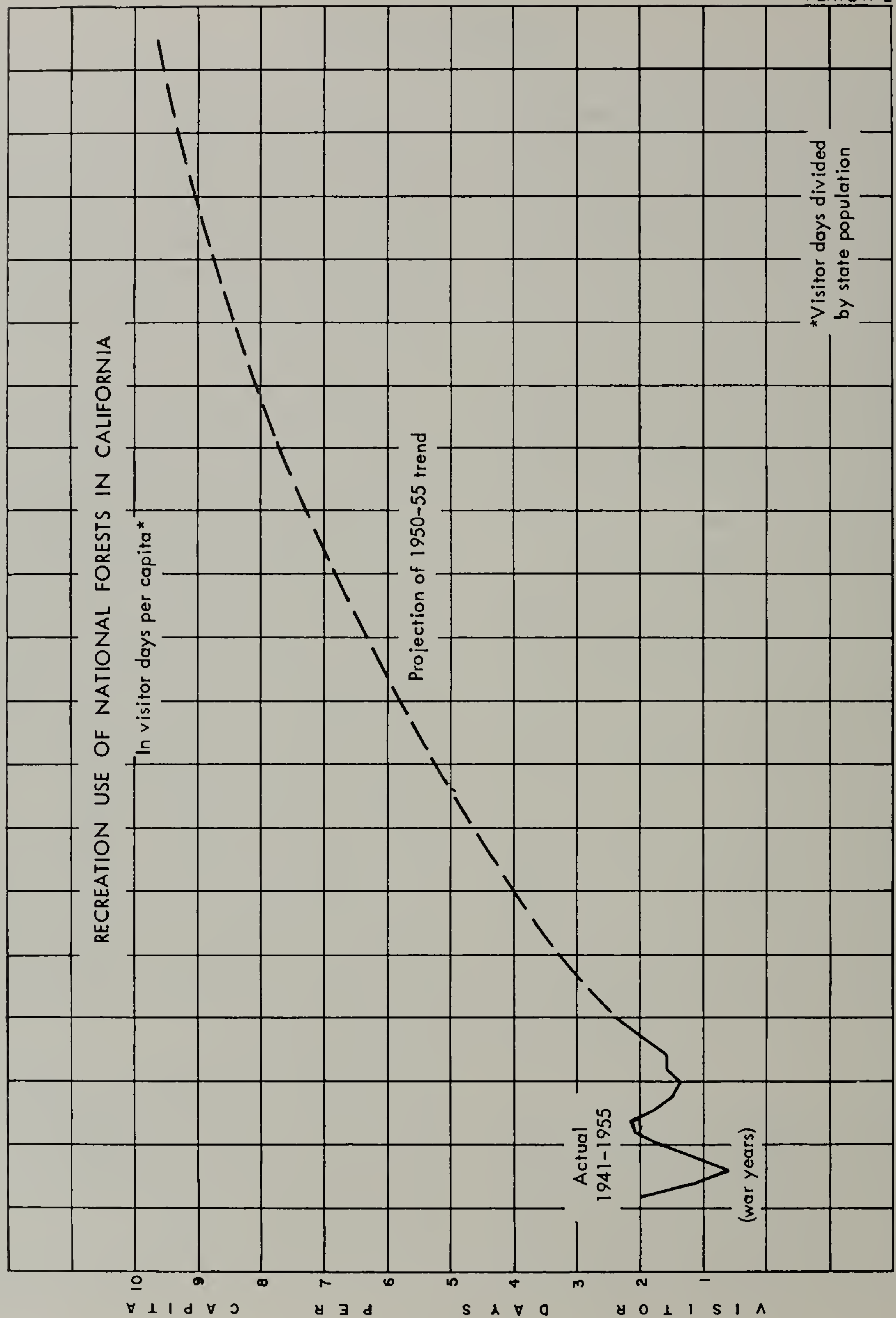
Present development of hotels, resorts, campgrounds and other facilities in the northeastern counties is relatively low. Despite the historic antiquity of the area, exploitation of its recreation resources is in its early stages. Thus the rate of development from this time forward to probable ultimate development can be expected to be very rapid, and to exceed the rate of state population growth by a considerable degree. Thus, although state population is expected to increase three or more times between now and ultimate development, recreation use of the northeastern county area may increase by 10 times or more.

Existing developed recreation facilities in the state and in the nation generally are inadequate to meet present demand, and a large "catching up" process in construction of facilities is urgently needed. For example, camp and picnic grounds in the national forests in 1955 had a safe, convenient and healthful capacity of about 17,600,000 visitor-days. Actual use was 25,500,000 visitor-days—an overload of 45 percent! At the rate of construction permitted by funds now available, the overload is expected to increase to 61 percent by 1958.

Comparable conditions are known to exist in the national forests and national parks in California. The State Park Commission has stated conservatively that "during the past several years, the demand for camp and picnicking sites has far exceeded the supply, and this will undoubtedly continue for some time in the future." (California State Park System, *Five Year Master Plan*, March 1, 1956).

Per capita use of outdoor recreation facilities will increase rapidly under the stimulation of higher in-

PLATE A-2


RECREATION USE OF NATIONAL FORESTS IN CALIFORNIA
In visitor days per capita*
Projection of 1950-55 trend
Actual
1941-1955
(war years)
*Visitor days divided
by state population
VISITOR DAYS PER CAPITA
1 2 3 4 5 6 7 8 9 10
1940 1945 1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030

comes, a shorter work-week, longer vacations, improved transportation, and other benefits of an expanding technology. From 1950 to 1955 visitor-days in the national forests and national parks in California has increased from 1.6 per capita to 2.7 per capita, an annual increase of 0.2. One hundred years hence at this rate of increase, the per capita user days would exceed 20. Therefore, it may be conservatively estimated that annual use of California's national parks and national forests, now about three visitor-days per resident, will ultimately increase to something on the order of 10 visitor-days per year, or even more.

The projections set forth in the first part of this report indicate a state population, as of the period of probable ultimate development (2020-2050), of 45,000,000. On this basis, visitor-days use of national forests and national parks in California might approximate 450,000,000—compared with an estimated 35,600,000 in 1955. (These estimates do not include visitor-days use of private resorts and other types of private recreation facilities, outside the national parks and national forests.)

RECREATION USE CAPACITY OF NORTHEASTERN COUNTY AREA

The survey of potential recreation areas described in the following pages indicates that the northeastern counties alone have the potential area and resources to accommodate this gross volume of recreation use, given the development of necessary public and private facilities. It is probable that actual use of recreation areas in the northeastern counties will be somewhat less than the capacity use estimated in this report, but will nevertheless be very substantial.

The water resources development projects proposed in the California Water Plan would contribute substantially to the achievement of such levels of recreation activity, as discussed below.

(If a state-wide inventory of potential recreation areas were available, which employed classifications and standards similar to those used in this survey of the northeastern counties, it would be possible to estimate with some precision how much of the state total of outdoor recreation activity might be accounted for by the northeastern counties. Lacking such inventory, it may be estimated very roughly that the northeastern county share of future outdoor recreation activity in the state may approximate one-third of the state total. It may be noted that the northeastern counties have 37 percent of the forested lands of the state. On the other hand, being inland counties they cannot provide the attractions of the "seashore.")

FOOTHILL RESIDENTIAL AREAS

The recreation use foreseen in this report includes the activities of the vacationer and tourist, the hunter and the fisherman. It also includes the establishment of permanent and summer homes by persons in retirement or semi-retirement, or having their place of work or business elsewhere, who are attracted to the area by its resources for relaxed, healthful living and immediate access to mountain recreation areas. The town of Paradise in Butte County is an example of this kind of development, which is expected to be duplicated in many parts of the area at elevations of 1,000 to 3,000 feet.

Professor David Weeks, who has done a number of studies of the Sierra foothills, believes there are very good prospects for clusters of population in the foothills, around the 3,000-foot level. These are areas which also have a high potential, according to Weeks and others, for agricultural use with sprinkler irrigation, thus providing additional support for communities whose economic base will largely rest on services to residents.

II. CLASSIFICATION AND MEASUREMENT OF RECREATION AREAS

In order to estimate the potential recreational use of the mountains, lakes, reservoirs and streams of the northeastern county area, it was necessary to develop assumptions and standards for classifying and measuring areas deemed suitable for development.

These standards are shown in Table 1 (page 257).

The preparation of these standards followed review of existing recreation studies prepared by the National Park Service, the United States Forest Service and the State Division of Beaches and Parks and discussion with officials of these agencies.

In the application of these standards to each county, great reliance was placed on the experience and judgment of local officials and private citizens who knew the area intimately and who could delineate on maps the forests, lakes, streams and other features having existing or potential recreational value.

A survey of each county was made by air, accompanied by an experienced official, usually a Forest Ranger. Large areas of each county were also visited by automobile.

CLASSIFICATION OF RECREATION AREAS

To describe the characteristics of potential recreation areas in some detail, some 22 area classifications were used. For each of these classifications, assumptions were made as to how much of the area could be developed (ranging from five to 60 percent), and what proportion of the developed areas was suitable for each of four types of major recreation facility: recreation residences, resorts, camping and picnic grounds, and organizational camps.

Density standards were also established for each type of recreation facility.

To illustrate: The R-1 classification in Table 1 includes areas which are usable for an average distance of one-half mile on each side of a stream or 640 acres per lineal mile of stream; it is assumed that 50 percent of such area is suitable for intensive development; it is further assumed that on the average the total developable area in an R-1 classification can be allocated as follows:

- 50 percent in recreation residences, at a density of one per acre;
- 30 percent in resort development, at a density of one unit per 15 acres;
- 20 percent in camp and picnic grounds, at a density of 2 family units per acre.

AREA CHARACTERISTICS

Characteristics of each of the 22 area classifications are as follows:

RECREATION AREA CLASSIFICATIONS

General Characteristics

R-1	Major rivers readily accessible to motor vehicles, having scenic, climatic, topographic, location and other resource values which will attract public and private recreation developments.
R-2	Rivers and major tributaries accessible to motor vehicles as for R-1. Ofter have considerable fluctuation in usable valley width and steepness of canyon walls.
R-3	Small rivers and tributaries accessible to motor vehicles as for R-1. Generally have steeper fall and intermittent flats and meadows.
R-4	Tributaries and streams accessible to motor vehicles as R-1. Generally have steeper fall and intermittent flats and meadows.
R-1-R	Reservoirs readily accessible to motor vehicles, having scenic, climatic, topographic, location and other resource values which will attract public and private recreation developments.
R-2-R	Reservoirs accessible to motor vehicles as for R-1-R. Often have considerable fluctuation in usable valley width and steepness of canyon walls.
R-3-R	Reservoirs accessible to motor vehicles as for R-1. Generally have steeper fall and intermittent flats and meadows.
R-4-R	Reservoirs accessible to motor vehicles as for R-1. Generally have steeper fall and intermittent flats and meadows.
S-1	Major streams and tributaries in part inaccessible to motor vehicles also having scenic, climatic, topographic and location and other resource values which will attract public and private recreation development.
S-2	Streams and tributaries in part inaccessible to motor vehicles, also having scenic, climatic, topographic and location and other resource values which will attract public and private recreation development.
S-3	Medium to small streams in part inaccessible to motor vehicles, also having scenic, climatic, topographic and location and other resource values which will attract public and private recreation development.
S-4	Small streams largely inaccessible to motor vehicles also having scenic, climatic, topographic and location and other resource values which will attract public and private recreation development.
P-1	Primitive and wild areas of 200,000 acres or more preserved in natural state for camping, hiking, scientific study, fishing, etc.
P-2	Primitive and wild areas of less than 200,000 acres and suitable for more intensive use.
L-1	Lake areas inaccessible to motor vehicles.
L-2	Lake areas accessible to motor vehicles.
RA-1	Desirable middle to high altitude areas of conifers, meadows, and rock out-croppings suitable for fishing, hunting, camping and hiking, etc. and generally inaccessible to motor vehicles.

RA-2 Desirable middle altitude areas of mixed conifers, aspen, streams, meadows, gentle topography.

RA-3 Juniper-sage plateau, some pine, bitterroot, grassland, suitable for some fishing and hunting.

H-1 Desirable major highway frontage where not included in other series, having scenic, topographic, location and other resource values; with primary emphasis on commercial development.

H-2 Less desirable major highway frontage where not included in other series, having some scenic, topographic, location and other resource values with primary emphasis on commercial development.

W Wildlife—waterfowl.

For presentation on maps, the 22 classifications were summarized in three groups, designated by the colors, "blue, green and yellow" (see Table 1). These groupings may be described as follows:

Blue: Areas of prime recreation potential readily accessible by motor vehicle during the entire vacation season.

Green: Areas of prime recreation potential *not* readily accessible by motor vehicle. This may include some areas accessible by jeep.

Yellow: Accessible areas having limited recreation potential such as the wide juniper sage plateau of the Lahontan Basin, the dry ranges of the Eastern Cascade slope, and the middle altitude mesquite and manzanita forest. This includes wildlife areas. Primary recreation uses are hunting and fishing.

Lands adjacent to present urban centers, or areas likely to become urban and suburban in character have also been designated. Their estimated acreages by county are shown in Table 2. For mapping purposes they are shown in red.

Urban and suburban areas are expected to contain a large number of residences of persons moving into the northeastern county area because of its attractions for living.

RECREATION FACILITY CLASSIFICATION

Within the classifications of recreation land shown in Table 1, it is assumed that there would be four major types of facilities to make the areas usable for public recreation. These are:

- Permanent and summer homes (recreation residences)
- Commercial recreation uses (resorts, hotels, motels, restaurants, dude ranches, pack stations, etc.)
- Campgrounds and picnic areas
- Organizational camps

1. *Permanent and Summer Homes*

According to demands for summer home sites within the United States National Forests, there will be an increasing trend for families to build summer and second homes in their favorite vacation areas. In addition, earlier retirement and longer lives are encouraging the construction of homes in desirable living areas previously considered financially impractical. There is also a tendency for families to move to the countryside to live on small farms with incomes supplemented by jobs in nearby urban centers.

2. *Commercial Recreation Uses*

Commercial recreation uses, such as resorts, hotels, motels, restaurants, dude ranches, pack stations and related business activities. Almost every public recreation area attracts service establishments patronized by vacationers. Other recreation areas are developed and served entirely by private business establishments; recreation is their means of livelihood.

3. *Campgrounds and Picnic Areas*

These areas vary from roadside rests and camps providing urban conveniences for the motoring tourist to the inaccessible wilderness and timberline bivouacs reserved for those who are able to find them on foot or horseback.

4. *Organizational Camps*

Outing and camping programs for youths, adults, and families have increased so rapidly that today many California cities operate extensive facilities to serve their residents. Private summer camps for boys and girls and the wide camping programs sponsored by service organizations have exceeded the capacity of existing facilities in all parts of the state.

COUNTY TOTALS OF POTENTIAL RECREATION AREA (Table 2)

With the assistance of forest rangers and other county residents having expert knowledge, every stream, lake, reservoir, meadow, plateau and primitive area in each county was classified and its capacity for potential recreation development was measured according to the standards and assumptions set forth in Table 1.

The results of this classification and measurement are presented, county by county, in Table 2.

III. ESTIMATION OF RECREATION USE

The estimates of developable area presented in Table 2 provide a basis for estimation of potential user-days if facilities are developed and used to capacity. These estimates are shown in Table 3.

The estimates employ conservative assumptions as to average number of persons using a facility and length of season. Nevertheless, the estimates add up to a grand total of 463,000,000 user-days per year.

This total includes approximately 89,000,000 user-days representing direct use of existing and proposed reservoir areas (Table 4). Indirectly, water resource projects are bound to have a much larger effect, as without such projects development along many other streams would not occur. A reservoir project which contributes to stabilization of stream flow, for example, will stimulate downstream use by fishermen and campers, and will increase the demand for resorts, camp and picnic grounds beyond the immediate vicinity of the reservoir.

No adequate comparison can be made between the estimate of 463,000,000 user-days, which is for capacity use and includes both public and private facilities, and present recreation use. For one thing, no adequate data are available on present use of commercial and other private facilities. For national forest areas, for which records are kept, total use in 1955 is estimated at 8,350,000 visitor-days, including persons driving through the forests to enjoy scenic attractions. More significant than the present level of recreation use is its rapid increase in recent years, as discussed earlier in this report.

Estimated visitor-days for Shasta County include the Shasta Lake area, which in 1955 had an estimated 340,000 visitor-days of use. This is a small proportion of the 20,874,000 visitor-days estimated as potential capacity recreation use of reservoir areas in Shasta County.

For planning purposes, it is probably reasonable to assume, conservatively, that annual *average* use of recreation facilities at ultimate development will be about one-third of the capacity estimates. This indicates a total of about 150,000,000 visitor-days for the northeastern counties, including 30,000,000 visitor-days in reservoir areas.

RECREATION BENEFIT

A figure of $2.00 per visitor-day is suggested for use in measuring recreation benefit. Use of this figure would give a total recreation benefit of approximately $300,000,000 at full development, including $60,000,000 in reservoir areas.*

By comparison, $300,000,000 is a little more than the value of 1955 agricultural production in the 15 northeastern counties (estimated by agricultural commissioners at $287,392,000 f.o.b. farms), and about 50 percent more than the value of current annual timber production (estimated at about $200,000,000 f.o.b. mills).

The $2.00 figure has been selected after extensive review of the problem of measuring recreation benefit with government agencies and other organizations working in the recreation field. It is recognized that no single monetary measure will be accepted by all persons, but the concept of benefit from a visitor-day of use probably finds the widest acceptance. The $2.00 figure is consistent with benefit figures currently used by Federal agencies for benefit-cost analysis, and is believed to understate recreation value from the point of view of public welfare and public policy.

The $2.00 figure represents a judgment of the *direct* benefit to an average tourist, vacationer, sportsman, or other "recreationist" of a day in the outdoors, using the types of facilities indicated in this survey. It represents the intangible value of recreation, over and above expenditures for food, lodging, transportation, sporting equipment and other factors necessary or incidental to enjoyment of the recreation.

The latter factors may appear as *indirect* benefits to the local business community in the form of gross receipts for food, shelter, automobile fuel and service, sportswear and sporting equipment, etc. Recent surveys indicate that at current income and price levels, such expenditures average $8.00 per visitor-day in the western states. (These studies are described in this consultant's report to the State Department of Water Resources on recreation potential of the Upper Feather River Basin).

RELATIVE CONTRIBUTION OF COUNTIES TO RECREATION BENEFIT

The relative contribution of each county to estimated total recreation benefit is indicated by the following percentages, which represent each county's share of total estimated annual visitor-days use of recreation areas in the northeastern counties at full development:

* All estimates are in dollars of present purchasing power.

PERCENTAGE OF POTENTIAL RECREATION USE (IN USER-DAYS) ACCOUNTED FOR BY EACH OF 15 NORTHEASTERN COUNTIES

(Based on Table 3)

Butte	5.4%
Colusa	2.4
Glenn	2.6
Lake	5.0
Lassen	7.9
Modoc	7.1
Plumas	10.0
Shasta	14.7
Sierra	3.3
Siskiyou	13.4
Sutter	1.3
Tehama	11.5
Trinity	9.5
Yolo	2.8
Yuba	3.1
	100.0

The same proportions might also indicate very approximately the share of each county in potential expenditures for recreation purposes. However, it is very difficult to estimate the volume of recreation expenditures which would appear as receipts to business in each county. For one thing, the average of $8.00 per visitor-day shown by available studies reflects primarily the expenditure of motorists visiting an area for a relatively brief period (several days up to two weeks). In the potential recreation development of the northeastern counties, on the other hand, about one-third of total user-days are expected to be accounted for by recreation residences; families in such residences may have substantially different expenditure patterns from families who are traveling and spend much less time in an area.

Even where the $8.00 per visitor-day figure (or a similar figure) applies, some of the expenditure is for food, gasoline, etc. enroute, and may not be spent in the county whose recreation area is the objective of the trip.

For crude estimating purposes, however, it may be said that at present price levels the total estimated annual recreation use of 150,000,000 visitor-days in the northeastern counties might involve something on the order of $1,200,000,000 of expenditure (@ $8.00 per visitor-day) and that various counties might share in such expenditures roughly in proportion to their share of developed recreation facilities and potential user-days in the 15-county total.

To sum up, it does not seem unreasonable to estimate that the northeastern counties have the potential in natural resources to support recreation activity worth one billion dollars per year or more, at ultimate development and in present dollars, in gross receipts to the construction, retail and service industries of the area.

IV. RECREATION RESOURCES OF THE NORTHEASTERN COUNTIES

This section contains brief descriptions of the recreation resources of the northeastern counties, to indicate principal features suitable for recreation development.

The descriptions reflect the findings of the inventory of recreation resources discussed in Section II.

BUTTE COUNTY

The climate, terrain, and accessibility of the foothill portions of Butte County have already encouraged a great diversity of recreation development which include a wide range of public and private activities. The community of Paradise located at about 2,000 feet elevation in the north central portion of Butte County is a notable example of a rapidly expanding resort, summer home, and retirement center. Similar low density rural communities will be duplicated many times in the future along the entire length of the Sierras, in some cases up to an elevation of 3,500 feet.

Butte County has many valuable natural resources that are especially suitable to encourage extensive resort and summer home development in the Sierra Foothills up to an elevation of 3,500 feet and public camping, hunting, hiking, skiing and related recreation activities at higher altitudes. Portions of The Lassen National Forest and Plumas National Forest lie within the county and comprise 12 percent of its land area.

The inventory of recreation resources indicates that approximately 25 percent of the gross area of the county is usable for permanent and summer homes, while an additional 11 percent of the county is suitable for group and family camps and resorts.

Extensive urban growth is anticipated around Chico and Oroville, particularly with the increased economic activity resulting from the construction of Oroville dam. Home building may extend from Oroville to Palermo and will doubtless expand in such valley towns as Gridley, Biggs, and small centers along the Sacramento River. In the Sierra foothills retirement homes and small farms are expected to follow the most desirable watercourses such as the Chico, Little Butte and Clear Creeks north to the county line. New water sources will change much of the high plateau rangeland into a pattern of small farms, resorts, and retirement centers. In time almost all of Butte County's eastern slope will be made accessible. Resorts and public recreation areas will be interspersed among the living areas. At higher elevations these public facilities will be more extensive.

Proper planning of the county's recreation resources should set aside large wild life and wilderness areas along the Sacramento and Feather Rivers and some of the picturesque rim rock country of the lower Sierras.

COLUSA COUNTY

The rich agricultural lands of the Sacramento Valley and the dry oak-studded range land of the western foothills comprise most of the county. The introduction of water storage reservoirs, particularly those that will be maintained at a constant water level will change the character of the area and increase its desirability for building vacation homes and resorts.

The upper reaches of Big Stony Creek, Mill Creek and Little Stony Creek are desirable for camping, fishing and some resorts. The higher ridges between Colusa and Lake County have desirable forest recreation characteristics. The area east and south of East Park Reservoir is dry range and for recreation purposes suitable only for hunting and a few mineral spring health resorts.

The Sacramento River which flows along the eastern county boundaries is the greatest recreation resource in Colusa County. Potentially this wonderful river could provide a wide range of water recreation activities: camping, picnicking, resort development and choice permanent and summer home location and the reservation of large river primitive areas in order to preserve the beauties and powerful significance of this jugular vein of Northern California.

GLENN COUNTY

Nearly one-fourth of Glenn County is in the Mendocino National Forest which reaches an altitude of over 7,000 feet. Good timber stands, many streams and springs and relatively easy access should result in continuing increase in use of this area.

Portions of this higher forested area would be most suitable preserved as an inaccessible wilderness and camping area. Medium altitude meadows and streams will attract campers, trailer camps, resorts and a sprinkling of vacation homes, particularly along the upper reaches of Grindstone Creek, Salt Creek, and the middle fork of Stony Creek and on the western slope along Black Butte Creek and its tributaries.

Below 2,500 feet elevation digger pines and native oaks indicate a dry grazing zone suitable for hunting but discouraging to other recreation pursuits except immediately along the major streams.

Stony Gorge Reservoir located in the foothills above the Sacramento Valley floor, attracts over 1,000 water sports enthusiasts during a Sunday for a four-month season even without facilities available to encourage this use. This is evidence that reservoirs built in this hot, dry foothill area will substantially increase the recreation potential of the county.

Bird refuges are important recreation resources of Glenn and other Valley counties and should receive considerable planned expansion to maintain the Pacific Flyway and meet the increasing hunting pressures. The Sacramento River is a major recreation resource that is receiving considerable increased use without proper controls to ensure orderly resort, summer home, and camping development and to preserve portions of the primitive river and wildlife scene.

LAKE COUNTY

Of the 15 northeastern counties under investigation Lake County is unique. The ability of this county to attract a large population may be surmised from the historic record of a dense Indian population which enjoyed the natural abundance of foods and the mild climate.

Although Lake County is one of the smallest of the northeastern counties it is one of the richest in natural recreation resources. Lying entirely within the coast range the southern portion of the county is typical foothill country of rolling hills, numerous streams and upland valleys. North of Clear Lake the terrain becomes more rugged with extensive lumber stands within the Mendocino National Forest. The recreation resources of the county have already been extensively developed. Resorts, homes and public parks around Clear Lake, the Blue Lakes and to a lesser extent Pillsbury Lake indicate the attractiveness of such natural or man-made water resources.

The inventory of recreation land indicates that approximately 30% of the county is suitable for permanent and summer homes and the expansion of urban centers. Approximately seven percent could be used for a wide range of resorts and approximately 14.2 percent for family and group camping activities.

Field investigations and conferences with county officials confirm the trend of increased construction of retirement homes and small farms. Sprinkler irrigation has made possible the planting of fruit and nut orchards in the hill areas. The favorable climate and easy commuting to the metropolitan area is encouraging large numbers of retired, semi-retired and week-end commuters to buy 5 or 10 acre orchards. There are strong indications that much of the county will become a bedroom satellite of the Bay Area.

A sampling of resort activity reveals an increase of 50 percent to 100 percent during the past year. Boating on Clear Lake has increased many times over in recent years according to experts close to this activity, though only 20 percent of the accessible shoreline is being used for recreation purposes. The mild climate favors the gradual increase of the tourist season to a 12 month operation. In addition to the usual resort development there is already a noticeable trend to construct golf courses and private and resort airports for pleasure aircraft.

LASSEN COUNTY

Geographically the Lahontan Plain which covers most of Lassen County seems unrelated to other parts of Northern California. Perhaps this remoteness is partly responsible for the relatively undeveloped state of the recreation resources of the region.

National forests—Lassen, Modoc, and Plumas—cover 21 percent of the county's area. The inventory of recreation potential showed that the county has a relatively high potential user-day capacity with major emphasis on camping and outing experiences and somewhat lesser potential for the building of resorts, and vacation homes.

The mild summer climate will encourage extensive use of the forest, many lakes and streams in the western half of the county. The Blue Lakes region in the southern end of the Warner Range, only recently discovered by the public, is an example of the excellent and as yet unused and unspoiled recreation resources in the county.

The extensive Pit River Watershed including Horse, Davis, Juniper, Willow and Ash Creeks provide opportunities for extensive camping and resort possibilities as well as centers for the best hunting field of Central and Eastern Lassen County. Such creeks as Red Rock, Snake and Buckstrom Canyon and a number of lakes and reservoirs along the eastern portion of the county provide recreation areas similar to the popular dry plateau vacation lands of Arizona and New Mexico.

Lassen Volcanic National Park and the Caribou Peak wild area are a small part of the choice vacation land that falls within Lassen County. Without question a large part of Lassen County's future depends on the wise use of these natural resources.

Eagle Lake, located approximately 17 miles northwest of Susanville promises to have a bright recreation future as a large resort or vacation center. Plans are now under way to maintain a constant level on this large inland lake, to provide paved road access and encourage the construction of resorts and summer home tracts. Susanville, the county seat, is already recognized as the hub of a wide range of recreation facilities, including winter sports, hunting, fishing, boating and family and group camping.

MODOC COUNTY

From a scenic and recreation viewpoint Modoc County is a land of contrasts with features ranging from lava beds with ice caves, and a labrynth of underground passages to the great inland seas of Goose

Lake and the Upper, Middle and Lower Alkali Lakes of Surprise Valley. Over half of the county is included in the Modoc National Forest. The wild and primitive Warner Mountains with extensive forests, perennial streams and small lakes, all are potential vacation lands which contrast with the broad juniper and bitter-weedplains in the south central parts. The great 30,000 head herd of muletail deer that migrate south from Oregon have made hunting the major recreation activity. A short season of goose and duck shooting is also a major attraction for sportsmen.

As with Lassen County, Modoc County has a very promising recreation future providing that the use of these natural wonders is carefully planned to protect the delicate natural balance between flora and fauna in this water deficient area. The development of family camping areas, attractive trailer parks and access to the many points of scenic interest will lengthen the recreation season and increase the importance to the county of this segment of the economy.

The balanced development of these scenic and wildlife resources also require the preservation of large wild life and game refuges and primitive areas. Guided by wise planning even the famous Modoc antelope may be returned to their former strength.

PLUMAS COUNTY

The boundaries of Plumas County coincide roughly with those of the Plumas National Forest, which occupies about 70 percent of the county. The rough terrain of the Sierra Nevada is here relieved by arable valleys—Sierra, Indian, American, Mohawk, and Genessee—and by the splendid watercourse of the Feather River and its tributaries.

Plumas County offers the tourist, vacationer, sportsman and other "recreationist" the finest in mountain scenery, environment, and sports opportunities, including winter sports.

(No detailed description of recreation areas in Plumas County is given here because, pursuant to contract, such is included in a separate report to the State Department of Water Resources on the recreation potential of the Upper Feather River Basin.)

SHASTA COUNTY

Shasta County may be considered the central show window of the recreation resources of Northern California because of its strategic location at the head of the great Sacramento Valley and because of its great variety of recreation resources, including deep canyons and high mountain peaks, dense forest and sun-scorched valleys, the headwaters of the mighty Sacramento River and secluded upland streams and meadows. These are a few of the easily accessible recreation resources to be sampled and enjoyed, and that inevitably lead to further exploration into the more inaccessible back country in Trinity, Siskiyou, Modoc and Lassen Counties.

As shown on the recreation resource map, there are many desirable recreation residence and resort locations in the county, especially along Hat and Montgomery Creeks and around the Castle Crags and the Castella areas. Urban expansion around Redding will probably extend eastward and south to the Tehama County border. In the Happy Valley and Balls Ferry area there are many examples of the conversion of larger farm holdings into small residence farms of from two to 10 acres. This pattern will be extended over large parts of this rich river bottom land to form a very low density and decentralized urban community. A relatively large proportion of the population that will settle in the Redding area will probably be retired, having been attracted to this scenic and enjoyable land to relax and "live" away from the congestion of metropolitan areas.

About one-fourth of the county area has recreation potential which is divided fairly evenly between possible public and private development. Estimates of capacity user days at ultimate development are higher than for any other of the 15 northeastern counties (Table 3).

SIERRA COUNTY

Although small in total gross area Sierra County could devote about one-third of its rugged streams to recreation activities. The Yuba River watershed accounts for the very high potential even though at present access is limited to state highways #49 and #89. The yearly capacity use of the camping and resort facilities of the Lakes Basin Recreation Area indicates the desirability of these resources for family camping and sportsman fishing and hunting. The eastern end of the county, being less precipitous forest land and including the southerly portion of Sierra Valley has many recreation streams of high recreation value, including the little Truckee River.

The Sacramento and San Francisco Bay Metropolitan populations are already placing heavy pressure on these forests because of their proximity to these expanding urban centers. Certainly with proper long range planning, the recreation resources of Sierra County will become the major economic activity.

SISKIYOU COUNTY

The largest and most rugged county in the area provides some of its finest scenery. A few of its scenic areas have already been protected within the Klamath National Forest as primitive and wild areas. These include the Marble Mountains which are famous for their Alpine beauty and are attracting more and more people to pack and hike into these remote regions. The recreation resource inventory shows that all of the streams have a high potential for a balanced recreation development with emphasis on small less accessible streams for organization camping.

The towns of Etna and Fort Jones in Scott Valley are reminiscent of a Swiss setting nestled among high forested mountains and watered by white water streams. Such restful spots are ideally suited to accommodate dude ranches and resorts developed to harmonize with the relaxed country environment. The proposed ski and winter sports development at Mt. Shasta Recreation Area and the use of Medicine Lake by increasing vacationists are two examples of current interest in large scale recreation potentials in Siskiyou County. The Klamath National Forest lies entirely within the western portion of the county. Forest Service personnel recognize the increasing pressure for fine recreation areas and are making good progress in coordinating the planning for multi-use of the forest. Most of Siskiyou has recreational potential and it is only a question of time when the primary problems will relate to planning and building camps, resorts, and vacation houses fast enough to meet the accelerating state-wide demands.

Along the Klamath River and at the mouth of each tributary summer resorts, public camps and vacation homes will be built. The Salmon River, Trout Creek and Butte Creek are examples of locations where camps and cabins can be expected eventually. The development of Shasta Springs as a group camp and summer religious center is an example of a recreation activity that will probably increase in Siskiyou County.

SUTTER COUNTY

The primary recreation resources of Sutter County are the waters of the Feather and Sacramento Rivers, which have so far received only incidental protection or development. Potentially these waterways can provide enjoyment for many people including water sports enthusiasts, campers, river tourers, birdwatchers, fishermen, farmers and other residents along the rivers. However, many spots along the river banks are now being used for dumping grounds and other inappropriate uses. Pollution of the river waters is common today and if continued will destroy the recreation values that nature so freely provided.

Because Sutter County is small and lacks the variety of recreation resources that other northeastern counties have, it has a special incentive to protect and develop its river recreation areas.

TEHAMA COUNTY

Reaching from the crest of the Coast Range across the upper end of the Sacramento Valley and high up in the Sierra slope, Tehama County has a great variety of natural recreation resources. Portions of four national forests (Lassen, Shasta, Trinity, and Mendocino) include approximately 20 percent of the county's area. These forests possess many desirable fishing streams, particularly in the Lassen forest where there are many suitable spots for vacation homes, resorts and extensive camping for families and organizations. Winter sports areas are already being developed near Lassen Volcanic National Park and several favorable sites are being considered at high elevations on the Coast Range. Below the timber line particularly on the west side of the valley the recreation potential is limited to hunting of deer and upland birds. However, the construction of reservoirs in these western foothills will attract heavy recreation use if desirable operation characteristics are maintained.

About one-fourth of the county has potential for homes, resorts, and camping, under optimum conditions.

As with other valley counties, the Sacramento River provides Tehama County with a large recreation potential for active use and passive enjoyment. This resource, unlike the inaccessible mountains, has been sadly neglected, misused and polluted. With rising recreation demand it will become increasingly urgent to stop these practices and inaugurate constructive measures to protect one of the major recreation resources of Northern California.

TRINITY COUNTY

In the remote and inaccessible parts of southern Trinity County are said to live mountain folk who have never seen the outside world. True or not, there is little question that all of this rugged mountain country is a paradise for the devoted camper, packer and mountaineer. Without doubt recreation use will ultimately be Trinity County's largest economic activity. The many secluded and wonderful valleys that now support a limited agricultural economy lend themselves to resort and vacation home use as already exist along Coffee Creek, around Trinity Center, and in the Hayfork and Wildwood areas. The preservation of the Salmon Trinity and Yolla Bolly Wilderness areas are tribute to the foresight of the Forest Service in protecting some of the finest scenic country in America. Such planning should extend to many other areas throughout the "Shasta-Cascade Wonderland."

Four U. S. Forests (Mendocino, Shasta, Trinity and Six Rivers) cover two-thirds of this county, indicating the extent of the national forest. The estimates of ultimate recreation use indicate that about 15 percent of the gross area of the county has recreation value and when fully developed could contain facilities sufficient to accommodate approximately 44,000,000 visitor-days per season at capacity use, or nearly 10 percent of the total use estimated for all of the 15 northeastern counties.

YOLO COUNTY

Yolo County is expected to receive a larger percentage of the urban population than any other of the northeastern counties. This population concentration will require that special attention be given to the proper and full utilization of the relatively limited recreation resources of the county. The Sacramento River along the easterly county line is the greatest natural resource, and has great potential for boating and water sports, home sites and resorts. Public access to the river is an immediate problem which, unless adequately provided before the cost is prohibitive, will seriously limit the full use of the Sacramento River and its tree-lined shores.

The western boundary of the county follows the crest of the Vaca Mountains which presently have a limited recreation potential. Hunting is a major attraction in this area.

Monticello Reservoir now under construction on Putah Creek and particularly the Monticello Dam Afterbay will attract great numbers of day and weekend people as well as extensive summer home and resort construction. Water, as a new reservoir or a freshened stream, will give new recreation life to the western hill country of Yolo County.

YUBA COUNTY

The description of recreation values of Butte County apply in large measure to Yuba County which lies just to the south. The number of small, pleasant towns such as Brownsville, Challenge, Camptonville, give an indication of the desirable character of the Sierra foothills for rural living. As most of the county is readily accessible it has been estimated from the recreation resource inventory that more than 20 percent of the total area has potential for family and group camping, vacation cabins and permanent homes and a wide range of resort and overnight accommodations. About 12 percent of the county is covered by the Plumas and Tahoe National Forests.

TABLES (PART TWO)

9—16762

TABLE 1

STANDARDS USED TO CLASSIFY AND MEASURE POTENTIAL RECREATION AREAS
Recreation Standards Chart — Area Suitable for Average Development

Recreation area classification	Total area classified for recreation development		Total intensive recreation development		Permanent and summer homes				Resorts, pack stations, restaurants, hotels, etc.				Camping and picnicking areas, etc.				Organizational camps, etc.			
	Distance from each side of stream	Acres per lineal mile	%	Acres per lineal miles	%	Acres	Units per acre	Units/lineal miles	%	Acres	Units per acre	Units/lineal miles	%	Acres	Units per acre	Units/lineal miles	%	Acres	Units per acre	Units/lineal miles
R1 Blue	½ mile	640	50	320	50	160	1	160	30	96	1 in 15 acres	19	20	64	2	128	--	--	--	--
R2 Blue	¼ mile	320	40	128	50	64	1	64	30	38	1 in 15 acres	8	20	26	2	54	--	--	--	--
R3 Blue	3/16 mile	240	30	72	40	29	1	29	20	14	1 in 15 acres	3	35	25	2	50	5	4	1 in 40 acres	1 camp per 10 mi. river
R4 Blue	1/8 mile	160	30	48	40	19	1	19	20	10	1 in 15 acres	2	35	17	2	34	5	2	1 in 40 acres	1 camp per 20 mi. river
R1R Blue	½ mile	640	50	320	50	160	1	160	30	96	1 in 15 acres	19	20	64	2	128	--	--	--	--
R2R Blue	¼ mile	320	40	128	50	64	1	64	30	38	1 in 15 acres	8	20	26	2	54	--	--	--	--
R3R Blue	3/16 mile	240	30	72	40	29	1	29	20	14	1 in 15 acres	3	35	25	2	50	5	4	1 in 40 acres	1 camp per 10 mi. river
R4R Blue	1/8 mile	160	30	48	40	19	1	19	20	10	1 in 15 acres	2	35	17	2	34	5	2	1 in 40 acres	1 camp per 20 mi. river
RA2 Blue	--	--	40	--	20	--	1 unit per 3 acres	--	20	--	1 in 15 acres	--	*50	--	1 in 3 acres	--	10	--	--	--
L2 Blue	--	--	60	--	40	--	1 unit per 2 acres	--	15	--	1 in 15 acres	--	*35	--	1 in 2 acres	--	10	--	--	--
H1 Blue	--	--	15	--	--	--	--	--	80	--	470′ frontage per unit	--	*20	--	470′ frontage per unit	--	--	--	--	--
H2 Blue	--	--	5	--	--	--	--	--	80	--	470′ frontage per unit	--	*20	--	470′ frontage per unit	--	--	--	--	--
S1 Blue	¼ mile	320	30	96	20	19	1	19	15	14	1 in 15 acres	3	50	48	2	96	15	14	1 in 40 acres	1 camp per 3 mi. river
S2 Green	3/16 mile	240	20	48	20	10	1	10	15	7	1 in 15 acres	15	50	24	2	48	15	7	1 in 40 acres	1 camp per 6 mi. river
S3 Green	1/8 mile	160	20	32	20	6	1	6	15	5	1 in 15 acres	1	50	16	2	32	15	5	1 in 40 acres	1 camp per 8 mi. river
S4 Green	1/16 mile	80	20	16	20	3	1	3	15	2	1 in 15 acres	½	50	8	2	16	15	2	1 in 40 acres	1 camp per 20 mi. river
RA1 Green	--	--	20	--	--	--	--	--	--	--	--	--	60	--	1 in 3 acres	--	40	--	1 in 40 acres	--
L1 Green	--	--	50	--	--	--	--	--	--	--	--	--	70	--	1 in 3 acres	--	30	--	1 in 40 acres	--
Primitive Green	--	--	100	--	--	--	--	--	--	--	1 pack station per 10,000 acres	--	--	--	1 camp per 200 acres	--	--	--	--	--
River Prim. Green	--	--	10	--	--	--	--	--	--	--	1 pack station per 10,000 acres	--	*30	--	1 in 3 acres*	--	10	--	1 in 40 acres	--
RA3 Yellow	--	--	10	--	20	--	1 unit per 3 acres	--	30	--	1 in 15 acres	--	--	--	--	--	--	--	--	--
Wildlife Yellow	--	--	100	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Blue: Represents areas accessible for maximum recreational use.
Green: Represents inaccessible areas of maximum recreational use.
Yellow: Represents accessible areas of limited recreational use.

R1R, etc.: Divide lineal miles by "2" and proceed.
Rivers dividing counties—take ½ lineal measurement.

To Measure "Quads":
62,500 quad: — wheel mileage.
48,000 quad: — lineal mileage × .75
24,000 quad: — lineal mileage × .325
* Includes trailer parks.

TABLE 2

ACRES IN POTENTIAL RECREATION AREAS AND URBAN AREAS

Area classification	Total area	Developed area	Recreation residences	Commercial facilities	Camping and picnic grounds	Organizational camps
Butte County						
Blue:						
R1	104,960	52,480	26,240	15,744	10,496	--
R2	51,520	20,608	10,304	6,183	4,121	--
R3	19,320	5,796	2,319	1,159	2,028	290
R4	2,960	888	355	178	311	44
S1	--	--	--	--	--	--
RA2	182,390	72,956	14,592	14,592	36,478	7,297
H1	285	43	--	34	9	--
H2	--	--	--	--	--	--
R1R	66,020	33,010	16,505	9,904	6,603	--
R2R	--	--	--	--	--	--
L2	10,170	6,102	2,441	915	2,136	610
Total	437,625	191,883	72,756	48,709	62,182	8,241
Green:						
S2	--	--	--	--	--	--
S3	--	--	--	--	--	--
S4	--	--	--	--	--	--
RA1	--	--	--	--	--	--
Primitive	--	--	--	--	--	--
Yellow:						
RA3	--	--	--	--	--	--
Wildlife	9,620	--	--	--	--	--
Red:						
Urban	191,460	--	--	--	--	--
Totals by col.	638,705	191,883	72,756	48,709	62,182	8,241
Colusa County						
Blue:						
R1	43,360	21,680	10,840	6,504	4,336	--
R2	12,000	4,800	2,400	1,440	960	--
R3	1,440	432	173	87	151	21
R4	5,920	1,776	710	355	622	89
S1	7,040	2,112	422	317	1,056	317
RA2	80,642	32,257	6,451	6,451	16,129	3,226
H1	294	44	--	35	9	--
H2	--	--	--	--	--	--
R1R	15,360	7,680	3,840	2,304	1,536	--
R2R	--	--	--	--	--	--
L2	--	--	--	--	--	--
Total	166,056	70,781	24,836	17,493	24,799	3,653
Green:						
S2	8,280	1,656	331	249	828	249
S3	7,440	1,488	298	223	744	223
S4	1,520	304	61	46	152	46
RA1	--	--	--	--	--	--
Primitive	--	--	--	--	--	--
L1	320	160	--	--	112	48
Total	17,560	3,608	690	518	1,836	566
Yellow:						
RA3	86,560	8,656	1,731	3,462	2,597	866
Wildlife	48,662	--	--	--	--	--
Total	135,222	8,656	1,731	3,462	2,597	866
Red:						
Urban	9,540	--	--	--	--	--
Totals by col.	328,378	83,045	27,257	21,473	29,232	5,085
Glenn County						
Blue:						
R1	32,480	16,240	8,120	4,872	3,248	--
R2	--	--	--	--	--	--
R3	--	--	--	--	--	--
R4	--	--	--	--	--	--
S1	13,920	4,176	835	627	2,088	627
RA2	122,874	49,150	9,830	9,830	24,574	4,913
H1	172	26	--	21	5	--
H2	--	--	--	--	--	--
R1R	24,160	12,080	6,040	3,624	2,416	--
R2R	--	--	--	--	--	--
L2	426	256	102	38	90	26
Total	194,032	81,928	24,927	19,012	32,421	5,566
Green:						
S2	23,880	4,776	955	716	2,388	716
S3	14,640	2,928	585	440	1,464	440
S4	2,880	576	115	86	288	86
RA1	--	--	--	--	--	--
Primitive	--	--	--	--	--	--
Total	41.400	8,280	1,655	1,242	4,140	1,242
Yellow:						
RA3	--	--	--	--	--	--
Wildlife	32,740	--	--	--	--	--
Red:						
Urban	3,520	--	--	--	--	--
Totals by col.	271,692	90,208	26,582	20,254	36,561	6,808
Lake County						
Blue:						
R1	44,004	22,002	11,001	6,601	4,400	--
R2	76,960	30,784	15,392	9,236	6,157	--
R3	840	252	101	50	88	13
R4	7,360	2,208	884	440	772	112
S1	--	--	--	--	--	--
RA2	436,030	174,412	34,882	34,882	87,206	17,441
H1	--	--	--	--	--	--
H2	--	--	--	--	--	--
R1R	11,020	5,510	2,755	1,653	1,102	--
R2R	320	128	64	38	26	--
L2	--	--	--	--	--	--
Total	576,534	235,296	65,079	52,900	99,751	17,566
Green:						
S2	600	120	24	18	50	18
S3	--	--	--	--	--	--
S4	--	--	--	--	--	--
RA1	--	--	--	--	--	--
Primitive	--	--	--	--	--	--
Total	600	120	24	18	50	18
Yellow:						
RA3	--	--	--	--	--	--
Wildlife	29,940	--	--	--	--	--
Red:						
Urban	102,160	--	--	--	--	--
Totals by col.	709,234	235,416	65,103	52,918	99,801	17,584

TABLE 2—Continued

ACRES IN POTENTIAL RECREATION AREAS AND URBAN AREAS

Area classification	Total area	Developed area	Recreation residences	Commercial facilities	Camping and picnic grounds	Organizational camps
Lassen County						
Blue:						
R1	36,800	18,400	9,200	5,520	3,680	--
R2	43,200	17,280	8,640	5,184	3,456	--
R3	32,980	9,895	3,958	1,979	3,463	495
R4	14,560	4,368	1,747	874	1,529	218
S1	--	--	--	--	--	--
RA2	501,451	200,580	40,116	40,116	100,290	20,058
H1	719	108	--	86	22	--
H2	81	12	--	10	2	--
R1R	33,920	16,960	8,480	5,088	3,392	--
R2R	10,160	4,064	2,032	1,219	813	--
R3R	6,770	2,031	812	406	711	102
R4R	740	222	89	44	78	11
L1	--	--	--	--	--	--
L2	11,150	6,690	2,676	1,044	2,342	669
Total	681,381	280,610	77,750	61,530	119,778	21,553
Green:						
S3	--	--	--	--	--	--
S4	--	--	--	--	--	--
RA1	--	--	--	--	--	--
Primitive	27,882	--	--	--	--	--
S2	--	--	--	--	--	--
L1	5,620	2,810	--	--	1,967	843
Total	33,502	2,810	--	--	1,967	843
Yellow:						
RA3	1,524,996	152,500	30,500	61,000	47,750	15,250
Wildlife	45,070	--	--	--	--	--
Total	1,570,066	152,500	30,500	61,000	47,750	15,250
Red:						
Urban	14,860	--	--	--	--	--
Totals by col.	2,299,809	435,920	108,250	122,530	167,495	37,646
Modoc County						
Blue:						
R1	30,721	15,361	7,681	4,608	3,072	--
R2	61,920	24,768	12,384	7,430	4,954	--
R3	23,520	7,056	2,822	1,411	2,470	353
R4	16,560	4,968	1,987	994	1,739	248
S1	--	--	--	--	--	--
RA2	383,068	153,227	30,645	30,645	76,614	15,323
H1	759	114	--	91	23	--
H2	--	--	--	--	--	--
R1R	23,360	11,680	5,840	3,504	2,336	--
R2R	8,800	3,520	1,760	1,056	704	--
R3R	9,720	2,916	1,166	583	1,021	146
R4R	3,360	1,008	403	202	353	50
L2	15,360	9,216	3,686	1,382	3,226	922
Total	577,148	233,834	68,374	51,906	96,512	17,042
Green:						
S2	--	--	--	--	--	--
S3	--	--	--	--	--	--
S4	--	--	--	--	--	--
RA1	--	--	--	--	--	--
Primitive	69,240	--	--	--	--	--
S2	--	--	--	--	--	--
L1	320	160	--	--	112	48
Total	69,560	160	--	--	112	48
Yellow:						
RA3	1,425,670	142,567	28,513	57,027	42,770	14,257
Wildlife	63,420	--	--	--	--	--
Total	1,489,090	142,567	28,513	57,027	42,770	14,257
Red:						
Urban	20,900	--	--	--	--	--
Total by col.	2,156,698	346,561	96,887	108,933	139,394	31,347
Plumas County						
Blue:						
R1	115,680	57,840	28,920	17,352	11,568	--
R2	19,760	7,904	3,952	2,371	1,581	--
R3	12,960	3,888	1,555	778	1,361	194
R4	160	48	19	10	17	2
S1	960	288	58	43	144	43
RA2	890,427	356,171	71,234	71,234	178,086	35,617
H1	--	--	--	--	--	--
H2	--	--	--	--	--	--
R1R	68,000	34,000	17,000	10,200	6,800	--
R2R	--	--	--	--	--	--
L2	14,890	8,934	3,574	1,340	3,127	893
Total	1,122,837	469,073	126,312	103,328	202,684	36,749
Green:						
S2	--	--	--	--	--	--
S3	480	96	19	14	48	14
S4	--	--	--	--	--	--
RA1	133,670	26,734	--	--	16,040	10,694
Primitive	48,180	--	--	--	--	--
L1	3,960	1,980	--	--	1,386	594
Total	186,290	28,810	19	14	17,474	11,302
Yellow:						
RA3	43,000	4,300	860	1,720	1,290	430
Wildlife	--	--	--	--	--	--
Red:						
Urban	10,560	--	--	--	--	--
Total by col.	1,362,687	502,183	127,191	105,062	221,448	48,481
Shasta County						
Blue:						
R1	113,120	56,560	28,280	16,968	11,312	--
R2	105,060	42,024	21,012	12,607	8,405	--
R3	55,080	16,524	6,610	3,305	5,783	826
R4	41,440	12,432	4,973	2,486	4,351	622
S1	2,560	768	154	115	384	115
RA2	696,350	278,540	55,708	55,708	139,270	27,854
H1	562	84	--	67	17	--
H2	--	--	--	--	--	--
R1R	173,420	86,710	43,355	26,013	17,342	--
R2R	53,310	21,324	10,662	6,397	4,265	--
L2	3,220	1,932	773	290	676	193
Total	1,244,122	516,898	171,527	123,956	191,805	29,610
Green:						
S2	21,240	4,248	850	637	2,124	637
S3	6,240	1,248	250	187	624	187
S4	8,200	1,640	328	246	820	246
RA1	--	--	--	--	--	--
Primitive	61,740	--	--	--	--	--
L1	1,880	940	--	--	658	282
Total	99,300	8,076	1,428	1,070	4,226	1,352
Yellow:						
RA3	483,380	48,338	9,668	19,335	14,501	4,834
Wildlife	--	--	--	--	--	--
Red:						
Urban	151,930	--	--	--	--	--
Totals by col.	1,978,732	573,312	182,623	144,361	210,532	35,796

TABLE 2—Continued

ACRES IN POTENTIAL RECREATION AREAS AND URBAN AREAS

Area classification	Total area	Developed area	Recreation residences	Commercial facilities	Camping and picnic grounds	Organizational camps
Sierra County						
Blue:						
R1	12,160	6,080	3,040	1,824	1,216	--
R2	22,720	9,088	4,544	2,727	1,817	--
R3	3,120	936	374	187	328	47
R4	--	--	--	--	--	--
S1	--	--	--	--	--	--
RA2	403,560	161,424	32,285	32,285	80,713	16,142
H1	--	--	--	--	--	--
H2	--	--	--	--	--	--
R1R	12,800	6,400	3,200	1,920	1,280	--
R2R	--	--	--	--	--	--
L2	11,680	7,008	2,803	1,051	2,453	701
Total	466,040	190,936	46,246	39,994	87,807	16,890
Green:						
S2	--	--	--	--	--	--
S3	--	--	--	--	--	--
S4	--	--	--	--	--	--
RA1	--	--	--	--	--	--
Primitive	--	--	--	--	--	--
L1	--	--	--	--	--	--
Yellow:						
RA3	--	--	--	--	--	--
Wildlife	--	--	--	--	--	--
Red:						
Urban	6,050	--	--	--	--	--
Totals by col.	472,090	190,936	46,246	39,994	87,807	16,890
Siskiyou County						
Blue:						
R1	128,640	64,320	32,160	19,296	12,864	--
R2	3,398	1,359	680	408	272	--
R3	49,920	14,976	5,990	2,995	5,242	749
R4	23,923	7,177	2,871	1,435	2,512	359
S1	68,500	20,550	4,110	3,083	10,275	3,083
RA2	276,175	110,470	22,094	22,094	55,235	11,047
H1	514	77	--	62	15	--
H2	34	2	--	2	--	--
R1R	125,760	62,880	31,440	18,864	12,576	--
R2R	--	--	--	--	--	--
L2	24,446	14,668	5,867	2,200	5,134	1,467
Total	701,310	296,479	105,212	70,439	104.125	16,705
Green:						
S2	81,031	16,206	3,241	2,431	8,103	2,431
S3	62,640	12,528	2,506	1,879	6,264	1,879
S4	79,720	15,944	3,189	2,392	7,972	2,392
RA1	30,609	6,122	--	--	3,673	2,449
Primitive	227,762	--	--	--	--	--
L1	3,216	1,608	--	--	1,126	482
Total	484,978	52,404	8,936	6,702	27,138	9,633
Yellow:						
RA3	778,808	77,880	15,576	31,152	23,264	7,788
Wildlife	65,805	--	--	--	--	--
Total	844,613	77,880	15,576	31,152	23,264	7,788
Red:						
Urban	113,900	--	--	--	--	--
Totals by col.	2,144,801	426,763	129,724	108,293	154,527	34,126

Area classification	Total area	Developed area	Recreation residences	Commercial facilities	Camping and picnic grounds	Organizational camps
Sutter County						
Blue:						
R1	60,910	30,455	15,228	9,137	6,091	--
R2	2,720	1,088	544	326	218	--
R3	--	--	--	--	--	--
R4	--	--	--	--	--	--
S1	--	--	--	--	--	--
RA2	--	--	--	--	--	--
H1	243	36	--	29	7	--
H2	--	--	--	--	--	--
R1R	--	--	--	--	--	--
R2R	--	--	--	--	--	--
R3R	--	--	--	--	--	--
R4R	--	--	--	--	--	--
L2	--	--	--	--	--	--
Total	63,873	31,579	15,772	9,492	6,316	--
Green:						
S2	--	--	--	--	--	--
S3	--	--	--	--	--	--
S4	--	--	--	--	--	--
RA1	--	--	--	--	--	--
Primitive	--	--	--	--	--	--
L1	--	--	--	--	--	--
Yellow:						
RA3	--	--	--	--	--	--
Wildlife	47,250	--	--	--	--	--
Red:						
Urban	22,710	--	--	--	--	--
Totals by col.	133,833	31,579	15,772	9,492	6,316	--
Tehama County						
Blue:						
R1	125,440	62,720	31,360	18,816	12,544	--
R2	69,120	27,648	13,824	8,294	5,530	--
R3	61,120	18,336	7,334	3,667	6,418	917
R4	36,960	11,088	4,435	2,218	3,881	554
S1	--	--	--	--	--	--
RA2	625,280	250,112	50,022	50,022	125,056	25,011
H1	409	61	--	49	12	--
H2	--	--	--	--	--	--
R1R	99,680	49,840	24,920	14,952	9,968	--
R2R	--	--	--	--	--	--
R3R	--	--	--	--	--	--
R4R	--	--	--	--	--	--
L2	7,200	4,320	1,728	648	1,512	432
Total	1,025,209	424,125	133,623	98,666	164,921	26,914
Green:						
S2	--	--	--	--	--	--
S3	--	--	--	--	--	--
S4	--	--	--	--	--	--
RA1	--	--	--	--	--	--
Primitive	131,370	--	--	--	--	--
L1	--	--	--	--	--	--
Total	131,370	--	--	--	--	--
Yellow:						
RA3	466,160	46,616	9,323	18,646	13,985	4,662
Wildlife	--	--	--	--	--	--
Total	466,160	46,616	9,323	18,646	13,985	4,662
Red:						
Urban	42,270	--	--	--	--	--
Totals by col.	1,665,009	470,741	142,946	117,312	178,906	31,576

TABLE 2—Continued

ACRES IN POTENTIAL RECREATION AREAS AND URBAN AREAS

Area classification	Total area	Developed area	Recreation residences	Commercial facilities	Camping and picnic grounds	Organizational camps
Trinity County						
Blue:						
R1	104,960	52,480	26,240	15,744	10,496	--
R2	49,920	19,968	9,984	5,991	3,994	--
R3	15,600	4,680	1,872	938	1,639	234
R4	16,880	5,064	2,026	1,011	1,773	252
S1	1,920	512	103	77	256	77
RA2	344,040	137,616	27,523	27,523	68,808	13,761
H1	--	--	--	--	--	--
H2	--	--	--	--	--	--
R1R	120,000	60,000	30,000	18,000	12,000	--
R2R	24,320	9,728	4,864	2,918	1,946	--
L2	10,980	6,588	2,635	988	2,306	659
Total	688,620	296,636	105,247	73,190	103,218	14,983
Green:						
S2	36,360	7,272	1,454	1,091	3,636	1,091
S3	7,520	1,506	300	227	752	227
S4	36,700	7,340	1,468	1,101	3,670	1,101
RA1	--	--	--	--	--	--
Primitive	322,340	--	--	--	--	--
Total	402,920	16,118	3,222	2,419	8,058	2,419
Yellow:						
RA3	--	--	--	--	--	--
Wildlife	--	--	--	--	--	--
Red:						
Urban	19,940	--	--	--	--	--
Totals by col.	1,111,480	312,754	108,469	75,609	111,276	17,402
Yolo County						
Blue:						
R1	78,400	39,200	19,600	11,760	7,840	--
R2	22,880	9,152	4,576	2,745	1,831	--
R3	4,920	1,476	591	295	516	74
R4	1,680	504	201	101	177	25
S1	--	--	--	--	--	--
RA2	36,960	14,784	2,957	2,957	7,392	1,479
H1	238	36	--	29	7	--
R1R	13,440	6,720	3,360	2,016	1,344	--
R2R	--	--	--	--	--	--
L2	--	--	--	--	--	--
Total	158,438	72,142	31,285	19,903	19,107	1,578
Yolo County—Continued						
Green:						
S2	--	--	--	--	--	--
S3	--	--	--	--	--	--
S4	--	--	--	--	--	--
RA1	--	--	--	--	--	--
Primitive	--	--	--	--	--	--
Yellow:						
RA3	52,970	5,297	1,059	2,119	1,589	530
Wildlife	40,750	--	--	--	--	--
Total	93,720	5,297	1,059	2,119	1,589	530
Red:						
Urban	56,460	--	--	--	--	--
Totals by col.	308,618	77,439	32,344	22,022	20,696	2,108
Yuba County						
Blue:						
R1	56,320	28,160	14,080	8,448	5,632	--
R2	20,800	8,320	4,160	2,495	1,665	--
R3	960	288	115	58	101	14
R4	640	192	77	38	67	10
S1	--	--	--	--	--	--
RA2	117,550	47,020	9,405	9,405	23,508	4,702
H1	78	12	--	10	2	--
H2	--	--	--	--	--	--
R1R	44,320	22,160	11,080	6,645	4,435	--
R2R	--	--	--	--	--	--
L2	640	384	154	58	134	38
Total	241,308	106,536	39,071	27,157	35,544	4,764
Green:						
S2	--	--	--	--	--	--
S3	--	--	--	--	--	--
S4	--	--	--	--	--	--
RA1	--	--	--	--	--	--
Primitive	--	--	--	--	--	--
Yellow:						
RA3	8,000	800	160	320	240	80
Wildlife	32,420	--	--	--	--	--
Total	40,420	800	160	320	240	80
Red:						
Urban	68,280	--	--	--	--	--
Totals by col.	350,008	107,336	39,231	27,477	35,784	4,844

TABLE 3

ESTIMATED USER-DAYS PER SEASON AT CAPACITY USE OF POTENTIAL RECREATION AREAS IN 15 NORTHEASTERN COUNTIES

Recreation area	Butte	Colusa	Glenn	Lake	Lassen	Modoc	Plumas	Shasta	Sierra	Siskiyou	Sutter	Tehama	Trinity	Yolo	Yuba	Total for 15 counties
Permanent and Summer Residences																
Total net developable acres	72,756	27,257	26,582	65,103	108,250	96,887	127,191	182,623	46,246	129,724	15,772	142,946	108,469	32,344	39,231	1,221,381
Total units	61,807	21,802	19,977	41,848	59,834	55,605	76,941	128,652	23,320	101,676	15,772	102,518	88,802	32,342	32,777	863,673
Average units per acre	0.85	0.80	0.75	0.64	0.55	0.57	0.60	0.70	0.50	0.78	1.0	0.72	0.82	1.0	0.84	0.71
R & S 1 unit per acre	55,723	19,075	16,650	30,221	34,958	34,043	51,123	116,474	11,158	86,187	15,772	81,873	78,311	28,328	29,512	689,408
L2 1 unit per 2 acres	1,220	--	51	--	1,338	1,843	1,787	386	1,401	2,933	--	864	1,317	--	77	13,217
RA 2-3 1 unit per 3 acres	4,864	2,727	19,977	11,627	23,538	19,719	24,031	11,792	10,761	12,556	--	19,781	9,174	4,014	3,188	177,749
Capacity users per season (4 persons @ 45 days = 180)	11,125,260	3,924,360	3,595,860	7,532,640	10,770,120	10,008,900	13,849,380	23,157,360	4,197,600	18,301,680	2,838,960	18,453,240	15,984,360	5,821,560	5,899,860	155,461,140
Commercial: resorts, hotels, etc.																
Total net developable acres	48,709	21,473	20,254	52,918	122,530	108,933	105,062	144,361	39,994	108,293	9,492	117,312	75,609	22,022	27,477	1,024,439
Total units	3,246	1,430	1,348	3,533	8,162	7,261	7,003	9,622	2,671	7,217	632	7,819	5,038	1,467	1,830	68,279
Average units per acre	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
R & S 1 unit per 15 acres	2,211	768	691	1,202	1,354	1,319	2,051	4,597	443	3,518	630	3,196	3,139	1,127	1,178	27,424
L2 1 unit per 15 acres	61	--	1	--	67	92	89	19	70	146	--	43	65	--	3	656
RA 2-3 1 unit per 15 acres	972	660	655	2,325	6,741	5,844	4,863	5,002	2,158	3,549	--	4,577	1,834	338	648	40,166
Highways 1 unit per 15 acres	2	2	1	--	6	6	--	4	--	4	2	3	--	2	1	33
Capacity users per season (4 persons @ 90 days = 360)	1,168,560	514,800	485,280	1,271,880	2,938,320	2,613,960	2,521,080	3,463,920	961,560	2,598,120	227,520	2,814,840	1,813,680	528,120	658,800	24,580,440
Camping: picnic areas, etc.																
Total net developable acres	62,182	29,232	36,561	99,801	167,495	139,394	221,448	210,532	87,807	154,527	6,316	178,906	111,276	20,696	35,783	1,561,956
Total units	50,618	27,049	32,020	54,258	84,775	74,743	110,201	162,635	37,412	162,493	12,618	123,786	104,413	26,409	31,776	1,095,206
Average units per acre	0.81	0.93	0.88	0.54	0.51	0.54	0.50	0.77	0.43	1.1	2.0	0.69	0.94	1.3	0.89	0.70
R & S 2 units per acre	47,118	20,770	23,784	25,190	34,292	33,298	43,038	110,820	9,282	132,160	12,618	76,682	80,324	23,416	23,792	696,584
L2 1 unit per 2 acres	1,068	--	45	--	1,147	1,613	1,563	338	1,226	2,567	--	756	1,153	--	67	11,543
RA1 1 unit per 3 acres	--	--	--	--	--	--	5,346	--	--	1,224	--	--	--	--	--	6,570
RA 2-3 1 unit per 3 acres	2,432	6,242	8,191	29,068	48,680	39,794	59,792	51,257	26,904	26,166	--	46,347	22,936	2,993	7,917	378,719
L1 1 unit per 3 acres	--	37	--	--	655	37	462	219	--	375	--	--	--	--	--	1,780
Highways 1 unit per 15 acres	--	--	--	--	1	1	--	1	--	1	--	1	--	--	--	5
Capacity users per season (4 persons @ 60 days = 240)	12,148,320	6,491,760	7,684,800	13,021,920	20,346,000	17,938,320	26,448,240	39,032,400	8,978,880	38,998,320	3,028,320	29,708,640	25,059,120	6,338,160	7,626,240	262,849,440
Organizational camps, etc.																
Total net developable acres	8,241	5,085	6,808	17,584	37,646	31,347	48,481	35,796	16,890	34,126	--	31,576	17,402	2,108	4,844	297,934
Total units	205	126	168	439	939	790	1,215	906	421	851	--	777	434	52	119	7,442
Average units per acre	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.02	0.02	--	0.02	0.02	0.02	0.02	0.02
R & S 1 unit per 40 acres	8	23	46	3	20	37	11	78	1	272	--	36	74	2	--	611
L2 1 unit per 40 acres	15	--	--	--	16	23	22	4	17	36	--	--	16	--	--	149
RA 1 1 unit per 40 acres	--	--	--	--	--	--	267	--	--	61	--	--	--	--	--	328
RA 2-3 1 unit per 40 acres	182	102	122	436	882	729	901	817	403	470	--	741	344	50	119	6,298
L1 1 unit per 40 acres	--	1	--	--	21	1	14	7	--	12	--	--	--	--	--	56
Capacity users per season (30 persons @ 90 days = 2,700)	553,500	340,200	453,600	1,185,300	2,535,300	2,133,000	3,280,500	2,446,200	1,136,700	2,297,700	--	2,097,900	1,171,800	140,400	321,300	20,093,400
Total user-days	24,995,640	11,271,120	12,219,540	23,011,740	36,589,740	32,694,180	46,099,200	68,099,880	15,274,740	62,195,820	6,094,800	53,074,620	44,028,960	12,828,240	14,506,200	462,984,420

TABLE 4

ESTIMATED ANNUAL USER-DAYS AT RESERVOIR FACILITIES AT CAPACITY USE

Type of facility	Butte	Colusa	Glenn	Lake	Lassen	Modoc	Plumas	Shasta	Sierra	Siskiyou	Sutter	Tehama	Trinity	Yolo	Yuba	Total
Recreation residences																
Developable acres	16,505	3,840	6,040	2,819	11,413	9,169	17,000	54,017	3,200	31,440	--	24,920	34,864	3,360	11,080	--
Units @ 1 per acre	16,505	3,840	6,040	2,819	11,413	9,169	17,000	54,017	3,200	31,440	--	24,920	34,864	3,360	11,080	--
User-days @ 180/unit	2,970,900	691,200	1,087,200	507,420	2,054,340	1,650,420	3,060,000	9,723,060	576,000	5,659,200	--	4,485,600	6,275,520	604,800	1,994,400	41,340,060
Commercial: resorts, hotels, etc.																
Developable acres	9,904	2,304	3,624	1,691	6,757	5,345	10,200	32,410	1,920	18,864	--	14,952	20,918	2,016	6,645	--
Units @ 1 per 15 acres	660	154	242	113	450	356	680	2,166	128	1,258	--	997	1,395	134	443	--
User-days @ 360/unit	237,600	55,440	87,120	40,680	162,000	128,160	244,800	779,760	46,080	452,880	--	358,920	502,200	48,240	159,480	3,303,360
Campgrounds, picnic areas																
Developable acres	6,603	1,536	2,416	1,128	4,994	4,414	6,800	21,607	1,280	12,576	--	9,968	13,946	1,344	4,435	--
Units @ 2 per acre	13,206	3,072	4,832	2,256	9,988	8,828	13,600	43,214	2,560	25,152	--	19,936	27,892	2,688	8,870	--
User-days @ 240/unit	3,169,440	737,280	1,159,680	541,440	2,397,120	2,118,720	3,264,000	10,371,360	614,400	6,036,480	--	4,784,640	6,694,080	645,120	2,128,800	44,662,560
Organizational camps																
Developable acres	--	--	--	--	113	196	--	--	--	--	--	--	--	--	--	--
Units @ 1 per 40 acres	--	--	--	--	3	5	--	--	--	--	--	--	--	--	--	--
User-days @ 2,700/unit	--	--	--	--	8,100	13,500	--	--	--	--	--	--	--	--	--	21,600
Total	6,377,940	1,483,920	2,334,000	1,089,540	4,621,560	3,910,800	6,568,800	20,874,180	1,236,480	12,148,560	--	9,629,160	13,471,800	1,298,160	4,282,680	89,327,580

Appendix B

COMMENTS OF INDIVIDUALS AND AGENCIES

On the Preliminary Edition of Bulletin No. 58
"Northeastern Counties Investigation"

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FOREWORD

In accordance with Section 12623 of the Water Code, the State Department of Water Resources and the California Water Commission held joint hearings on September 3, 1958, in Yreka, California; September 4, 1958, in Redding, California; September 5, 1958, in Susanville, California; and November 6, 1958, in Sacramento, California, to secure comments on the preliminary edition of Bulletin No. 58, ''Northeastern Counties Investigation.'' After consideration of these comments, a number of revisions were made in the preliminary edition.

This appendix contains the comments presented verbally and in writing at the public hearings, as well as written comments submitted to the Director of the Department of Water Resources and to the California Water Commission relating to the preliminary edition of the bulletin. Verbal comments contained herein are selected statements from the transcript of record.

YREKA HEARING

JOINT HEARING OF THE CALIFORNIA WATER COMMISSION AND DEPARTMENT OF WATER RESOURCES

Held at Courthouse, Yreka, California, September 3, 1958

WRITTEN COMMENTS

STATEMENT BY T. W. WILLIAMS

Chairman Water Problems Department
Siskiyou County Farm Bureau

YREKA, CALIFORNIA, September 3, 1958

Bulletin No. 58 Northeastern Counties Investigation appears to be a very thorough study of the water needs of the Northeastern Counties. There are several items that should be studied further. One is on page 127, the figure shown is 52,800 acres as the probable ultimate irrigated land in Shasta Valley, Siskiyou County. This appears to be the land which can be irrigated by water developed within the Valley and does not include all the land that is irrigable which could be provided for by water developed from the Klamath River.

Since this report will no doubt be used in setting reservations for water in the counties of origin, I believe, that any irrigable land, where it is engineeringly feasible to service with water, should be considered as land that will be irrigated at the time of ultimate development.

While at the present time financial feasibility of some of the local import water projects to serve this irrigable land which is in excess of land that can be developed by waters within these valleys may be in doubt, at sometime in the future this additional water may be developed at a price that the user can afford.

I would like to recommend that all the land, that is irrigable and can be served by a source of water, be included as irrigated land in the ultimate development of the region.

RESOLUTION BY BOARD OF SUPERVISORS OF SISKIYOU COUNTY

YREKA, CALIFORNIA, September 23, 1958

MR. HARVEY O. BANKS, *Director*
Department of Water Resources
P.O. Box 388
Sacramento 2, California

DEAR MR. BANKS: Enclosed please find copy of Resolution adopted this date by the Board of Supervisors of Siskiyou County in regular session, approving the Comments on Bulletin 58 as made by the Water Study Committee of the Siskiyou County Farm Bureau, copy of which is also enclosed herewith.

Yours very truly,

DON S. AVERY, Chairman
Board of Supervisors
Siskiyou County, California

Resolution

Be It Resolved by the Board of Supervisors of Siskiyou County in regular session this 23rd day of September, 1958, that:

1. The allocation of ultimate irrigated acreage and ultimate water requirements for Siskiyou County, as contained in Department of Water Resources Bulletin 58, is inadequate.
2. No firm allocation of either ultimate irrigated acreage or ultimate water requirements be made until an exhaustive study of the situation has been conducted.
3. We approve the Comments on Bulletin 58 made by the Water Study Committee of the Siskiyou County Farm Bureau.

Dated this 23rd day of September, 1958.

Ayes: Supervisors Barr, Jackson, and Daly.
Noes: None.
Absent: Supervisor Ager.

Attest: /s/ DON S. AVERY
Chairman of the Board of Supervisors

/s/ RACHAEL N. CORDES
Clerk of the Board of Supervisors

STATEMENT BY THE WATER STUDY COMMITTEE OF THE SISKIYOU COUNTY FARM BUREAU

YREKA, CALIFORNIA, September 23, 1958

The Water Study Committee of the Siskiyou County Farm Bureau has carefully reviewed the findings in Bulletin No. 58 and desires to protest some of the determinations made in this bulletin, as follows:

1. We note in Chapter II, Table 35, that the gross irrigable acreage in Siskiyou County is listed as 432,420 acres while in Table 37 it has been determined that the probable ultimate irrigated acreage can be only 263,000 acres. We feel that it will be economically feasible in the future to irrigate a much greater acreage and that this determination deserves careful review.
2. In Chapter III, Table 54, the probable ultimate water requirement for irrigated lands, plus reservoir evaporation, has been set at 677,900 acre feet. This quantity of water would allow only 2.6 acre feet per acre for the proposed 263,000 acres of irrigated lands. Transmission losses, which are great, have not been considered, therefore not even 2.6 acre feet per acre would reach the farm land. We feel that not less than 3 acre feet per acre of water should be available at the farm.
3. Table 44 shows the consumptive use of water by truck crops to be only 69 per cent that of alfalfa, while quite the reverse is true. Potatoes, the principal truck crop, has been given a consumptive use value of 1.1 acre feet per acre and, with 50 per cent efficiency, would mean 2.2 acre feet per acre would be provided. Farm Advisor records show that 4 acre feet of applied water is necessary for potato production.
4. Professor Viehmeyer, of the University of California, reports errors in the Blaney-Criddle formula ranging from 14 to 38 per cent. It is known to be least reliable at higher elevations as found in the Butte Valley and Tulelake areas.
5. Seven atmometer station records were kept in 1955 but the season records were incomplete and in Butte Valley only one reading, in the month of July, was taken. Viehmeyer reports that errors in the atmometer method range from .2 to 8.5 per cent.

We therefore recommend that:

1. The ultimate irrigated acreage figure for Siskiyou County be reconsidered.
2. Further studies be carried on to determine more accurately the consumptive needs of water and total water requirements for our crops.
3. No move be made to determine total water requirements or amount of surplus water until further studies have been made.

Respectfully submitted,

Glenn Barnes, Chairman
Water Study Committee of the
Siskiyou County Farm Bureau

STATEMENT BY W. A. BARR
Supervisor, Second District
Siskiyou County

Mount Shasta, California, October 23, 1958

Mr. Harvey Banks
Sacramento, California.

Dear Mr. Banks: Referring to the notice of a meeting in Sacramento Nov. 6th, for the purpose of receiving comments on bulletin 58.

Our agricultural department as well as our board of supervisors feel that a more comprehensive study should be made before a firm allocation of water has been made.

The allocations of water per acre for the different crops would, according to our best information be inadequate for even the number of acres shown in bulletin 58 as the ultimate maximum. Further the findings of our water resources men, and our department of water resources demonstrates the amount per acre allocated for various crops falls far short of even the minimum of water needed for prolific production.

Our board of supervisors, under date of Sept. 23rd passed a resolution, concerning these shortages, your office with others being furnished copy of same.

It may well be that Siskiyou county's needs compare favorably with that of other counties, in the proportionate allocation of waters. Perhaps our resolution should have embraced the entire northern portion of the state.

In any event we will have a representative there to present the matter before the meeting.

Sincerely,

W. A. Barr

VERBAL COMMENTS

MR. M. V. MAXWELL, FARM ADVISOR
Siskiyou County

Mr. Maxwell: Mr. Chairman, I really didn't come to testify. I really came to ask questions. However, I would like to make a few statements regarding the study. I want to say first that I think you have done a very excellent job in preparing this study with certain reservations.

The main thing I am concerned about is the consumptive use of water which you have set for different valleys in the County. And I believe that is on page 154 if I am not mistaken. If we can just concentrate for a minute on the consumptive use for alfalfa, for instance, I note there in the Tule Lake Basin you have determined that 1.6 acre feet are sufficient for the production of alfalfa. In Butte

Valley you have 1.4 acre feet. Now, in comparing those two valleys, Butte Valley needs a great deal more water for alfalfa production than Tule Lake. Butte Valley soil is principally very fine sandy loam with a low water holding capacity. Tule Lake is a "muck" with a high water holding capacity. So certainly Butte Valley should be allotted considerably more than Tule Lake.

Now, let's go to Shasta Valley. You have 1.9 acre feet, and for Scott Valley you have 1.6 acre feet. Ordinarily we figure that about a quarter of an inch of water is needed daily in alfalfa production, which means about three acre feet per year. Now, I happen to know the methods you used in determining consumptive use and one of them is the Blaney-Criddle formula which I am told is from 18 to 38% inaccurate. And another is your atmometer readings which are from .5 to 8.5% inaccurate. Now, my opinion and not only my opinion, but our studies indicate that we should be allotted just about double the amounts which are contained here.

Now, as far as truck crops are concerned you have allotted 1.1 acre feet for Tule Lake and Butte Valley 1.1 acre feet. Now, in our studies we find that they need about 4 acre feet for truck crops.

As far as re-use of water in the Tule Lake Basin is concerned, it is not a very good practice to re-use it because of the total salt content of the water. Now, another point I had was your figures on evaporation losses from reservoirs. We figure here on Dwinell Reservoir, for instance, from 15 to 20% evaporation loss per month. I have a few figures here. Taking the total holding capacity of the reservoir at 40,600 acre feet, with evaporation loss of 15 to 20% of the water each month, there would only be 15,100 acre feet available at the ranch, and with 9,060 acre feet with 60% efficiency available for irrigation and your water losses by evaporation are very very much less than those figures.

MR. EDSON FOULKE
Gazelle

Mr. Foulke: Edson Foulke, rancher, Gazelle, California. Under Table 2 of this sheet I picked up here it shows projected ultimate irrigation acreage, Siskiyou County, to be 263,600 acres. Table 4, Consumptive Use . . . These are tables in this document—Table 4 of page 13. The ultimate consumptive use of water in Siskiyou County is shown as 483,600 acre feet, which I figure to be approximately 1.9 acre feet. That is a consumptive use. Now, I will turn to Table 5 on page 14, line 1, irrigated lands, which shows water requirements now—as I understand this is not consumptive use, this is water requirements—as 611,200 acre feet, the ultimate. Now, that as I calculate the ultimate water requirement as shown in approximately 2.3 acre feet while the consumptive use is 1.9. My question is: I understood from conversation here a short time ago that these figures, that the consumptive use was practically double to obtain the water requirement and yet as I read these tables, the consumptive use is shown as 1.9 acre feet and the total requirement is only 2.3. I may be confused on this, but I would like to be clarified if I am.

MR. F. L. LATHROP
Siskiyou County Water Board, Yreka

Mr. Lathrop: Mr. Chairman, and ladies and gentlemen, we have on the county level prepared a statement which was not approved or adopted yesterday because we only had three members of the Supervisors. It was postponed until the following week and that final prepared statement will be forwarded to your office. . . .

It is on this basis, Mr. Chairman, it is on the basis of policies and overall position rather than on any criticism of any of the details contained in these two reports.

We are thinking in terms of origin counties and in terms of Federal ownerships and in terms of our local problems here and what we may look toward in presenting favorable legislation on waters of origin and their disposition to deficient areas.

I think you will find interest in it. We have at the local level another statement Mr. Williams might care to make, but I would like to ask a question if I may. At the county level I feel that we have yet a lot of information that has not been provided us in the many studies we have had. I do not think we have any plans yet or any facts on which you can base your water problems in the Butte Valley. We have had very able underground reports that have been made by the U.S.G.S. groundwater studies and today I don't think we have full knowledge of the full yield of the underground basins, nor do we have full knowledge of their recharge and we have not any plans for utilizing the vast flood waters that go into Mead's Lake and flood over the country.

We have flood problems in Butte County. Those problems are being studied by the Bureau. The Bureau has promised to make a plan for that development of Butte Valley and part of the original 1905 projects, but our State has also made studies in there.

The people of this County are very dependent upon Butte Valley's development. It is a vast area, very rich soil, very productive. It must have water and must have drainage. It must have flood control and I don't think the State or the Federal Government have as yet finished any plans that you can say are final because we have in no way as yet taken any steps to put those vast amounts of flood waters underground to recharge the underground. Whether it is geologically possible or engineeringly possible I do not know, but it is a problem. Its got to be solved. We can't do it at the local level.

Another thing that we do know, is that every small upstream storage in this County has not been investigated. We are not interested whether it is financially feasible or not. We have surpluses of water in the spring and winter. We don't know where to put them. We have six million acre-feet running out of this County every year on a normal year. We want small upstream storage. We want to know from some official source where that can be accomplished. I think that is a safe position for us to ride at this time.

We would like further cooperation, may I say, in looking at these things from their ultimate standpoint because we are in that area where water may be exported to other areas. We feel that those exportable waters should first be developed for full local uses, beginning at Northern California instead of other parts because Siskiyou County is the largest county—has the largest amount of surface water of any county in California.

ASSEMBLYWOMAN PAULINE DAVIS
Portola

Assemblywoman Davis: The thing that I am interested in, Mr. Hill, is to see that to the very fullest extent the small tributary streams that feed into the larger streams in Northern California are considered as far as small storage facilities are concerned. Now, I personally feel and I have always felt that if we are going to go into the thought of finances that we first must set up policy as far as the Legislature is concerned, and apply those policies to the financing and see if we can afford them and then after that see how we are going to raise the money to do these things, but I definitely feel that there are two scopes that we are endeavoring to undertake and one is that where there is an export project, that it be the responsibility of the State of California to develop the full basin up above that export project for all uses of water with the cooperation of the local areas, but if they are not in the financial position to do so, it will be responsibility of the State then in other areas such as this where there may never be a direct export project as far as a large structure like Oroville Dam, that we should have something that is going to assist these people on a long-range basis for the construction of some of these small storage facilities that are feasible so that they are not left out of the picture, because that is a very, very important phase. And I think that we are—I personally believe we are not going anywhere on this California Water Plan until we are willing to sit down and stipulate these policies and then apply these policies to money and then after that say where we are going to raise this kind of money to do this and that is, I feel very strongly about it, and I personally feel that some of the Northern California counties have not been given adequate consideration for this type of concept and I say that with all due respect.

I have discussed this with Mr. Banks personally in his presentations throughout the entire state. I do feel that the Department of Water Resources, and I wish and I hope that you take this back to him—I discussed it with him at length that there is more emphasis being placed by the Department of Water Resources at the diversion point of water rather than to where it originates and all I am asking for is a fair play that just as much emphasis is placed on where the water originates and the necessity of the development.

Now, we generalize. Mr. Banks does too. He has been very kind about it. He has recognized that the counties of origin must receive consideration. Reservations are fine but certainly they are not adequate, but of course, we have to have the storage facilities or your reservations are of no earthly good because it is going to be taken away from us in time anyway if we don't put it to beneficial use. So my point is, all I am asking for is the same fair play that is being given to more deficient areas than we are because we too during certain seasons are deficient areas and as far as the emphasis on the need of these storage facilities, they need to be developed and truly I believe that we haven't had that. . . . Then, another comment too—I might as well take my time on the agenda right now . . .

Comments are being made throughout the State that concern me very much relative to two items that Northern California is going to have to horse trade on. First of all, I feel that those choice of words are very poor. Secondly, I don't think that Southern California is offering to Northern California any trade issue, if you want to put it that way.

For instance, they are saying to us, "You either take the wording that we are desirous of having in a constitutional amendment, or we will not renew the State Water filings that come up for renewal this legislative session." Both of them are a disadvantage to us, Mr. Chairman. There is nothing to compromise on and legislation is compromise. So, I feel that if Southern California, with all due respect to them, has the feeling of the pulse of the people of the entire State at heart, which I certainly hope that they have, that they first of all show good faith and renew all of the State water filings at the very earliest date when we reconvene in Sacramento, and then let us try to resolve the wording in a constitutional amendment, if that is what it must be, but I definitely feel that more emphasis and more study should be placed on these areas such as Siskiyou County.

You have had an independent study going in Shasta County which I know you are very much aware of and so am I, but some of the other counties have not had that advantage and I am going to have to smoke my own pipe here because the Division of Water Resources is taking credit for this Northern California investigation and they really were not the author of the legislation, I must admit.

I recall when the Water Resources Board on which you had the privilege of serving and other members when it was enacted in 1933 had the responsibility of making an investigation of all the ultimate needs of water throughout the State, and I recognize that this area of the State just didn't have adequate information, if any, to amount to anything. So I took it upon myself to present this Northern California investigation and I feel once again that we are going to have to urge the Department to appropriate more money to make a furtherance of these evaluations so we can have a true picture when we are in Sacramento, because we are not in a position to engage outstanding attorneys, outstanding engineers such as Southern California that come to Sacramento and say, "This is what we want," and try to establish the entire policy and impose it upon the State of California.

We have to have some consideration from the Department of Water Resources which we have had as far as the staff is concerned, but we need more, and with that I will close.

MR. T.W. WILLIAMS
Siskiyou County Farm Bureau, Montague

Mr. Williams: Mr. Chairman, if it is permissible, I would like to expand this question. I think it is very important, this question on what is going to be considered feasible. Now, in Shasta Valley there is 140,620 acres that is irrigable. That is from the report on ultimate development which is estimated at, I believe the year 2050, when they claim the ultimate acreage to be irrigated is 52,800. Now, that leaves a difference of 87,820 acres. Now, what concerns me is not so much what is being done as far as financial feasibility within the next ten or fifteen years, but if we are looking ahead to the year 2050 and we are going to use the feasibility figure of water that is in the area—I don't know how good their crystal ball is that sets the policy up, but I certainly don't want us in the north here to be stuck with this 52,800 acres. We don't know what power resources are going to become available that might easily make it feasible to irrigate this 87,000 additional acres. Now, that is what concerns me. As far as the present survey that is going on in Shasta Valley now, we will get the information and probably the Legislature will decide what kind of financial benefits we are going to get. I mean that is within the immediate present but what scares me is that if our kids in the future want to develop this land and the waters are gone we have no recourse.

REDDING HEARING

JOINT HEARING OF THE CALIFORNIA WATER COMMISSION AND DEPARTMENT OF WATER RESOURCES

Held at Bridge Bay Resort
Redding, California, September 4, 1958

WRITTEN COMMENTS

STATEMENT BY JOHN F. REGINATO
Shasta-Cascade Wonderland Association

BRIDGE BAY RESORT, September 4, 1958

GENTLEMEN: For the record my name is John F. Reginato, general manager of the Shasta-Cascade Wonderland Association, with offices in Redding, California.

The association is made up of representative businesses in the six counties of Lassen, Modoc, Shasta, Siskiyou, Tehama and Trinity.

Basically, the association is primarily concerned with the development of tourism to northern California. In conjunction with that objective, we are vitally interested in the development of recreational facilities, both by public agencies and private enterprise.

Comprising an area that is to a large extent in federal ownership, a great deal of our recreational planning involves federal agencies, inasmuch as the growth of recreation in California hinges upon proper development of our natural resources, consistent with the multiple use philosophy.

Properly planned development of our recreational resources is therefore of great importance to our area as envisioned under the California Water Plan. Appendix A of Bulletin No. 58, Northeastern Counties Investigation confirms the belief held by many in the Shasta-Cascade Wonderland Association, that recreation will provide a sound economic growth in our six counties—at the top of California.

On page 114 under *Recreation: "a new industry."*, it states— "Historically, the economic life of the northern mountain counties has consisted of timber, mining, and agricultural operations and related service industries. In recent years, however, recreation activity has increased rapidly to a position of major importance in the region's economy. There is now every reason to believe that its future volume will surpass the visions of the far-sighted men who some time ago formed the Shasta-Cascade Wonderland Association to inform the world of the resources of the northeastern mountain counties.

"It appears evident the northeastern counties are on the threshold of enormous growth in the development and use of their recreation resources. These counties have some of the finest mountain country in the state. All or parts of eight national forests are included in their boundaries, plus one national park and one national monument. *The pressure of population upon the older, more developed recreation areas of the state is sending more people into the northeastern counties already each year in search of recreation opportunities.*"

The report further states that by the years 2025-50, it does not seem unreasonable to estimate that the northeastern counties have the potential in natural resources to support recreation activity worth one billion dollars per year or more, at ultimate development and in present dollars, in gross receipts to the construction, retail and service industries of the area.

To break it down further, figures show that the six counties this Association represents will garner 64.1 percent of the recreational dollar. The breakdown is as follows:

Lassen County ______	7.9%	$ 94,800,000
Modoc County ______	7.1%	$ 85,200,000
Shasta County ______	14.7%	$176,400,000
Siskiyou County ____	13.4%	$160,800,000
Tehama County _____	11.5%	$138,000,000
Trinity County ______	9.5%	$114,000,000

The Division of Highways has taken cognizance of the importance of recreation in their $10 billion plan for State Freeways. J. W. Vickrey, deputy State Highway engineer told the Joint Interim Committee on Highways earlier this week, "Travel in this State is dominated by the metropolitan areas of Los Angeles and San Francisco Bay Region and residents of these areas generate two-thirds of California's vehicle miles . . . but trips extend to every region of the State and the increasing demand for recreation facilities have greatly accelerated travel in recent years." It is obvious the Department of Public Works has taken into consideration the need for freeways to take people to the recreation areas of the State.

The reservoirs that will be created by the California Water Plan will provide millions of people throughout this State with recreational opportunities heretofore believed not possible. These recreational opportunities will, however, only be available if the State integrates recreational development plans with the overall objectives of the State's plan of diversion of irrigation, domestic and commercial water, flood control, electrical energy production and the preservation of fish and wildlife.

It would indeed be a setback to California's potential economic growth, and particularly northeastern California, if recreational planning was not integrated into the overall State Water Plan.

To allay and quell any conception of the costs involved in the problem of recreational development, when we speak of recreational facilities we are considering only the *basic minimum facilities,* such as access roads, campgrounds, picnic sites, organizational camps, palatable water, launching ramps and parking areas. We do not concern ourselves here with resort type facilities, which can best be developed by private enterprise.

It is most important that *basic minimum facilities* be established at these reservoir sites. To show the value of the recreational opportunities of these reservoir sites, figures released by the Army Corps of Engineers show that attendance in 1957 at Corps constructed projects reached an all-time high of 84,704,800, an increase of 19.7 percent over the 1956 total of 70,800,000. In 1951 visitation was only 21,020,000. The Corps now has 126 civil works projects open to public recreational use. These projects contain 3,085 access points; 1,346 boat launching ramps; 1,247 boat landings; 1,025 picnic areas; 616 campgrounds; and 220 organized camps.

The use of these Corps sites by the public, as well as other facilities established by the Bureau of Reclamation, U. S. Forest Service, State Division of Beaches and Parks and other agencies has been phenomenal. And, it would be greater if adequate facilities had been provided as part of the development program of the projects concerned.

This problem is especially true here at Shasta Lake, where demand for facilities as mentioned above are lacking. For example, during the July 4 week-end this year, 20,400 man use days of just the camping facilities occurred, and it was necessary for the public to use areas that were not developed for recreational use, creating a fire hazard, as well as a health and sanitation problem.

Inasmuch as the recreational facilities will be used by all of the people of the State, we believe that the State has a responsibility to provide *basic minimum facilities* on a non-reimbursable basis, as is the policy of some federal agencies, as well as state, county and city units of government. This cost of recreation development should be borne by all of the people of the State, and included as an overall cost of any projects.

Precedent is set for development of *basic minimum facilities* on a non-reimbursable basis by both the federal government and the State. The Engle Bill, which calls for construction of the Trinity River Division of the Central Valley Project, clearly specifies that *basic* minimum facilities will be constructed. The Wildlife Conservation Board provides for construction of access facilities, parking and sanitation facilities on a non-reimbursable basis.

A number of bills have been introduced into Congress this past session, which provides that from 10 to 15 percent of the overall cost of a project can be spent for development of recreation facilities on a non-reimbursable basis, and shall be included as a cost of the project. A conspicuous number of Senators and Congressmen are looking favorably upon such legislation.

One of the most recent pieces of legislation passed by Congress this session was a supplementary appropriation bill, which provided $750,000.00 to the Army Corps of Engineers for constructing such facilities as boat launching ramps, roads, water supplies and other basic services at Army Engineers built reservoirs. Congressman B. F. Sisk of Fresno won a major battle in his effort to have Congress establish a policy that the recreational potentials of flood control projects should be developed to meet the country's increasing population and the public's growing leisure time.

The need for basic minimum facilities at reservoir sites is further enhanced by the increase in boating activities—a family type of recreation. Figures compiled by the Outboard Boating Club of America showed that in 1957 35,000,000 persons participated in recreational boating, or about 20 percent of all persons living in the continental United States; $1,912,000,000 was spent at the retail level during calendar year 1957, and of this amount, $391,400,000 was spent for the purchase of new outboard boats, motors and trailers; a total of 7,071,000 recreational craft is in existence on all waters of the United States as compared to 6,686,000 in 1956; there is a total of 5,190,000 outboards in use, including 605,000 new units sold in 1957; and there are 1,300,000 boat trailers in use.

California rates third in the nation in sales of outboard motors accounting for 6.92 percent of the total, exceeded only by New York with 9.41 percent and Michigan 7.26 percent.

From 1947 through 1957, outboard motors in use increased from 1,857,000 to 5,190,000; outboard boats sold jumped from 143,000 to 320,000; and boat trailers sold skyrocketed from 3,790 units to 165,000.

Unquestionably the development of *basic minimum facilities* at State built reservoirs will boomerang the use and sale of boating equipment in California, and although the majority of reservoirs will be built in northern California, recreational use will be by all of the people in California.

The Shasta-Cascade Wonderland Association makes the following recommendations to the California Water Commission:

1. In the planning of State Water Projects development of *basic minimum facilities* be integrated into the overall State Water Plan.
2. That *basic minimum facilities* be constructed as an overall cost of the project on a non-reimbursable basis, inasmuch as these recreational facilities will be used by all of the people of California.
3. Once the *basic minimum facilities* are constructed, the State give consideration to allow operation and maintenance of the facilities by another state agency, county, district or city governmental unit.
4. That in the acquisition of lands for state water projects sufficient lands be acquired around the reservoir site for development of *basic minimum facilities*, and that sufficient land be acquired around the perimeter of the reservoir to insure public access in perpetuity.
5. That inasmuch as the preservation of our fish and wildlife is a non-consumptive use of water, special emphasis be placed on conserving this natural resource.
6. That in the elimination or destruction of natural spawning areas, that consideration be given to restoring tributaries to provide suitable natural habitat, and where necessary hatcheries or egg taking stations be constructed, particularly for the preservation of the anadromous fisheries.

We appreciate the privilege and opportunity of appearing before the California Water Commission. We sincerely hope that the Commission will give consideration to meeting in the Shasta-Cascade Wonderland area again in the near future. Thank you.

STATEMENT BY TEHAMA COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT

Bridge Bay Resort, September 4, 1958

We in Tehama County have two questions relative to the Northeastern Counties Investigation.

First is in regard to the amount of land considered irrigable. Sheets 10, 11, and 13 of Plate 4 show relatively small amounts of hill land in hydrographic units 24, 26, 27, 28 and 29 have been classified irrigable.

In this area there are considerable areas of land we believe to be irrigable but cannot be sure it has been considered such by the Department.

Second is in regard to the amount of water allowed per acre. Table 37 indicates 297,200 acres may be irrigated in Tehama County under full development. Table 62 shows an allowance of 896,900 acre feet of water for irrigation. This is slightly over 3 acre feet per acre. On the basis of experience on lands we are now irrigating, we question the adequacy of this allowance.

We recommend the Department of Water Resources make no projections of surplus water supplies until we can be certain that all potentially irrigable land has been included and that enough water has been allowed for it.

/s/ Lynn Raymond
Tehama County Board of Supervisors

/s/ John L. Moran — Chairman
/s/ O. L. Sutfin — Member
Tehama County Flood Control and Water Conservation District

/s/ Alvin Lanphear — Chairman
/s/ Fred H. Weeks — Member
Tehama County Planning Commission

STATEMENT BY HARRY D. GRACE
Assistant Forest Supervisor
Shasta-Trinity National Forests

Bridge Bay Resort, September 4, 1958

Chairman Hill, members of the Commission, Mrs. Davis and guests: My name is Harry D. Grace, Assistant Forest Supervisor, Shasta-Trinity National Forests with headquarters in Redding.

I wish to make a brief statement concerning the need for studies of administrative impacts of water storage developments on National Forests lands, and which could apply to State, County and private lands.

Twenty-five years ago the water development planners interested in water storage facilities were principally concerned with one or two uses—water for irrigation, flood control and hydro-electric generation.

The job of the water development planner is now one of planning so that uses and services will be combined in such a manner that they are complimentary, insofar as obtainable. This is the multiple use concept.

The Trinity River Project was one of the first to plan for these multiple use problems on National Forest lands. Shasta Lake is an example of an area which was not studied in detail before construction. As a result, recreational use is greater than the recreational facilities will handle. Even though facilities are lacking, the public camps in the surrounding area, creating fire control and sanitation problems.

In the early stages of planning for the Trinity River Project—1950 to be exact—the Bureau of Reclamation requested the National Park Service to make a study of the Recreational potential in the Upper Trinity River area. This study was completed in December 1951. This report established the need for more detailed recreation planning in the area. It also brought out possible conflicts with other planned uses of the area.

In 1952 the Bureau included an estimate of the cost of recreational impact in their report to Congress.

Then in 1954, the Bureau of the Budget included an estimate of \$215,000 for recreation in its report to Congress.

When Congress approved Public Law 386 in 1955, this amount of money was set up for Public Use minimum basic facilities.

In addition, Public Law 386 also authorized the Bureau to finance an Impact study of the area. This study was made by the Forest Service at a cost of $45,000.

The report, "Impact of Trinity River Project upon National Forest Administration" was prepared by the Shasta-Trinity National Forest.

Two years were spent in studying the problems and outlining proposed solutions for the management of the local natural resources plus impact upon fire, roads, administrative improvements and ranger district work loads.

It brought out the fact that the professional work load adjacent to the two proposed lakes would be increased by nearly 100%. A new ranger district was created and the two adjoining ranger district boundaries were adjusted.

It is interesting that the greatest single impact on National Forest administration was created by the estimated recreational need.

It was estimated that the annual recreational use of the area would jump from the present 3,900 camper-use days per year to 17,600 camper-use days per year in 1970. This is seven years after completion of the dam.

To handle the camper load alone would require 300 family campground units by 1970.

Unfortunately the $215,000 will only construct approximately 30% of the facilities needed by 1970. However, it is a step in the right direction—that of planning the financing of such use.

The Forest Service plans to construct approximately 150 camp units with this money, plus roads to one summer home tract, one picnic area and two boat launching ramps.

This type of study is now considered a must by Forest Service administrators. We understand it will continue to be a policy of the Bureau of Reclamation to conduct such a study on all future projects. We trust that the commission will consider studies of this type in their planning for California State Water developments.

STATEMENT BY SHASTA COUNTY BOARD OF SUPERVISORS

Redding, California, September 15, 1958

Mr. Harvey O. Banks, *Director*
State Department of Water Resources
P.O. Box 388, Sacramento, California

Dear Mr. Banks: Enclosed for your consideration are the official comments of Shasta County on Department of Water Resources Bulletin No. 58, Northeastern Counties Investigation, and the statement prepared by Joseph E. Patten, Manager of our Department of Water Resources.

Our greatest concern regarding the contents of the report is related to the treatment of evaporation from reservoirs and the figures used for consumptive use of applied water. It is our understanding it will be a relatively simple matter to make the necessary corrections to clarify the relationship of evaporation to other consumptive uses. In regard to the consumptive use figures for irrigation, however, we realize there is an extreme lack of basic data. In any event, it would appear revisions in these figures would tend to be upwards and for this reason we feel that the consumptive use figures appearing in the report may leave the wrong impression as to ultimate requirements for the area.

We will be very happy to work with your staff as may be necessary to work out any differences of opinion regarding these two items. Our Department of Water Resources has been directed to cooperate fully with you on this matter.

Respectfully yours,

A. T. Jessen, Chairman
Shasta County Board of Supervisors

STATEMENT BY JOSEPH E. PATTEN
Manager
Shasta County Department of Water Resources

Bridge Bay Resort, September 4, 1958

My name is Joseph E. Patten. I am manager of the Shasta County Department of Water Resources and am appearing on behalf of the Shasta County Board of Supervisors.

We sincerely appreciate this opportunity to again appear before the California Water Commission and the Department of Water Resources to express our views regarding investigations related to the planning and construction of The California Water Plan.

In accordance with the Director's letter of April 28, 1958, we have reviewed Bulletin No. 58, The Northeastern Counties Investigation, and are here submitting our comments for your consideration. I am not going to read all of these comments, however I do wish to discuss certain of the principal points contained therein.

We are very pleased to see the compilation of data contained in Bulletin No. 58, which is in much more detail than was contained in Bulletin No. 2 of The California Water Plan. This, of course, is of great interest to us as is well pointed out in the report itself because of the need for such information as related to the so-called counties-of-origin problem. We are well aware of the history of the Legislature declaring its position time after time in regard to the protection of the areas of origin as to its rights to water originating therein. We certainly hope the Legislature will continue to make this declaration and we as a county of origin are ready and willing to assist in any way possible to bring about a fuller understanding of the problems that are involved.

So that you do not get the impression that we are only concerned about our own interests, let me say that we are also interested in the data which will be available in Bulletin No. 58 as a guide to that amount of water which is surplus to the areas of origin and could and should be made available to other areas where it can be put to beneficial use.

Not only are we interested in this report from the standpoint of the so-called water rights issue, but as Appendix A so very well demonstrates, there is a great economic future ahead for all of the Northeastern Counties under this investigation which will result from the expansion of industry and recreation. The report refers to recreation as a new industry to the area. I prefer not to think of it as a *new* industry but rather one which is just now being visualized as regards its potential. I don't care to review the entire history of the economy of this area except to say that the rapid population migrations caused by the two world wars and abrupt initiation and cessation of various mining operations for gold, as well as other metals and minerals, have adversely affected the stability of the area. We can look forward, I am sure, to a greater and more stable economy stimulated by both new industries and recreation.

By far the greatest potential consumptive user of water in Shasta County is our land suitable for agricultural development. Because we anticipated this at the beginning of the investigation we worked very closely with the staff of the Department making the land classification surveys throughout the area. In connection with this phase of the investigation we wish to commend the Department and the staff on their efforts to cooperate with us. Since this work was done here in the local area we were able to work with the field personnel and except for substantially minor differences of opinion we were able to reach rapid agreement as to irrigability of our lands. Also, in this connection I would like to take this opportunity to publicly express my appreciation for the cooperation of our own agricultural people in Shasta County and the Shasta County Water Resources Board. Because of this cooperation we find no quarrel with the data contained in the report regarding any phase of the land classification survey.

For all practical purposes, my discussion and our concern here today will center around the subject of water utilization and requirements. More specifically, our interests are in:

(a) The figures contained in Table 44, "Estimated Mean Seasonal Unit Values of Consumptive Use of Applied Water on Irrigated Crops Within the Northeastern Counties."

(b) The manner in which you treat evaporation as a consumptive use.

Irrigation Water Requirements

The estimated mean seasonal unit values of consumptive use of applied water on irrigated crops within the Northeastern Counties as shown in Table 44, in our opinion, are entirely inadequate. Sufficient data are not presented in the report to substantiate the figures contained in this table. Until such data is presented to us in such a manner as to convince us of their validity we cannot accept them. It somewhat surprises me that under the heading of "Irrigation Water Use," page 149, you discuss the research program on consumptive use and soil moisture depletion caused by the growing of various crops under irrigated conditions but do not tabulate data therefrom nor make use of it. In the paragraph discussing this subject it is stated, "Although much valuable data was gathered during the three-year investigation period it was not adequate to provide the basis for new estimates of unit values of consumptive use throughout the northeastern counties." We seriously question the validity of this statement. Several atmometer stations were established throughout the county and fairly good records maintained. As a matter of fact, we cooperated on the maintenance of these stations. In addition, full season records of moisture depletion tests were kept and these also were substantially good records. These data were never published nor made available in full to our people in the local area. What fragmentary information we do have in this regard, however, indicates that the information should have been used in this report and would substantially increase the figures used in Table 44. Under this same heading, the Blaney-Criddle method of determining values of consumptive use is discussed as the method used in the report. This formula is not always reliable because it is based on a limited number of elemental factors.

Again we are particularly concerned with the extremely low figures used for the hydrographic units such as McArthur, Hat Creek, Montgomery Creek, etc. This is probably because the Blaney-Criddle formula is least reliable at the higher elevations. I refer you to Shasta County's comments on Bulletin No. 3, The California Water Plan, just two years ago, September 7, 1956. At that time the same question was raised and it was raised on the basis of information that was available from the Northeastern Counties Investigation as related to soil moisture depletion studies. It was found at that time that the consumptive use for agricultural crops was approximately the same in the higher areas as it was for the Sacramento Valley.

The figures in this single table have tremendous bearing on the figures in practically all of the following ones. They are of great interest to us because they affect the greatest potential consumption of water and we want to be realistic about the quantities that are used in this report. We therefore request that appropriate changes be made in these figures.

Along this same line, may I call to your attention the fact that the conversion from Table 54, "Probable Ultimate Mean Seasonal Water Requirements," to Tables 55 and 56, which show Mean Seasonal Depletion of Water Supply, is not clearly explained in the report. There is insufficient basic data to check the conversion. It may not be necessary to include in the report such detail, however this information is necessary for us to properly analyze the figures presented in the final tables.

Evaporation

There is serious need for clarification of the use of the terms "evaporation" and "net evaporation" as they apply to consumptive use and net depletion in water supply in this report. At one point in the text of the report it is stated that transpiration and evaporation from land surfaces that have been artificially wetted by irrigation are the only actual physical losses to the quantity of water in the stream basin. On the basis of this statement alone, the effects of evaporation appear to be somewhat belittled. Evaporation from the surface area of artificial reservoirs is a non-recoverable consumptive use which is not of little significance. For example, documented records of total evaporation at Shasta Lake for the past five years indicate an average of over 108,000 A.F. per season. I fully realize the net evaporation is somewhat less than this figure; however, it is not zero as is indicated in the report.

The term "net evaporation" is found in several points throughout the text of the report as well as in tables and is defined in the report as "the difference between mean seasonal precipitation and mean seasonal water surface evaporation." As expressed in the report, this definition is used for evaluating consumptive use of evaporation from water surface areas of all reservoirs under ultimate development of The California Water Plan in the northeastern counties area. The application of net evaporation as defined and applied in the report technically is not correct. Total evaporation from reservoir surfaces is a complete loss and must be treated as a consumptive use charged against the project. Only evaporation which took place from the reservoir area prior to inundation can be considered a legitimate reduction in the total evaporation to arrive at a net figure.

The generally accepted figure for net evaporation in the foothill areas in north Sacramento Valley is 3 to $3\frac{1}{2}$ feet of depth. This is predicated upon the fact that total evaporation is in the neighborhood of five to six feet of depth, from which you would deduct that amount of precipitation which would not have appeared as runoff from the reservoir area under natural conditions.

Within the Shasta County area we are quite concerned that there is no net reservoir evaporation listed in the report for the following hydrographic units: Montgomery Creek, McCloud, Dunsmuir, Shasta Lake, Clear Creek, and Keswick. The areas for principal reservoirs as shown in the report for these hydrographic units total 38,300 acres. On the basis of a net evaporation figure of something over three feet you are talking about approximately 120,000 A.F. per year consumptively lost through evaporation from these reservoirs. As applied to the total principal reservoir areas in the 15 counties, the report is short on net evaporation losses to the tune of approximately 1 million acre feet.

We are vitally interested in presenting evaporation and its effect upon reservoir operations, etc., in its proper perspective as related to who is charged with the loss. Basically, the bulk of the reservoirs considered in this report for ultimate development are for export water. We must be careful not to neglect this loss, nor to commit water for export without its consideration as a reduction in the gross yield from projects. We as an area of origin do not want to be charged with those losses except as in relation to the proportionate share of such reservoirs which are used for local purposes. Under the circumstances some clarification must be made of the treatment of evaporation as it is related to consumptive use in this report before it can be acceptable to Shasta County.

Appendix A dwells in considerable length on the recreation potentialities of the area under investigation and suggests that Shasta County has a slight advantage over the others as to ultimate development. So also Bulletin No. 58 itself discusses recreation and its potentialities as an industry, utilizing the natural resources of the area. Because of many statements by various parties interested in water development which have emphasized possible *conflict in use,* I would suggest that more emphasis be placed upon the *non-consumptive* part recreation plays in water development. In the majority of cases the use of water for recreation purposes, or more properly stated, the greater realization of our natural resources through recreation by virtue of the presence of water, is a non-consumptive use which is incidental to the primary purpose of the development. There are proposed such reservoirs as some of those in the upper Feather River Basin which would be designed primarily for recreation, or more specifically for stream flow maintenance. In this case there would be some net loss in water chargeable to recreation by virtue of the evaporation losses. The use of water for stream flow maintenance in the upper watershed generally adds to the total water supply downstream.

To clarify a misconception which apparently is widespread among even so-called water experts that large quantities of water are to be consumed by recreation, we feel that a specific discussion of this problem should be contained in the report. If there is concern regarding financial responsibilities, etc., associated with recreation, that is another subject separate and distinct from the physical consumption of water. I have restricted my comments to the subject of Bulletin No. 58—primarily, water utilization.

In conclusion, I wish to thank the Commission and the Director for this opportunity to be heard and request that they review Bulletin No. 58 figures on the net depletion in water supply, both as related to irrigation water and net evaporation from reservoirs in Shasta County. We will be very happy to work with your staff toward agreement as to what figures should be used.

SUPPLEMENTAL STATEMENT BY JOSEPH E. PATTEN
Manager
Shasta County Department of Water Resources

BRIDGE BAY RESORT, September 4, 1958

Under the heading of "Agriculture" on page 37, the statement is made that "strawberry plants are a relatively new crop . . ." Strawberry plant production on a commercial basis has been carried on for over 35 years in Shasta County, starting in the Sacramento River canyon near Delta.

In Table 6 on page 37, Grover and Wilcox Ditch should be changed to Gover and Wilcox Ditch. In addition, the Cook-Butcher Ditch, Bella Vista, serving 300 acres, should be added to this list.

On the bottom of page 37, reference is made to law suits resulting from smoke damage resulting from early copper smelter operations in Shasta County. Since it was the acid fumes that caused the damage it might be more appropriate to refer to this as damage resulting from air pollution.

Reference is made on page 105 to the unfitness of Spring Creek water for *most* beneficial purposes during periods of low flow. Except after dilution by Sacramento River water these flows are not fit for *any* beneficial purpose during low periods of flow.

Getting into the discussion of water utilization, and more particularly consumptive use, on page 148, it is stated "For practical purposes these two losses [transpiration and evaporation from land surfaces that have been artificially wetted] of irrigation water, known as 'consumptive use,' are the only actual physical losses to the total quantity of water in a stream basin." Evaporation from the surface area of artificial reservoirs is a consumptive use or loss of water which is not of little significance. Documented records of total evaporation at Shasta Lake for the past five years indicate an average of 108,000 A.F. per season. This is an irrecoverable loss.

Under the heading of "Irrigation Water Use", page 149, there is a discussion relative to research on consumptive use and studies on soil moisture depletion caused by the growing of various crops under irrigated conditions. In the paragraph discussing this subject it is stated, "Although much valuable data was gathered during the three-year investigation period, it was not adequate to provide the basis for new estimates of unit values of consumptive use throughout the northeastern counties". We seriously question the validity of this statement. Several atmometer stations were established and fairly good records maintained. In addition, full season records of moisture depletion tests were kept and these also were substantially good records. These data were never published or made available in full to any of the people in our area, however the fragmentary data that we do have indicates this information should be used.

Under this same heading, on page 149, the Blaney-Criddle method of determining consumptive use of water is discussed as the method used in the report. The Blaney-Criddle formula is not always a reliable index of consumptive use of water by plants. In Hilgardia, Vol. 24, No. 9, Veihmeyer and co-workers report errors ranging from 14 to 38 percent. By contrast, errors by the atmometer method ranged from 0.2 to 8.5 percent. The formula is least reliable at higher elevations, resulting in an unreasonably low figure for consumptive use in the Fall River Valley.

Table 44, on page 154, summarizes the estimated mean seasonal unit values of consumptive use of applied water on irrigated crops within the northeastern counties. There are substantial differences indicated for the same crop at various hydrographic units. It is our firm belief that the data gathered in the three year determinations indicate that these figures should be substantially higher, particularly in the area such as Fall River Valley. The Department's own figures on the atmometer readings would indicate this to be true. In addition, we note that the value for consumptive use for deciduous orchards is only about 56 per cent of the consumptive use figure for alfalfa. Veihmeyer, using alfalfa as the standard, rates the consumptive use of walnuts at 101 per cent, peaches at 82 per cent and prunes at 81 per cent. Table 43 rates deciduous orchards at 76 per cent of the value for alfalfa.

As discussed above, the data gathered from the moisture depletion studies was not made available to us in full but the fragmentary information we do have indicates that all of the figures in Table 44 are substantially low. In particular, we are concerned with the extremely low figures used for the hydrographic units such as McArthur, Hat Creek, Montgomery Creek, etc. I refer you to Shasta County's comments on Bulletin 3, September 7, 1956, at which time this same question was raised and it was raised on the basis of information that was available at the time from Northeastern Counties Investigation.

In several places throughout the report, in tables as well as in the text, there are references to evaporation from reservoirs which is considered as a consumptive use. This is an irrecoverable loss and is a substantial one which needs some clarification as to its treatment throughout the report. In this regard there is a paragraph under the heading of "Use of Water for Recreation Development", on page 156, which deals with evaporation and gives a definition of the term as used in the report. This paragraph also implies that evaporation is a consumptive use chargeable against recreation. There is no relationship between evaporation and recreation except in the case of a single purpose recreation reservoir and chances are that will be for the enhancement of fish and wildlife.

In this same paragraph the term net evaporation is defined as the difference between mean seasonal precipitation and mean seasonal water surface evaporation. This definition is used as explained on Page 162 for evaluating consumptive use of water by evaporation from water surfaces of all reservoirs under ultimate development of The California Water Plan in the northeast counties area.

The application of net evaporation as herein used is not technically correct. Total evaporation from reservoir surfaces is a complete loss and must be treated as a consumptive use charged against the project or the specific reservoir. Evaporation which took place from the reservoir area before inundation is the only legitimate deduction from total evaporation to arrive at a net figure. Generally, the evaporation under the natural condition is less than 2 feet.

In the case of some reservoirs which fill every year the precipitation occurring during winter months cannot be applied as a net reduction to the evaporation which occurs during the summer season.

Even for reservoirs providing long term carry over storage the generally accepted figure for net evaporation in the foothill areas of north Sacramento Valley is 3′ to 3½′ of depth. Precipitation occurring on these reservoirs during the winter months cannot be fully applied as net reduction in evaporation. The only effect as to net increase in precipitation by virtue of existence of the reservoir is the net decrease of losses experienced by the conditions of "before" and "after" reservoir. This effect is minor and applies only to that amount of precipitation which would not have appeared as runoff under natural conditions.

Under the heading of "Net Reservoir Evaporation" in each of the tables from No. 48 through No. 54, figures are shown which are not at all clear as to their derivation and in other cases true net evaporation is completely ignored.

In Tables 50-51 and 53-54, net reservoir evaporation for Stillwater Plains hydrographic unit is 26,000 A.F. We question whether there are reservoirs planned within this hydrographic unit sufficient to show such evaporation losses.

In these same tables there is no net reservoir evaporation for the following hydrographic units: Montgomery Creek, McCloud, Dunsmuir, Shasta Lake, Clear Creek and Keswick. As previously mentioned, total evaporation from Shasta Lake over the past five years has averaged 108,000 A.F. per year. Most of this is a loss of water over and above that which would have occurred under natural conditions and is therefore an additional consumptive use.

The low figures shown in Table 44 for consumptive use of applied water are reflected in all of the figures under the heading of "Irrigated Lands" in Tables 48 through 56. These figures should be raised in accordance with revised figures for Table 44.

There is insufficient data presented in the report to adequately explain the conversion of figures contained in Table 54 to those in Tables 55 and 56. There is some discussion as to use of return flows, etc.; however, it is totally inadequate to check one against the other.

In the summary and recommendations on page 179 there is discussed principles adopted by the legislature re protection of areas of origin, etc. Referring to the principles in Section 11460 of the Water Code, the Watershed Protection Act, the text uses the term "areas *contiguous* thereto." This should be "areas *adjacent* thereto."

Again there is reference to evaporation in the summary and recommendations on page 182 under the heading of "Water Requirements." The term net evaporation losses is used which needs to be clarified as to its application.

In appropriate places throughout the report there is substantial discussion regarding recreation and its potentialities as an industry utilizing the natural resources, particularly water to make it available. In the discussion of this subject, however, on page 171, under the general heading of "Water Requirements" there is no specific nor clear reference to the nonconsumptive uses of reservoir waters for recreational purposes. Because of many statements made by various parties interested in water development which have emphasized possible *conflict in use,* it should be clearly stated in this report that such uses are incidental to the primary purpose of development. In such cases as reservoir developments primarily for recreation and for stream flow maintenance the only consumptive use of such water is the loss by evaporation from the water surface. The use of water for stream flow maintenance in the upper watershed generally adds to the total water supply available downstream.

STATEMENT BY RALPH W. CARLSON
Butte County Farm Bureau

BUTTE COUNTY FARM BUREAU
OROVILLE, CALIFORNIA, September 24, 1958

MR. CLAIR HILL, *Chairman*
California State Water Commission
Sacramento, California

DEAR SIR:

I am enclosing a written statement concerning reservation of water for Butte County. This is to supplement my remarks at the hearing before your Commission at Shasta Lake on September 4, 1958.

Yours truly,

/s/ Ralph W. Carlson
Water Problems Department

Bridge Bay Resort, September 4, 1958

As chairman of the Butte County Farm Bureau Water Problems Department, I, Ralph W. Carlson, present the following remarks:

Butte County Farm Bureau Water Department is a committee composed mostly of experienced agriculturists. We have had—either sitting in on our committee, or assisting us in our studies at various times—directors of irrigation districts, farm advisors, agricultural commissioners, the Butte County Public Works Department head, and also members of the State Water Resources staff.

Our findings in regard to "Reservations for Water for Butte County" show that our conclusions differ from those of the State Department of Resources.

Our facts were arrived at after a careful survey by a qualified engineer who was also a former head of an irrigation system in this County. As a result of our study we find the "Reservations" by the State failed to provide water for some 84,000 acres of land which we consider irrigable and which is as follows:

62,000 acres foothill land
approx. 7,000 acres shallow "doodlebug" dredge tailings
approx. 5,000 acres bucket-line dredge tailings

The 62,000 acres mentioned above are easily adapted to clover or pasture land and, in some areas, deciduous and citrus fruits. I draw your attention to one particular ranch in clover production as an example: very representative type soil topography, which raised 400 lbs. seed per acre, valued at $480.00 per acre.

We can point out hundreds of acres between Oroville and 99-E highway now in irrigated pasture or under development. The same is true of land east of the Feather River to a lesser degree due to *lack* of *water*. We can trace citrus production on similar land in the Oroville-Wyandotte system.

Considering the 7,000 acres shallow dredge tailings in the Wyandotte-Honcut-Palermo area, we find much of this land has already been leveled; some planted to olives and some planted to pasture grasses.

The 5,000 acres of deeper tailings also show development. Much of this lies just south of Oroville. A considerable acreage has already been leveled and utilized as commercial and industrial property, for which water is also necessary. Area of this type can to some extent be utilized for deciduous fruit or nut trees, as evidenced by a small acreage planted east of the city of Biggs at the end of Walnut Avenue.

Further evidence that these areas have not been given due consideration for water use: I recall—in answer to a question at a meeting of our Department on April 30, 1957—Mr. Teerink and Mr. W. Fairbank of the Department of Water Resources stated that no water had been allocated for use in the area east of the Feather River. This is part of the area mentioned earlier in this report. I may also point out that possibly this area was omitted because it could not be served by water from Oroville Dam Project without relifting.

We also believe a second look should be taken at the calculations of return flows and also of consumptive uses. Butte County is concerned in the reservation of adequate water necessary to realize full potential production. Many crops will grow with little water, but production is increased by the addition and use of water in proper amounts. Production in many orchards has doubled by the addition of irrigation.

VERBAL COMMENTS

RALPH W. CARLSON
Butte County Farm Bureau

Mr. Carlson: Chairman Hill and Commission, I have no written statement today, but I would like to make a few remarks regarding what we have found in Butte County in our studies. Unfortunately, of course, our County Department of Water Resources Head is in Turkey at the present time and will be there for some time, and this meeting probably caught us in an awkward position. But, we are particularly concerned in regard to the unit water requirement as set up in the Bulletin. Our discussions with water district heads, directors and our studies on actual per unit use do not bear out the figures as set up in this Bulletin and Butte County has made a study as to irrigable acres, which do not coincide with the findings of the Department in that regard. Something around 84,000 acres that we in our studies show to be irrigable and of great value for agricultural land or pasture land, irrigated pasture, will need water and that is about all I have to say at the present time. I would like to send you a prepared statement right away. . . .

At the time Mr. Marshall Jones was our Director of Butte County Water Resources Board, under his leadership this study was made and it was pretty conservative and pretty accurate and due to the changes of type of agriculture and the type of land being used, we feel sure that figure is conservative, that figure of 84,000 acres.

As a rule I would say they are on the margin between—on the foothill areas between the upper lands and the valley areas. It is on the fringe. There is quite an area that—some would go into citrus fruits and a great deal of it at the present time is being developed for irrigated pasture by using wells and so forth and other types of irrigation available to it, and I think our agricultural commissioner here who is a member of the County Water Resources Board will make the same report or similar remarks. . . .

You probably know where the Oroville-Wyandotte District is. This is the area immediately below that in the low rolling foothill area primarily. I wouldn't say that is it in total. There is also considerable land, river bottom land, that was originally dredged but it is being reclaimed and planted to orchards and also it is classed as non-irrigable by the Department and we are finding through practical uses that it is being developed and it is of considerable value.

MR. FRED R. PLATT
Agricultural Commissioner, Butte County

Mr. Platt: My name is Fred R. Platt, Agricultural Commissioner and Secretary of the Butte County Water Board, and I am appearing in behalf of the Butte County Board of Supervisors. I will go into this item of soil, land classifications in a little bit. This prepared statement I will have mimeographed and available for you.

To the California Water Commission and the Department of Water Resources, Gentlemen:

Butte County citizens are concerned about the present figures of the State Department of Water Resources for the ultimate water requirements for Butte County.

We appreciate the untiring efforts of their personnel and realize they worked with budget and time limitations plus method of observation and calculation which did not give the proper answers in some cases.

Crops and crop patterns have historically changed in agricultural areas. We must admit the pattern is now toward crops and double-cropping with as high or higher water use and it is safe to plan in this direction.

But, the County is concerned about a number of items and methods used in Bulletin 58 entitled "Northeastern Counties Investigation" by the Department of Water Resources. We respectfully request that the following problems be restudied and more practical approaches be used.

1. That the necessary laws or machinery be developed so that water requirements can be changed in the future as conditions change.

2. The farmers of Butte County have many misgivings regarding the State's amounts of water for specific crops. They feel some are not too far off while others are seriously deficient.

3. We are concerned about the efficiency factors of irrigation which are too high for many crops from a practical standpoint.

4. We would request a restudy of reservoir, canal and ditch losses through evaporation and seepage before it reaches the farmer's headgates. The consumptive use of the evaporation is of concern.

5. We request a restudy of the return flow of water use to surface streams as well as the underground. We feel the Department figures are too high for our County.

6. The shallow-type soils (often with some outcroppings) of our low and medium foothills have thousands of acres classified by the Department as non-irrigable. Recently, our County Water Board made a survey in the field and found over 84,000 acres of irrigable land which the Department called non-irrigable. This figure is very conservative. The figure of 84,000 acres with Department figures for water use would require some 280,000 acre feet of additional water.

We request a revision of the standards for lands called non-irrigable to be followed by a resurvey of these lands.

7. In conclusion, we must remember that acres of irrigable land and crop requirement of water quickly vary water requirements by tremendous amounts.

We will be very happy to discuss these problems further with the Department personnel. Thank you for the opportunity of appearing at this hearing.

MR. E. I. LANE
Butte County

Mr. Lane: Mr. Chairman and gentlemen of the Commission, first my name is E. I. Lane, resident of Oroville, Butte County, and before I read my little prepared statement I want to tell the Board that I live in about the middle of this disputed land, this 84,054 acres, and I am, I think, successfully farming it into almonds, oranges and olives, and Butte County in that particular locality has, we claim, the best olives in the State or as good as any at least and they are planted on this rocky land that the State has classed as non-irrigable. In fact, when I bought my land there I asked an old friend of mine, an olive grower for many years, about buying this particular place. He asked me if it had rocks or whether it was gravel and I in my ignorance thought the gravel land was the best, but I told him it was rockier than the dickens. He says, "It is all right then, take it." And I did and I haven't been sorry for it and I could demonstrate that anytime to any committee that wants to come, not only on my place, but all the surrounding area. I am an ex director of the Oroville-Wyandotte Irrigation District and know pretty well that country.

Now, in regard to the ridge lands, that is in this 84,000 acres, there are only a few thousand acres included in that and it can be and has been and is being reclaimed profitably now.

In offering these figures of Butte County's water requirements I am taking the Department of Water Resources' own figures for acreages and crop pattern, with one exception as noted later. The State's figures were for water at farm headgate while my figures are for point of diversion, mostly from 5 to 25 miles distant, and are also based on the experience of actual users for the different crops and for rather large acreages up to a couple of thousand; for while a test plot or small acreage may be able to get by with a certain amount of water per acre, that amount must be increased considerably in actual practice for larger operations, as you will no doubt agree.

With the above in mind I submit the following figures for the amounts required at point of diversion for Butte County water needs.

- Alfalfa, 17,800 acres at five acre-feet per acre, 89,000 acre-feet.
- Irrigated pasture, 102,100 acres at five acre-feet, 510,500 acre-feet.
- Deciduous fruit, 54,500 acres at three acre-feet, 163,500 acre-feet.
- Citrus fruit, 15,100 acres at three acre-feet, 45,300 acre-feet.
- Truck crops, 11,111 acres at three acre-feet, 33,000 acre-feet.
- Rice, 95,000 acres at three acre-feet, 760,000 acre-feet.
- Field crops, 50,000 acres at three acre-feet, 150,000 acre-feet.
- Hay and grain, 12,900 acres at two acre-feet, 25,800 acre-feet.
- Miscellaneous field crops, 50,000 acres at four acre-feet, 200,000 acre-feet.
- Urban uses, 41,200 acre-feet, which I have no figures to dispute.

In addition to the foregoing state figures on acreage, there must be added the 84,054 acres that the State has classed as non-irrigable, but the county hired a competent irrigation engineer, who made a careful survey and sampling inspection of the area and is ready and available to substantiate its findings before your or any state board.

This land is the same class as is now being irrigated in the Oroville-Wyandotte Irrigation District with water costing $9.00 per acre-foot. That is what we pay for water, gentlemen, some of it being in said district. Some of this land is really in our Oroville-Wyandotte Irrigation District. The balance is adjoining.

On a recent landowner survey of future plantings in this area present owners stated they would plant over 85 per cent to irrigated pasture, and less than 15 per cent to fruit, and the survey covered over 30,000 acres, so using those percentages there would be irrigated pasture at 85 per cent of 71,446 acres at five acre-feet per acre, which would make 357,230 acre-feet and 12,608 acres of fruit at three acre-feet per acre, a total of 37,820 acre-feet which together with the balance carried from the previous total of 2,017,800 acre-feet makes a total of 2,412,854 acre-feet as now estimated. However, with new methods for uses of water this may be substantially increased and likewise if more land that is now classed as non-irrigable by the State is found to be irrigable enough to properly irrigate such lands more water will be needed. Thanks for your consideration.

MR. JOHN L. MORAN
Tehama County Flood Control and Water Conservation District

Mr. Moran: We don't have this statement mimeographed. We can get it mimeographed if it is necessary. That represents, Mr. Chairman and gentlemen, the feeling as represented here today by the Board of Supervisors of Tehama County Flood Control and Water Conservation District, and the Tehama County Planning Commission. As Chairman of the Tehama County Flood Control and Water Conservation District I am not too familiar with this. Our District is one year old. We haven't had a chance really to get into this very much and we have brought along today from Tehama County a man who has studied this for many years and I am going to ask him to make the comments on this summary as we have presented it. Mr. Lee Frye, of the University Extension Service, who is a farm advisor of Tehama County—Mr. Frye.

MR. LEE FRYE
Farm Advisor, Tehama County

Mr. Frye: Like Mr. Moran said, we don't have mimeographed copies of this to pass out. However, one has been passed forward. I will first read this brief statement and then if there are questions, we can elaborate on it from that.

"We in Tehama County have two questions relative to the Northeastern Counties Investigation.

"First is in regard to the amount of land considered irrigable. Sheets 10, 11, and 13 of Plate 4 show relatively small amounts of hill land in hydrographic units 24, 26, 27, 28 and 29 have been classified irrigable.

"In this area there are considerable areas of land we believe to be irrigable but cannot be sure it has been considered such by the Department.

"Second is in regard to the amount of water allowed per acre. Table 37 indicates 297,200 acres may be irrigated in Tehama County under full development. Table 62 shows an allowance of 896,900 acre feet of water for irrigation. This is slightly over three acre feet per acre. On the basis of experience on lands we are now irrigating, we question the adequacy of this allowance. We recommend the Department of Water Resources make no projections of surface water supplies until we can be certain that all potentially irrigable land has been included and that enough water has been allowed for it."

I might add in regard to where this land lies, starting in about immediately from Red Bluff and from there south, in the study it shows stringers of land running up into that area has been classed as irrigable. Now, within that area there are considerable areas of a deep soil out there, that really are good class of land. As near as we can tell from the maps they have not been included. Unless there are questions, that concludes the statement.

MR. HARRY D. GRACE
United States Forest Service, Redding

Mr. Grace: Chairman Hill and members of the Commission, Mrs. Davis and guests, my name is Harry D. Grace, and I am assistant supervisor of the Shasta-Trinity National Forest and you are our guests today here within the Shasta-Trinity National Forest. Our headquarters are located in Redding.

I want to make a few brief comments which tie in with the statement prepared by Mr. Reginato of the Shasta-Cascade Wonderland Association. I will be quite brief here. I don't have this typed as yet, but I will and give you a copy of it, Mr. Chairman.

I want to comment briefly upon the need for studies of impacts upon water storage developments, especially as it pertains to national forest lands and it would pertain to other lands, state, county, private or however you wish to apply it.

About 25 years ago I believe the water development man who was interested in planning or was in charge of the planning was principally concerned with the phase of water flood control, irrigation and hydroelectric generation. Today that has changed considerably and he is now concerned with land use problems brought about by other agencies and the general public, and we of the forest service are especially interested in these land use problems as they pertain to the multiple use concept of land management.

Now, he has to consider all of the uses and all of the services of that water and the adjoining land and consider the various things that are going to conflict within these uses and try to make them fit together into a workable pattern. In planning for water development reservoirs, the first I believe our national forest land really went into this problem in detail on was the Trinity River Project, and, of course, Shasta Lake here was one on which no detailed plans were made in advance for the recreation use which we are experiencing right now, and without those plans and without the development, the public, as you would see here on Labor Day and the Fourth of July use the facilities as best they can. Some of them camp in undeveloped lands and cause sanitation and a fire problem.

On the Trinity Project the Bureau of Reclamation early in its study, in fact in 1950, I believe, asked the National Park Service to make a survey of the Upper Trinity River Basin from the standpoint of recreation use. The Park Service made this study at which time they pointed out many of the problems which would result not only from recreational use but the other land uses. Then in 1951 or thereabouts, December, the report was submitted to the Bureau of Reclamation and in early 1952 the Bureau included an estimate prepared by the National Park Service for the amount of money needed to construct the minimum basic public use facilities, and when we speak of minimum basic use facilities Mr. Reginato brought out the use of camp grounds and also the construction of roads, boat launching ramps and items of that type.

In 1954 the Bureau of the Budget included an amount of $215,000 in its report to Congress for recreational use as well the sizeable amount for fish and wild life and also for problems that they would create within Trinity County.

In 1955, when public law 386, the Engle Bill, was passed this $215,000 was included in that particular bill. In addition, the bill also authorized the Bureau of Reclamation to make a study or have some other agency make a study of the impacts upon Natural Forest Administration as well as public use in that particular area and they set up a total of $45,000 which was given to the Forest Service to make this study. The study was started in 1955, and after a period of two years we came out with our report on the impact of Trinity River Project upon National Forest Administration, and it brought out many interesting facts, all of which are going to be helpful to us in planning the area as well as administration.

Starting just, well even before the report was completed we recognized many problems which we had attempted to solve at the present time. For instance, the work-load from an administration standpoint, the National Forest Administration standpoint, more than doubled in that particular area. It was necessary to create a new ranger district as well as adjust the boundaries of the two adjacent ranger districts so that we would have suitable personnel located close by to administer the area, and when I speak of administering the area, I don't mean particularly from the standpoint of recreation, because recreation is only one of the many impacts upon the area, but also those impacts upon the grazing industry, the timber industry, as well as fish and game and general water management.

The recreational use in that particular area at the time of the study, 1957 when the study was completed, showed 3,900 camper use days in the upper Trinity River Basin adjacent to what would be the lake shore. And our study showed that even at a very minimum use in there we would receive at least 17,600 camper days on or about 1970. This was based upon recreational, the rates of recreational use here on the Shasta Dam as well as other reservoirs on which we have figures available to use in our study. This is all within a period of seven years after the completion of the dam.

To handle this load we estimated we would need as minimum basic facilities 300 camp units. Now, a camp unit is a stove, a table and a place for an individual to put up his tent and also the necessary sanitation facilities. When the project money was allotted here about a year ago for the completion of some of these minimum basic facilities, we received this $215,000, plus the increase in dollar value which made it $234,000, to construct the minimum basic facilities. Unfortunately the $234,000 will only construct about 150 camp units of what we figure we will need 300.

Now, this type of planning not only considers the recreation impact, but also as I mentioned before timber, grazing as well as the impact upon administration of those lands from the standpoint of fire, which is a definite problem in this area, as well as transportation and general water use, and especially from the standpoint you mentioned, water use from the standpoint of erosion control, just how we would cut our timber, harvest our crops and prevent this additional erosion in depleting the storage area of this dam.

Now, we feel that this type of study is a must for all National Forest lands and we feel that we have benefited greatly from the study. We have a plan now which has been approved by the National Park Service and the Bureau of Reclamation and our own Forest Service Organization, and we are starting at the present time and have started six months ago to construct these minimum basic facilities. Thank you.

MR. PAUL STATHEM
United States Forest Service, Redding

Mr. Stathem: I would like to elaborate on Harry's remarks this morning. If we created the impression at all that what we are doing in addition to these reservoir areas was just something nice, we want to dispel any such idea. It is not optional. It is a job that is there and it is created by the creation of these reservoirs and we found it to our sadness, I guess you would call it, the fact that when we weren't prepared on Shasta Lake the cost of administration without this preplanning was greatly in excess of what we hoped it will be on Trinity Reservoir, so if we did create the impression we are trying to do something that is nice, while it may be nice, it is not optional. The job is going to be there whether we do it or not. It is going to be harder to take care of it if we don't plan ahead before the construction of the dam.

Chairman Hill: I am glad you commented on that and that is one of the reasons that I thought it was desirable for your organization to discuss the subject here, because it has not been customary, and the private companies building reservoirs as well as the government have all been faced by the necessity of doing something and a comment was made a while back on the use of power company reservoirs for recreational purposes and who is going to pay the cost of that? To my knowledge there are none of the power companies' reservoirs that aren't available for recreational purposes, but by the same token there is a lot of cost involved in preparing for recreation. There is a lot being done on that up in the Northwest by the power companies up there and huge picnic areas which seem to be in tremendous demand, so it is a problem. I have here a whole list of questions that if we have any time this afternoon I would just like to throw out for consideration of the people here—as to just who is going to do the planning and who is going to pay for the planning on this development, on this recreational development of reservoirs in the State regardless of who builds them, and my feeling is that certainly the agricultural and power and municipal and industrial users of water can't—there is a limit to what they can go on and I think there are some very pertinent questions that some of the Legislative Committees are going to be asking, and there are going to have to be some answers very shortly. Thanks for your remarks.

Mr. Stathem: We used this as an example. It is immaterial whose lands these reservoirs might be developed upon. If it is completely outside, the same problems are going to be created. I am sure that you have similar problems wherever you build regardless of the ownership of land.

MR. JAMES J. HERBERT
Shasta County Planning Commission, Redding

Mr. Herbert: Thank you, Mr. Chairman. I have a prepared statement and I will provide you with a retyped copy as soon as possible. The statement is as follows:

Shasta County's Planning Commission appreciates the efforts of the California Water Commission and the Department of Water Resources in compiling Bulletin 58, "Northeastern Counties Investigation" and Appendix A, on future population, economic and recreation development. This study appears quite comprehensive and from the viewpoint of the Planning Commission will serve as a welcome addition to available statistics as well as fulfilling the objective of stating ultimate water needs. The data on natural resources, lands, population, employment and recreation use in arriving at ultimate water needs will greatly assist in guiding physical development within the County of Shasta.

We concur that the Northeastern Counties are on the threshold of substantial growth and believe that sufficient and suitable quality of water must be retained for beneficial uses.

Your policy states that no assignment of water appropriations will be made which will deprive the county of origin of the water necessary for the development of the county. This policy should be retained. Shasta County is vitally interested in the development of the industry and natural resources. In line with the potential recreational uses shown in Appendix A which indicates Shasta County has the most recreational potential of the 15 northeastern counties, the Board of Supervisors and the Planning Commission have recently adopted a master plan of recreation, and Unit 1 thereof is the recreation plan of Whiskeytown Reservoir. In these plans the phenomenal increase in the boating use of large man-made lakes by sportsmen, vacationists and tourists, is recognized, as well as increases in camping, riding, hiking and stream fishing, all of which depend upon the non-consumptive beneficial use of water. Now, while recreation is a proper function of county government to assist in meeting this basic need, there is also State interest in State water projects and there is a State obligation to provide basic minimum facilities for recreation on a non-reimbursable basis. The Federal Government has recognized this premise.

Recreationists can no longer find their own ground but must be provided with improved recreational facilities including access roads, potable water supply, sanitary facilities, boat launching ramps, parking, camp sites and picnic areas. As indicated in your studies, recreation users originate on at least a statewide basis. It is hoped that the investigations of the California Water Resources Board will continue to be reviewed periodically. Updating of statistics is of great importance in the State of California where unprecedented growth and change has become the ordinary course of events. Thank you.

ASSEMBLYWOMAN PAULINE DAVIS
Portola

Assemblywoman Davis: Thank you, Mr. Chairman, and gentlemen of the Commission. At the very outset of my remarks I want to thank you and the members of the Commission for taking the time to make this tour throughout our Northern California area and for holding these hearings. I personally feel not merely because it happened to be my legislation to some extent that created this investigation that we are discussing here today, but I do want to stress to all of us here the very important role that I feel that this Northeastern Counties Investigation is going to play in the legislation that is going to be presented to us this year in Sacramento.

I attended the Siskiyou County Meeting yesterday in Yreka and in listening to the testimony here today I sincerely request that the members of this Commission consider advising the Director who is here today that you consider some re-evaluation of your criteria that you have used for this report should be made and perhaps make a further analysis in the areas, the field, that it is inadequate as far as the recommendations in the Northeastern Counties Investigation pertaining to those areas.

I say that for this reason because I know as a legislator that this year we will be faced with legislation that will stipulate the renewal of the State filings throughout the State of California and also there is no doubt there will be one or more constitutional amendments before us.

I feel that it is very important that the entire state look at the renewal of these State filings as something that is very important to the entire state and that Southern California does not use it as a vehicle or a club, if you please, if I might use that expression, over the heads of Northern California and say to the Northern California Counties, "If you do not give us the provisions that we are desireous of obtaining in a constitutional amendment" which would then nulify the now existing counties of origin, "We will not consent to renew the State filings that are before us." I think that that would be very poor philosophy to use in Sacramento and I certainly urge upon the southern part of the State and the people throughout the State to see that this does not occur.

Then again, I feel that this report and the recommendations that will be made of its contents is going to play a very important part in whatever recommendations might be made for reservations of water for the counties of origin.

Since we are gazing into a crystal ball and since it has been stipulated that as far as the people are concerned this report is not adequate as far as the water supply that will be necessary, I feel that it is very important to once again take a good look at it because I think that we all recognize that many of the proposals in The California Water Plan are being based on an interim use of water and certainly it should be pointed out that since the concept is that these projects might become a reality on the interim use of Northern California's water that we should be very, very careful as to what our needs are and if and when we have the financial ability to build them that we are able to recapture this water, if you please, without throwing the northern California counties into court litigation against the State of California.

I personally feel that before we nulify the county of origin law and adopt perhaps a constitutional amendment which I have been very reluctant in accepting any that have been proposed so far, that we take as an example the City of San Francisco, if I may. Years ago before the county of origin statutes became a reality, the City of San Francisco filed under the civil code for the water rights on the Tuolumne River and certainly those are very firm water rights and deprive the counties of origin of their adequate development in those areas that will never become a reality because they can never recapture that water.

Then as another example also take the East Bay Municipal Utility District which did the very same thing on the Mokelumne and the same situation applied there.

So I think that calls to the attention of Northern California the necessity of watching very, very closely what legislation is going to be contemplated, what is going to be considered, and also I would suggest to the Northern California people that they start counting noses as far as votes are concerned for Northern California from a practical standpoint in the State Legislature.

Now since I see two or more supervisors here, may I say this in closing, that I urge upon the Northern California Supervisors Association, if they are not individually, that they post themselves very, very thoroughly on every piece of legislation that is going to be introduced on water policy this year in Sacramento and evaluate it yourself because between the supervisors and the Legislature we are going to have the stake of Northern California in our hands.

MR. JOHN F. REGINATO
Shasta-Cascade Wonderland Association, Redding

Mr. Reginato: I believe the big problem is that basic capital outlay, the basic minimum facilities that the majority of these counties or cities or districts are not able to meet. They are not able to meet that particular phase of it, and I believe that you will find that the majority of counties, the majority of cities, that they will gradually assume the maintenance and operation of those facilities once they are established by the state agency.

MR. ROSCOE ANDERSON
Shasta County

Mr. Anderson: Mr. Chairman, I might make a few comments, but I am not going to stick to the subject. I am going to give you a little history way back. I am not a young fellow any more. In 1915 the Legislature passed a resolution creating the California Water Problems Conference. Assemblyman Ellis presented the legislation creating a board of 16, 10 of them ex officio members because of their official positions and six of us were appointed. I was one of those appointed by Governor Hiram Johnson. We served for 18 months on that without any salaries, but we did have expenses.

Our object was to try to co-ordinate the various water agencies of the State into one institution if we could. But being ten ex officio members, and I think some of them felt that they didn't want to legislate themselves out of a job, we didn't get very far, but we six that were appointed did hold for a consolidation at that time. However, we did get agreement from practically all of the members that was the ideal and it should be accomplished, but the time wasn't yet ripe. Three of us wrote minority opinions criticising the stand taken, but nevertheless we didn't get very far.

I think I gave you a copy of that report over 40 years' ago. Well, I want to congratulate you and commend the Legislature for having passed the measure that now makes you the sole head of the water conditions of the State and I think we are now getting somewhere. I think you are doing a good job and God bless you, keep going, because it is the big problem of California and you now have an organization that can solve them. Even though we can't make everybody happy, you are going to make the great majority happy if you keep going through with it, and you gentlemen and Harvey over here, I want to commend you for your great work and go ahead.

SUSANVILLE HEARING

JOINT HEARING OF THE CALIFORNIA WATER COMMISSION AND DEPARTMENT OF WATER RESOURCES

Held at
Mt. Lassen Hotel, Susanville, California

WRITTEN COMMENTS

September 5, 1958

STATEMENT BY TULE IRRIGATION DISTRICT

Tule Irrigation District
Susanville, California, September 5, 1958

California State Water Commission
State Department of Water Resources
Sacramento, California

Tule Irrigation District is a political subdivision of the State of California organized in 1923 under the Irrigation Districts section of the Water Code. Since 1947 it has been operating under the control of the Federal District Court and a trustee in bankruptcy, due to financial difficulties.

Under supervision of the Federal Court and the trustee Tule Irrigation District has been reorganized, and is functioning. Assessments have been levied and collected for the past two years, and a levy for expenditures during the calendar year 1959 will be made at the meeting of the Board of Directors to be held in Susanville on September 6, 1958.

The District comprises about 3700 acres of the approximate potential value of $750,000 lying generally between Litchfield and Wendel. The land is classified as irrigable in current Department of Water Resources bulletins, as well as in the original studies made of the entire area prior to and as a condition precedent to certification of the original bonds. It owns a tunnel about 8,000 feet long which diverts water from Eagle Lake to upper Willow Creek, a by-bass canal, water and flooding rights, and ditch rights. Its land owners are in large part the holders of the original bonds of the District, the default of which caused the District to become bankrupt, and whose eventual reimbursement depends entirely upon the ability of the District to put water to beneficial use.

The District has consistently urged the full economic utilization of Eagle Lake waters. This envisions multiple use features of the existing facilities of the District, and any other structures which may be built in connection with the utilization of the lake surface. Fishing, hunting, boating, recreational, and other nonconsumptive uses of the water of Eagle Lake appear to be fully consistent with beneficial consumptive use of water released for essential agricultural use on lands lying below the lake in Willow Creek Valley and the lower Susan River area.

Bulletin No. 58 contains very valuable data on the availability of water for all purposes from Eagle Lake. The studies currently under way by the Department of Water Resources will add more valuable data, and enable the fullest economic use to be made of the area and the investments which have been, and will be made in the future. The District will be pleased to work with all other agencies and groups interested in securing the soundest long time development of Lassen County. It is fundamental knowledge that with full development of the presently unirrigated, arable land susceptible of economic development using Eagle Lake water, there will still be insufficient water for full agricultural needs of the area.

With this knowledge in mind it is proper that all factors be carefully evaluated in making plans for long range investments in the many purposes to which Eagle Lake waters ultimately will be put.

Respectfully submitted,

Tule Irrigation District
/s/ Loren E. Blakeley
by *Loren E. Blakeley,* President

STATEMENT BY JIM E. BRONSON
Chairman, Lassen County Water Resources Board

Susanville, California, October 30, 1958

The Lassen County Water Resources Board had the opportunity to appear before the California Water Commission and the Department of Water Resources at a joint hearing held in Susanville, California on September 5, 1958 at the Hotel Mt. Lassen. At that time the chairman of the Lassen County Water Resources Board, Jim E. Bronson, appeared and asked permission to file a written statement regarding Bulletin No. 58.

The Lassen County Water Resources Board appreciated the opportunity to appear before the California Water Commission and the Department of Water Resources and asks that you continue your investigation pertaining to the planning and the execution of the California Water Plan as compiled in Bulletin No. 58 and Appendix A thereof.

Lassen County Water Resources Board Recommends:

1. That adequate funds be made available to further agricultural and recreational development in the Northern part of Lassen County on the Pit River watershed, including Horse Creek, Davis Creek, Juniper Creek, Willow Creek and Ash Creek, and Cedar Creek on Tule Lake.

2. That adequate funds be made available to further the agricultural and recreational development possibilities on creeks and rivers draining into Honey Lake, namely, Susan River, Willow Creek, Balls Canyon Creek, Pete's Creek, Baxter Creek and Long Valley Creek.

3. That surveys of underground water reservoirs in the Lassen County area be completed.

4. That in connection with the recreation possibilities of Eagle Lake it be recommended that the high level be maintained so that resorts and boat harbors can be established on the lake, also that the Tule Irrigation District be dissolved and surplus water from Eagle Lake, if any, be stored in accordance with the California Water Plan in Pete's Valley Reservoir for irrigation in Honey Lake Valley.

5. That estimates of the ultimate water requirements of Lassen County, for domestic, irrigation and recreation purposes be periodically reviewed in order to assure the availability of adequate water supplies for the future development of the county.

VERBAL COMMENTS

MR. E. J. HUMPHREY
Plumas County Board of Supervisors, Greenville

Mr. Humphrey: I have our Resolution Number 1002 which reads as follows:

"WHEREAS, notice has been given that the California Water Commission, and the Department of Water Resources will conduct a joint public hearing for the purpose of receiving comments on Bulletin No. 58 'The Northeastern Counties Investigation' preliminary edition, and the appendix thereto, the 5th day of September, 1958, at the hour of 2:00 o'clock P.M., at the Mt. Lassen Hotel in Susanville, Lassen County, California, being the time and place fixed for said hearing; and

WHEREAS, it appears from statements made in said Bulletin No. 58 that adequate data was not available to determine definitely the consumptive use of water;

Now Therefore, Be It Resolved by the Board of Supervisors of the County of Plumas, State of California, that said Board hereby approves recommendations Nos. 1, 2, and 3, appearing on page 183 of said Bulletin No. 58.

The foregoing Resolution was duly passed and adopted by the Board of Supervisors of the County of Plumas, State of California, at a regular meeting of said Board held on the 3rd day of September, 1958, by the following vote:

AYES: Supervisors Cloman, Flanagan, Blackman, Donnenwirth and Humphrey.

NOES: None

ABSENT: None

E. J. HUMPHREY
Chairman of said
Board of Supervisors."

MR. JIM E. BRONSON
Lassen County Water Resources Board, Susanville

Mr. Bronson: While our Committee has reviewed Bulletin 58 at this time we have not prepared a written statement to present to you and we would like to present that at a later hearing or send it to you for a later hearing that you might have in October or some other time. . . .

. . . In commenting, if it is all right to make a comment or two, our Recreation Resource Board feels that some of our water is more suitable for recreation than irrigation and then we also feel that further studies of the Susan River, and tributaries upstream could be made and also the Pete's Valley Water Site for further study.

MR. JULIAN MAPES
Litchfield

Mr. Mapes: Mr. Chairman, I don't know that I have prepared a statement quite in line with the trend of thought right now, but this has definite and restricted comments toward Eagle Lake. It is something I wanted read into the record and it has no ulterior motives whatever. I just represent myself as an individual.

Chairman Hill: You are from Litchfield?

Mr. Mapes: Yes.

Chairman Hill: And you are a farmer there?

Mr. Mapes: Yes. I will read this brief letter. It kind of sums up my thoughts on the agricultural use of Eagle Lake.

"September 5, 1958

"STATE WATER RESOURCES BOARD
"SACRAMENTO, CALIFORNIA

"Gentlemen:

"This letter will express my views concerning the development of the Eagle Lake water for agriculture use.

"It is evident that the watershed for the lake extends over a considerable area, accumulating water which has some potential agriculture use. This was proven by its past use when the Irrigation District was in full operation. It is my firm conviction that some agriculture beneficial use can be made of these waters and on this reasoning provision was made for the passage of these waters through a proposed Willow Creek dam. This was done by acquiring a head gate large enough to allow for passage of water greater than would be required for the impounded waters.

"It is of paramount importance that all potential agriculture water be preserved for future use. The vested rights that are held by the Tule Irrigation District places the waters in Eagle Lake under the status of appropriated rights thereby for the present, safeguarding future agriculture use of these waters. Until agreements can be developed with competing interests that may in the future acquire priority rights based on other than agriculture use, these rights should be preserved.

"In no way should these comments be construed as opposing the development of other beneficial uses of the waters of Eagle Lake. It is hoped that these thoughts will further the complete development of the entire resources for the benefit of Lassen County and all people who may want to enjoy the Lake in any manner they desire and wherever they may reside.

"Yours very truly,

"JULIAN W. MAPES"

Julian W. Mapes: I can discuss any part of this that might bring up a question.

Chairman Hill: Well, since you have put that in the record and it certainly, I think, is proper, it seems to me that for the benefit of the Commission somebody should more or less review the history of that Eagle Lake in the water development there and also point up its present status. Could you do that?

Mr. Mapes: Well, I don't know whether I am thoroughly qualified to review all the history.

Chairman Hill: Well, I don't mean an extensive history, but there are several here who don't know the background of this Eagle Lake development and to understand what you are talking about I think they should have some statement concerning it. In other words, prior to diversion, the Lake had no outlet?

Mr. Mapes: That is right.

Chairman Hill: And what then controlled the water level?

Mr. Mapes: Evaporation.

Chairman Hill: And that is what kept it in balance, is it?

Mr. Mapes: Yes.

Chairman Hill: And then the diversion was made and when was that made?

Mr. Mapes: I think in 1922.

Chairman Hill: And then that drew the Lake down to how far?

Mr. Mapes: I think 74 feet, I am not sure about that. It drew it down say 30 feet.

Chairman Hill: And where is—is any being diverted now?

Mr. Mapes: No.

Chairman Hill: And where is the Lake level now? Did it ever come clear back up?

Mr. Mapes: Yes, I think it is about 84 to 86, somewhere in there.

Chairman Hill: Where was it before you started diverting?

Mr. Mapes: The highest was 109, I think around—roughly let's say 110 feet.

Chairman Hill: And how long has it been since you diverted for irrigation purposes?

Mr. Mapes: Twenty years.

Chairman Hill: And then since that time the Lake has never in spite of the wet years quite filled to where it was?

Mr. Mapes: We didn't have any wet years until the last three or four.

Chairman Hill: Well, you say 20 years. We have had a state-wide wet period in that time.

Mr. Mapes: In that time, but it has been on the tail-end of the 20 years here. We had one in 1937 or was it 1938 and 1939 that caused all the disastrous floods which brought it up, but at one time it was below the outlet of the diversion point. In other words, they were bringing up red ink.

Chairman Hill: Is it now below or above the diversion point?

Mr. Mapes: Yes, six or eight feet.

Chairman Hill: Above or below?

Mr. Mapes: Above, but prior to that time it is my understanding that there was exorbitant waste of water. In other words, they didn't cut the water off when they got through irrigating. It ran all winter. So then during the 30's, during that dry period and in the early 40's, well, it wasn't enough to replenish all of that. It took all of that to bring the water back up to its present status. It would be hard to go into the intricate phases of it, but one of the main faults of the whole district is that they had too much land for the amount of water. There is some beneficial use.

The headwaters of Eagle Lake extend back 40 or 50 miles above Eagle Lake or so and the watershed between that and the area we propose to put our own dam in had a watershed—I think the engineers estimated—of 100 square miles or something like that. In other words, I believe that a complete study should be made of Willow Creek. Everyone discussed Susan River, but here is a watershed that is several miles long and contains several hundred square miles up the Willow Creek and Eagle Lake which is one channel now if you consider the old tunnel and it does have potential. How much, I am not prepared to say, but it certainly has some. In other words, a foot or two on Eagle Lake would probably irrigate 8 to 10 thousand acres.

Chairman Hill: Is that tunnel still useable?

Mr. Mapes: I think so with a little repair. However, they don't have a head gate in it. As I said before, they didn't have one before. They just let the water run out.

Chairman Hill: Why doesn't the water run out now?

Mr. Mapes: They have a bulldozer dam across it. It is just a levee. I mean they didn't have a manually controlled gate. At one time they had, but as they lowered the cut they just kept cutting enough for each year's irrigation and let the balance run out.

Mr. Frew: Is there any of that land under irrigation that was formerly under irrigation at Eagle Lake?

Mr. Mapes: Yes.

Mr. Frew: Where are they getting their water from?

Mr. Mapes: They have a riparian right from the Susan River and Willow Creek natural flow and what they did was augment that with their Eagle Lake water. The lands that were absolutely dependent on Eagle Lake are barren now.

Chairman Hill: Well, thank you very much.

Mr. Bunker: I would like to ask Mr. Mapes a question. Did the quality of Eagle Lake—does that stay pretty good or does it get pretty salty?

Mr. Mapes: Well, the only thing I can review in my own mind is the quality of crops grown. I saw mighty fine fields of alfalfa. There was an old Dane, a professional gardener, who lived above us. I think if you check the records he took several purple ribbons, for example eggplants, watermelons. The salinity in the lake is no doubt strong, but many, many plants have a great deal of tolerance for that salt. And I believe it will grow plants—for how long, I do not know. It isn't as salty as Honey Lake and they are pumping out of Honey Lake to start crops.

Chairman Hill: You speak of Honey Lake. It was pretty dry for a long time.

Mr. Mapes: Yes, but I am talking about the quality of the water. Certainly Honey Lake is more salty or basic than Eagle Lake.

Chairman Hill: Any further questions of Mr. Mapes? Senator Arnold.

Senator Arnold: Mr. Chairman, I believe this Bulletin 58 in some place or other, which I can't locate at the moment, states that the quality of the water of Eagle Lake has deteriorated since the outlet has been lowered to where the outlet should be shut off. And also it states somewhere that the quality of the water would not sustain an unrestricted irrigation use. And in regard to the Willow Creek, I would like to have if we could, Mr. Horn tell us what, if any, consideration had been given to Willow Creek when the entire area was gone over and the projects recommended that are in Bulletin 3.

Mr. Horn: Well, I would first like to comment on the water requirements investigation and Bulletin No. 3. As Mr. Pyle indicated, the water requirements of this hydrographic unit were based on the availability of the water supply. It was considered that the plans that were presented in Bulletin 3 were the methods of development for that water supply.

One of the plans presented in Bulletin 3 was the reduction in the surface area of Eagle Lake plus a storage at Pete's Valley and by the combined use of off-stream storage and Eagle Lake a yield which I don't have on the tip of my tongue was developed and that yield was utilized as the basis for providing a future supply of water.

Senator Arnold: That was in connection with a diversion of Pine Creek, was it, and the lessening of the area of Eagle Lake?

Mr. Horn: Yes, that is correct.

Senator Arnold: That would raise the quality of the water.

Mr. Horn: That is right, it would provide a greater yield and would aid the quality by using surface streams.

Chairman Hill: Anybody wish to discuss that subject further? If not, those are all that are here who expressed a desire to be heard on this particular bulletin, except Senator Arnold and AssemblywomanDavis.

ASSEMBLYWOMAN PAULINE DAVIS
Portola

That is right, but getting back to the report that we are considering here today, may I state here that even though perhaps there aren't too many people testifying here today the interest is very intensive, and I might say to my surprise I understand that a few people did write to the Department of Water Resources for these reports and they didn't receive them in what they felt was sufficient time to adequately study them. So from now on I have suggested that they contact me and of course I will be haunting the staff of the Department of Water Resources and perhaps we can analyze this report a little bit more thoroughly and we might make another presentation. That depends upon the desires of the counties at your Sacramento meeting. I do feel that this area, particularly Lassen County, if I might take that at the very outset, comes in one of the categories that I think I commented to you gentlemen about in the City of Yreka, relative to the policy question that wherever there is an export project being considered by the State of California for the exportation of perhaps large quantities of water, that the State of California, if the local agencies and individuals are not in the position of financing the small structures, that should be considered to be a State responsibility to develop the entire basin. I think this area comes into the second category that I mentioned and that is that we should set up an appropriation within what is many times referred to as the Grunsky Bill that I am quite familiar with and which I hope to amend so that it is operative this next year, actually giving areas such as this that perhaps will never have a direct export project—by direct I mean a large reservoir such as Oroville Dam and others that are contemplated throughout the northeastern and northwestern part of the State, and so they should come in the possible category that if they do not have the financial ability and it is so proven that they have the opportunity of using the credit of the State and making an application for a loan, at perhaps a very low rate of interest, perhaps a going rate of interest at that time, and perhaps during the first 10 years there be no repayment due.

Now, I think that Lassen County comes within the scope of that category, and then Modoc County is in somewhat the same situation. I do feel that those policy questions should be established by the legislation giving the opportunity to the people that if and when they have the desire to do this, the mechanics are there and also that whatever legislation is introduced in Sacramento pertaining to statutes or constitutional amendments, if it must be that, that adequate language is contained in those measures that will leave it open so that this actually can become a reality rather than having water available merely through reservation that we might lose at a certain date because we can't place it to beneficial use.

Then going over further into Sierra Valley, Sierra County, Plumas County, I might state that I personally feel that the supervisors there and the people on the County Water Resources Board have a terrific responsibility. You are actually embarking upon a policy question that affects not only yourselves but the entire State and so we feel, I know I do, the terrific responsibility that we have in that part of the State since we are actually in the area of an emergency so to speak since the State of California as all of us well know is contemplating the construction of the Oroville Reservoir, which is immediately in our back yard.

We want to be sure that that particular basin comes in the category of number one that I mentioned, that if the different irrigation districts or the counties there are not in a financial position to construct the necessary small reservoirs that we feel will safeguard our water supply for our deficient areas, and believe me we are a deficient area in Sierra Valley, because if you will note, and I don't have the time to go into the background, during the precipitation period, it actually falls off so much and to the extent that Sierra Valley is a very deficient area and we can absorb and use all the water from proposed Grizzly Reservoir in addition to Frenchman and still not have our adequate supply of water there and possibly will never have because it is going to be an impossibility and we have more or less conceded ever diverting water from the Truckee River.

So I think this is a very important policy question as far as Plumas and Sierra Counties are concerned. As many of you know, we are now trying to acquire land for the Frenchman Reservoir which we have appropriations for to give consideration to this very policy, very important policy question.

I have discussed this many, many times with some of my fellow colleagues from Southern California and they are all very fine men, including the fine gentleman sitting in the audience that represents the Metropolitan Water District, but they sometimes fear and I don't think that they need to, to the extent that they do, that if his policy question becomes a reality that it isn't only this area we must consider but other areas and other basins within the State that will also have to receive attention, and that is true. I feel that the policy should apply state-wide and what is good for one is good for all and we are all a part of California.

So I believe in that way with you gentlemen, in my concluding remarks, pointing out that we are dealing here with a policy question.

I was interested I might say in some of the remarks in our little session, get-together at Redding yesterday, that some of the Southern California people still feel, "Well, we have the assessed valuation and we have the votes." I wish sincerely that we could dispose of that type of philosophy. I think that the only way we are going to get this California State Water Plan off the ground and see it become a reality is for all of us to stop thinking in those terms and I say that in all sincerity. That is all that I heard, or the greatest portion of the conversations in Sacramento, from the Southern California people and that was, "We have the assessed valuation and we have the votes."

Personally, I might say with no offense, that I don't think that is a statesman-like attitude to assume and I certainly hope that that thought and that cloud can vanish very, very quickly. Thank you very much.

STATE SENATOR ARNOLD
Susanville

Senator Arnold: Mr. Chairman. Mrs. Davis, members of the Commission and members of the Department of Water Resources, I want to personally thank you and the Commission and the staff of the Department of Water Resources for bringing your group up and making this meeting possible here in this area, the center of the three counties which I represent in the State Senate of Modoc, Lassen and Plumas. And unlike the areas in which you have visited in the last two meetings, I would like to point out to you that in the population statistics in the front of Bulletin 58 you will find that up to 1950 and in fact up until the present time the population of the 15 counties comprising this Northeastern Counties Investigation has, with the exception of Lassen, Plumas and Modoc Counties, and I believe Colusa, Lake and Sierra, increased in population up until 1950. That was true of all of these counties and since 1950, Colusa, Lake and Sierra have lost population to a somewhat lesser degree and Modoc, Lassen and Plumas have lost population to a greater degree, and I would like to point out to you that this has been due to the depletion of our timber resources and to the termination of lumber operations in at least two of these counties, Lassen and Plumas.

There have been four major lumber operations terminated within the last five or six years, one of them 23 miles west of here, Westwood, an operation that employed as high as 5,000 people at some time in their existence, having started in 1914, and the town was sold for salvage something like a year ago, and I would like to point out that the impact of such a loss on a county of the population of Lassen, I think presently somewhere between 16 and 17 thousand, has a very severe impact on the economy, and we are grateful to Mrs. Davis for the foresight in 1954 of instigating this Northeastern Counties Investigation, and particularly I think it is one of the incidental results of the encouraging report of the Planning and Research Agency in pointing out that in the ultimate population figures compared as I believe to 2050, that all of these counties will proportionately increase along with the rest of them.

It points out in that report that this will be due to the increase in the recreational facilities and as they so aptly mention there that recreation is a new industry and they also point out that it will be due to the adaptability of this area to other light industries not dependent, so-called footloose industries, not dependent upon the natural resources of timber in this area. It will be due to the attractiveness of the area as a living place, its out-door recreation, and with all deference to you gentlemen from Southern California, might I point out to you that we have many of your folks who live for a year down there planning a two-week or one-month vacation in our area and we find now that many of them upon retiring spend 12 months out of the year in our area.

And so I say that that report is encouraging, but further it is all predicated upon development, full development of our local water resources and those can only be developed in the manner that Mrs. Davis points out by the building of small projects and that that will have to be a necessity and it will have to be on such a basis that they can be financed with due consideration to the factories in this area that we are not raising high market priced crops and that much of our land is owned by the Federal Government and that we are very limited in wheeling our own project up here, but through the inauguration of this policy of the State making possible—we don't want a gift. We are not asking for charity, but in the various projects bill which Mrs. Davis and I have introduced into the legislature they comprised, as Mrs. Davis pointed out, long-term repayment provisions with small interest rates which will make these projects possible and so I sincerely submit to you gentlemen that we in this part of the country can contribute a substantial part of the necessary recreation and desirable living areas to the great State of California, and that we feel that it is an unhealthy condition when any part or any number of counties in the State of California are in the economic situation which they find themselves at the present time, and we sincerely hope that you will all join in looking upon this as one state and allowing us to offer our contribution to the overall welfare and well-being of the State of California.

MR. V. A. PARKER
United States Forest Service, Susanville

Mr. Parker: Well, Mr. Chairman, I didn't come prepared to make any particular comments. I might while recreation is being mentioned say this, that under a program known as operations outdoors which has been adopted by the Department of Agriculture and the Forest Service which is a branch thereof and has the blessing of Congress, why it provides that we will double our recreational facilities in the national forest within a five-year period. Two years of that five-year period have now passed and already we are seeing some rather major strides forward in our development of campgrounds and picnic areas and other types of outdoor public recreation.

All of these will require of course a certain amount of water for their development and their adequate use. So I think we will see in these northeastern counties on which this study is based, and in which there are several national forests located, and a rather major portion of the area in National Forest lands of which a rather major portion could well be devoted to recreational development, that strides will go forward that will require considerable thinking towards the full recreational development and the need of the water that is in that area. I think that is about all I have.

Chairman Hill: Thank you, Mr. Parker. I would commend to all of you people the reading of that publication, "Operations Outdoors" that was put out by the Department of Agriculture and the Forest Service two or three years ago.

Mr. Parker: It was two years ago.

Chairman Hill: It was approved by all agencies. The only thing that hasn't been approved is the appropriations to make it work. By this time I believe there was to have been 27 million dollars expended and I believe about three million has been expended or appropriated on a program. Those figures may not be quite right because you can't analyze them quite in the budget because they are not earmarked and that is nation-wide and not just California. They get eight million—they got 11 million dollars nation-wide for the Forest Service recreation development this year and you can see that is spread pretty thin, isn't that figure right?

Mr. Parker: That figure is correct and we received about 8 million dollars a year ago and that is considerably behind the program in the five-year period. I believe we should have received 80 million dollars to effectually put the program into being, so it is a little behind time, but it is stepping up many times over what it was before operations outdoors came into being.

MR. ALFRED STOLOFF
Tule Irrigation District, Susanville

Mr. Stoloff: Yes, Mr. Chairman, I am Alfred Stoloff. I am speaking on behalf of the Tule Irrigation District. I will hand this to the reporter, but I will summarize it for the meeting.

Tule Irrigation District was organized under the statutes of the State in 1923 and it is now operating under the auspices of the Federal District Court and trustee in bankruptcy. The reason for this was default in payment of the bond interest and principle which led to the ultimate bankruptcy of the District under Chapter 9 of the Federal Bankruptcy Law and it is now operated as a district but under the supervision of the trustee in bankruptcy and under the ultimate jurisdiction of the Court. It is an operating district and assessments have been levied and collected for the past two years, and a levy for expenditures during the calendar year 1959 will be made at the meeting of the Board of Directors to be held in Susanville on September 6, 1958.

The land lying within the district comprises some 3,700 acres of the approximate potential value of $750,000. The land is classified as irrigable in current Department of Water Resources bulletins, as well as in the original studies made of the entire area prior to and as a condition precedent to certification of the original bonds. The assets of the district include a tunnel of approximately 8,000 feet in length which leads out of Eagle Lake By-Pass Canal, incidental ditches and so forth, and include water rights, flowage rights and ditch rights in connection therewith.

The holders of the land are in a large part the original bond holders of the district or their representatives, whose eventual reimbursement for their investment would depend in a large part upon the use of Eagle Lake water to irrigate these lands to produce crops and pay them off. So that it is quite essential that a sufficient amount of water from Eagle Lake be appropriated or set aside or at least be allowed to be used by these landowners in order to recoup their original investment which was made I would say back in 1923.

The District has consistently urged full economic utilization of the waters of Eagle Lake and it recognizes, of course, that multiple use of the lake is desirable. It feels that multiple use which includes use for irrigation, other consumptive uses, recreation, are all compatible and all can be going on at the same time without conflict. It feels that Bulletin 58 contains very valuable data with respect to availability of water for all purposes. It feels the studies currently under way by the Department of Water Resources will add more valuable data and enable the fullest economic use to be made of the area. The district offers whatever information it has available and its entire cooperation to this organization and to all other organizations which contemplate studies of the area and contemplate full economic use of the lake and of the surrounding reservoirs. If there are any questions —I know you had some technical questions about the history of the District or lake levels and that sort of thing and Mr. Blakeley who is the President of the District is here and he might be able to answer some of them, or if you prefer we could submit them in writing.

Chairman Hill: Thank you very much.

Senator Arnold: Mr. Chairman.

Chairman Hill: Senator Arnold.

Senator Arnold: I would like to ask one question and that is whether his plan for irrigation contemplates the building of a dike across Eagle Lake and the diversion of Pine Creek to a place below the dike which would raise the quality of the water?

Mr. Blakeley: I think I can answer your question, Senator. The District plans do not consider diverting Pine Creek water across the lava bed to the lower third or therabouts of the lake as shown on the plat in Bulletin 58. That was another plan studied by the Water Resources Board in a preliminary work on Bulletin 58. Evidence shows and proves the studies made prior to any utilization of the water, that the water becomes better by dilution as the water is used out of the lake and replenished annually by snow water and rainfall.

It is a long detailed study to go through the chemistry of all of the measurements and quality measurements and quality determinations which have been made. That data I understand is now being gathered and analyzed by the Department of Water Resources and all records which the resident District Directors have were either made available or will be to the State. Most of the essential ones already have been furnished, but we have recently in going over some old records found additional reports on water quality which were not available a few years ago. Does that answer your question?

MR. DONALD P. CADY
Susanville

Mr. Cady: Mr. Chairman, I didn't want to turn this hearing into an argument over Eagle Lake, but considerable has been said about it. I would like to just for the record make a couple of statements in connection with it. Perhaps I misunderstand the purpose of your hearing or the function of your Board. . . .

I am speaking as an individual right now. I just wanted to call to the Board's attention the fact that this Eagle Lake water proposition is a subject of some rather hopelessly contested litigation before the State Water Rights Board at the moment. Whether you gentlemen are aware of that I don't know, but I did want to point out that there may be considerable difference of opinion as to the use to be made of those waters and since it is possible you may make a recommendation concerning the economy of this portion of the State and the use of the water therein in a manner that will best bolster the economy of this portion of the State, I think you should know that there are a good many people, including myself, and in fact I am involved in the litigation of which I spoke on behalf of the County of Lassen, and we believe that the waters of Eagle Lake could be better used and would better bolster up the economy of this County and overcome some of the problems that Senator Arnold pointed out in his remarks by developing them for recreational purposes primarily and that they would have a greater value to the county in that respect than they would as waters used to irrigate certain farm lands as Mr. Stoloff said, about 3,700 acres of irrigable land, which in my opinion are of rather questionable quality anyhow.

So, we think that that water could better be developed and used for recreation to build a recreational industry here, rather than try and produce a doubtful outcome by using it for irrigation purposes.

SACRAMENTO HEARING

JOINT HEARING OF THE CALIFORNIA WATER COMMISSION AND DEPARTMENT OF WATER RESOURCES

Held at Public Works Building, Sacramento, California, November 6, 1958

ADDITIONAL WRITTEN COMMENTS

STATEMENT BY PLUMAS COUNTY BOARD OF SUPERVISORS

QUINCY, CALIFORNIA, November 3, 1958

CALIFORNIA WATER COMMISSION
and the—
STATE DEPARTMENT OF WATER RESOURCES
Department of Public Works Building
Sacramento, California

GENTLEMEN:

In addition to the Resolution submitted at the joint meeting of the California Water Commission and the Department of Water Resources, held at Susanville on September 5, 1958, the Plumas County Board of Supervisors make the following request:

That in addition to Appendix A of Bulletin No. 58, Northeastern Counties Investigation, that the Report of Harold F. Wise and Associates, on the Evaluation of Recreation Benefits from Five Proposed Reservoirs in the Upper Feather River Basin, in Bulletin No. 59, be also taken into consideration.

The reason for making this request is the following statement which appears on page 144 of Appendix A of Bulletin No. 58, quote: "No detailed description of recreation areas in Plumas County is given here because, pursuant to contract, such is included in a separate report to the State Department of Water Resources on the recreation potential of the Upper Feather River Basin."

With the above being taken into consideration, Plumas County approves Bulletin No. 58, insofar as it concerns Plumas County.

Very truly yours,

PLUMAS COUNTY BOARD OF SUPERVISORS
/S/ by E. J. HUMPHREY

STATEMENT BY YOLO COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT

SACRAMENTO, CALIFORNIA, November 6, 1958

We have studied Bulletin 58—Northeastern Counties Investigation, issued by the State Department of Water Resources in December 1957. This bulletin, as we understand it, is for the purpose of determining future water needs in the counties of origin in order that surplus waters may be allocated to areas of deficiency within the state. Since Yolo County is included in this study, this committee would be derelict in their responsibility if they did not examine this report very carefully with regard to the future requirements for Yolo County. A more thorough study could have been made if more advance notice were given of these hearings.

The State Department of Water Resources should be commended for the thoroughness of their investigation of the water requirements of the Northeastern Counties. It has done an outstanding job on a difficult assignment with the time and personnel available. Their staff have been most helpful and cooperative in their work with the counties. An investigation of this type is very technical in nature and therefore may be misinterpreted by lay personnel who have not made the study of water their specialty. Therefore, some of the statements made by this committee may be due to misinterpretation of the data reported in Bulletin 58.

In the summary of the Northeastern Counties Investigation, the ultimate irrigated land in Yolo County is given as 387,800 acres and the ultimate water requirement to irrigate this land is 1,003,600 acre-feet. This amounts to 2.59 acre-feet of water per acre. This is the calculated amount of applied water after deducting for effective rainfall and allowing for efficiency of water aplication. It would seem in order to evaluate the theoretical use with that of grower experience. Many responsible growers and officials, through experience, have used a rounded figure of 3.0 acre-feet per acre per year as an average irrigation requirement for all crops grown in Yolo County. If this yearly acreage requirement is valid, it would result in a deficiency, based on estimated present use, of 128,802 acre-feet for Yolo County.

To arrive at a basis for this discrepancy, a study was initiated, in the limited time allowed prior to this hearing, to evaluate the conclusions set forth in Bulletin 58.

In order to make direct comparisons between the figures shown in Bulletin 58 and the actual farm use, it was necessary to convert the estimated theoretical consumptive use of applied water on crops given on page 154 of the report to irrigation water requirements. This was done by applying the weighted efficiencies of water application, computed from the efficiency figures given on page 168, to the consumptive use of applied water for various crops. Table I

TABLE I

WATER APPLICATION EFFICIENCY (Weighted)

Data from page 168, Bulletin No. 58, Department of Water Resources

Hydrographic unit	Efficiency	
West Yolo		55
Capay		85
Woodland		85
East Yolo		70
Colusa	70	
Cortina	50	60
Arbuckle	60	

give the efficiency factors of the hydrographic units in Yolo County and the county average.

The efficiency data in Appendix A was used as a basis for computing the countywide water requirements for the various crops shown in Table II below.

TABLE II

CROP REQUIREMENT

(From Department of Water Resources Data, Bulletin No. 58)

No.	Crop	Theoretical water requirement	Weighted efficiency (from Appendix A)	Calculated requirement
1.	Alfalfa	2.4 ft.	76 %	3.15 ft.
2.	Improved pasture	2.6	71.5	3.76
3.	Grain and hay	.53	70	.76
4.	Truck	.84	72.5	1.16
5.	Field	1.0	71	1.41
6.	Deciduous orchard	1.6	70.5	2.27
7.	Rice	4.1	71	5.76
8.	Vineyard	1.18	82	1.44

It was felt that the calculated water requirements in the above table based on data contained in Bulletin 58 appear to be too low for certain crops to satisfy their irrigation requirements. Two approaches were taken in analyzing this problem—(1) the efficiency factor may be too high for certain hydrographic units, or (2) the theoretical water requirements for certain crops were too low.

It was first deemed desirable to analyze the efficiency factors of each hydrographic unit to determine if they compare with other studies and experience.

In comparing the efficiency factors contained in Bulletin No. 20, "Interim Report, Cache Creek Investigations" dated April 1958, with those in Bulletin 58, we find on page 32, Table 3, an efficiency factor of 70 to 75 per cent for crops grown in the Cache Creek service area. (see Table III on the following page)

A major portion of this service area would be in the Woodland and Capay hydrographic units, as designated in Bulletin 58 as having an efficiency factor of 85 per cent. Because of the large area in the Woodland hydrographic unit, the weighted efficiency for the county becomes proportionately higher. If the Woodland and Capay units were reduced to 75% efficiency, the overall county efficiency would be 68.3% compared with 72.5% in Bulletin 58. A 68% efficiency would be more in line with general experience in Yolo County. This would also bring the average water use per year for all crops in Bulletin 58 to 2.76 acre-feet per acre.

It is recognized that some of the water loss in application is restored to the underground water table through deep percolation. It should be pointed out, however, that farmers are encountering difficulty in getting water to penetrate the depth of plant rooting due to soil compaction. Therefore, it is believed that considerable water, both rainfall and irrigation water, is lost through surface run off and evaporation which never reaches the underground water table. This is another reason for believing that 85% efficiency is too high for the Woodland and Capay hydrographic units.

In studying the water requirements of crops contained in Bulletin 58, it would appear that the rice, alfalfa, truck and field crop values are low. These are the major irrigated crops grown in the county. Sugar beets and tomatoes are the major field and truck crops grown in Yolo County. Therefore, the water use requirements for truck and field crops should be weighted toward their values.

It should also be pointed out that as our agricultural land becomes more valuable, there will be more intensive cropping and double cropping. More water will be required per acre to satisfy this cropping pattern. This trend has been evident in the last ten years and will continue.

TABLE III

ESTIMATED UNIT VALUES OF WATER REQUIREMENTS FOR PRINCIPAL CROPS IN CACHE CREEK SERVICE AREA

(From Department of Water Resources, Bulletin No. 20)

Crops	Consumptive use of applied water, in feet of depth	Farm irrigation efficiency, in percent	Farm delivery, in feet of depth
Fruits and nuts			
Almonds	1.5	75	2.0
Apricots	2.0	75	2.7
Prunes	2.0	75	2.7
Walnuts, peaches	2.5	75	3.3
Field and truck			
Alfalfa	2.7	75	3.5
Irrigated pasture	3.0	70	4.3
Sugar beets	1.8	75	2.4
Tomatoes	2.0	75	2.7
Beans, milo, etc.	1.5	75	2.1
Melons and other truck	1.5	70	2.1
Rice	4.1	75	9.0

In comparing the unit values of Water Requirements contained in Bulletin 20, Cache Creek Investigations (see Table III) with those in Bulletin 58, we find some variance in water requirements for certain crops. The crops listed and the unit values in Bulletin 20 are more representative of conditions in Yolo County. They are also more representative of conditions where expansion in irrigated acreage will take place. You will note that all estimated unit values in Bulletin 20 are higher than they are in Bulletin 58.

There is some question with regard to the amount of water credited to crop use from precipitation. It is recognized that winter rainfall contributes to the moisture supply of crops. Some of the precipitation, however, is lost by surface run off and does not enter the soil. Soil compaction has aggravated this problem, particularly during heavy precipitation.

Assuming that precipitation values used in arriving at theoretical water usage was taken from Table 113 of Bulletin 2, Water Utilization and Requirements of California, we find that the consumptive use of crops from precipitation ranges from 1.0 to 1.4 acre-feet per acre. It is estimated that the water penetration into the soil from these precipitation values would range from 4.9 to 13.6 feet in depth. The effective rooting depth of crops grown in Yolo County range from 2.0 to 10.0 feet. Along the Sacramento River, the depth of rooting for all crops is restricted by high water table.

Many of these crops are, therefore, unable to extract all of the precipitation moisture from the soil. The consumptive value of 1.0 to 1.4 acre-feet per acre from precipitation would appear to be somewhat high in these studies.

In addition to evaluating the theoretical use of water for Yolo County, actual farm water use data were collected. The amount of water used was in addition to precipitation. The Clear Lake Water Company of Woodland, which supplies surface water from Clear Lake to the Woodland and Western Yolo areas of the county, has water use records on various crops for the period 1948-1957 inclusive. Table IV gives the water delivery by crops.

TABLE IV

WATER DELIVERY BY CROPS, CLEAR LAKE WATER COMPANY

1948-1957

Crop	Acre-feet water
Alfalfa	2.50
Tomatoes and truck crops	2.43
Sugar Beets	2.55
Milo and Corn	1.55
Beans	1.51
Orchard and Vineyard	1.18
Rice	9.13
Miscellaneous crops	1.30

It should be called to the attention of this committee that with the exception of rice, well water is used to supplement Clear Lake water in most instances. Therefore, for crops other than rice, the water deliveries shown are less than the farmers actually use.

A survey of farmer's actual water use was made, at the request of the chairman of the Yolo County Flood Control and Water Conservation Committee, by the Agricultural Extension Service in Yolo County. A letter and return survey card was sent to about 500 farmers requesting, for each irrigated crop grown, the number of irrigations, the number of hours per irrigation, and the flow of well or head of water. From these data, water use by crops was calculated by one of the following formulas:

$$(1)\ \frac{\text{cu. ft. per sec.} \times \text{hrs.}}{\text{acres}} \qquad (2)\ \frac{\text{gal. per min.} \times \text{hrs.}}{450 \times \text{acres}}$$

Table V gives the acreage by crops and the applied water per acre.

It is anticipated that the above survey will be carried out more completely when farmers are less busy with their harvest and more time is available for this study. Data contained in Table V represent replies from 70 farmers.

Table VI summarizes the irrigation requirements data taken from Bulletin 58 and Bulletin 20 based on theoretical consumptive use (columns 1 and 2) with comparisons with farmers' actual water use taken from Clear Lake Water Records and the Agricultural Extension Service Survey (columns 3 and 4).

TABLE V

WATER USE SURVEY

AGRICULTURAL EXTENSION SERVICE

September 1958

No.	Crop	(1) Acres	(2) Acreage × Ac. ft. per acre	(3) Weighted average, ft. (2)/(1)
1.	Alfalfa	6,198	28,572.46	4.45
2.	Alfalfa seed	145	232.00	1.6
3.	Almonds	1,716	3,089.19	1.8
4.	Apricots	179	216.68	1.21
5.	Barley	190	150.30	0.79
6.	Beans	979	3,238.53	3.3
7.	Clover	43	157.54	3.66
8.	Corn	937	2,697.61	2.87
9.	Milo	1,657	4,354.07	2.62
10.	Orchards	262	618.34	2.36
11.	Improved pasture	603	2,160.65	3.58
12.	Peaches	75	221.87	2.95
13.	Prunes	208	395.12	1.9
14.	Rice	4,283	36,565.07	8.53
15.	Sudan	3,160	7,836.00	2.48
16.	Sugar Beets	1,710	6,566.08	3.84
17.	Tomatoes	2,272	8,317.27	3.69
18.	Walnuts	279	1,198.00	4.29
	Average (unweighted)			3.11
	Average (weighted)			4.2

Recommendations

1. Due to discrepancies in the data presented in Bulletin 58 and Bulletin 20, and with actual farmers' survey, further water use studies should be carried on by the Department of Water Resources on water requirement for Yolo County.
2. It is recommended that the water use values contained in Bulletin 20, Cache Creek Investigation, with an average efficiency of 70% be used.
3. It is recommended that the efficiency factor for the Woodland and Capay Hydrographic Units in Bulletin 58 be reduced from 85% to 70-75%.

In conclusion, I would like to again commend the Department of Water Resources on a job well done on a difficult assignment. Any statement contained in this report should be taken as constructive in nature and in no way critical. Any difference can be resolved by further study and cooperation.

s/ J. Bernell Harlan
Chairman, Yolo County Flood Control and Water Conservation District

TABLE VI

IRRIGATION WATER REQUIREMENTS

Summary Sheet

No.	Crop	Average total water requirement (1) Bull. 58 State Dept. Water Res.	(2) Bull. 20 State Dept. Water Res.	(3) 1948-1957 Clear Lake Water Co.	(4) Ag. Ext. Service Study ¶Sept. 1958
1.	Alfalfa	3.15	3.5	2.50	4.45
2.	Improved pasture	3.76	4.6		3.58
3.	Grain and grain hay	.76	--	--	0.79
4.	Tomatoes	--	2.7	2.43	3.69
5.	Truck crops	1.16	2.1		--
6.	Sugar Beets	--	2.4	2.55	3.84
7.	Sudan Grass	--	--	--	2.48
8.	Milo	--	--	1.55	2.62
9.	Corn	--	--		2.87
10.	Beans	--	*2.1	1.51	3.30
11.	Field crops	1.41	--	--	--
12.	Almonds	--	2.0	--	1.80
13.	Apricots	--	2.7	--	1.21
14.	Prunes	--	2.7	--	1.90
15.	Walnuts	--	†3.3	--	4.29
16.	Vineyard	1.44	--	1.18	--
17.	Deciduous Orchard	2.27	--		2.36
18.	Rice	5.76	9.0	9.13	8.53
19.	Alfalfa Seed	--	--	--	1.6
20.	Clover	--	--	--	3.66
21.	Peaches	--	--	--	2.95
22.	Miscellaneous	--	--	1.30	--
	Average all crops (Unweighted)	2.46	3.34	2.77	3.11
	Average all crops (Weighted)	2.59	‡4.42	4.51	4.2

* Includes milo.
† Includes peaches.
‡ See Appendix B.
¶ Does not include supplemental water supplied from wells.

APPENDIX A

AVERAGE COUNTY IRRIGATION EFFICIENCY (WEIGHTED)

(Data from Department of Water Resources)

Crop	(1) Hydrographic unit	(2) Efficiency	(3) Present crop acreage	(4) (2) × (3)	(5) Weighted efficiency
Alfalfa	West Yolo	55%	0	0	
	Capay	85%	610	508	
	Woodland	85%	23,770	20,200	
	East Yolo	70%	13,750	9,620	
	Colusa	70%	12,820	8,980	
	Cortina	50%	250	125	
	Arbuckle	60%	2,850	1,710	
			54,050	41,143	76%
Improved pasture	West Yolo	55%	60	33	
	Capay	85%	400	340	
	Woodland	85%	12,010	10,210	
	East Yolo	70%	14,840	10,400	
	Colusa	70%	53,330	37,300	
	Cortina	50%	290	145	
	Arbuckle	60%	3,930	2,360	
			84,860	60,788	71.5%
Grain and grain hay	West Yolo	55%	0	0	
	Capay	85%	0	0	
	Woodland	85%	0	0	
	East Yolo	70%	6,410	4,490	
	Colusa	70%	5,650	3,960	
	Cortina	50%	0	0	
	Arbuckle	60%	200	120	
			12,260	8,570	70%
Truck	West Yolo	55%	0	0	
	Capay	85%	0	0	
	Woodland	85%	11,450	9,740	
	East Yolo	70%	15,850	11,100	
	Colusa	70%	32,440	22,740	
	Cortina	50%	10	5	
	Arbuckle	60%	2,750	1,650	
			62,500	45,235	72.5%
Field	West Yolo	55%	0	0	
	Capay	85%	70	60	
	Woodland	85%	10,000	8,500	
	East Yolo	70%	24,510	16,650	
	Colusa	70%	26,660	18,680	
	Cortina	50%	50	25	
	Arbuckle	60%	2,210	1,327	
			63,500	45,242	71%
Deciduous orchard	West Yolo	55%	200	110	
	Capay	85%	970	824	
	Woodland	85%	7,380	6,270	
	East Yolo	70%	650	455	
	Colusa	70%	11,590	8,120	
	Cortina	50%	1,460	730	
	Arbuckle	60%	7,840	4,700	
			30,090	21,209	70.5%

APPENDIX A—Continued

AVERAGE COUNTY IRRIGATION EFFICIENCY (WEIGHTED)

(Data from Department of Water Resources)

Crop	(1) Hydrographic unit	(2) Efficiency	(3) Present crop acreage	(4) (2) × (3)	(5) Weighted efficiency
Rice	West Yolo	55%	0	0	
	Capay	85%	0	0	
	Woodland	85%	17,870	15,200	
	East Yolo	70%	25,900	18,140	
	Colusa	70%	199,980	140,000	
	Cortina	50%	40	20	
	Arbuckle	60%	6,310	3,780	
			250,100	177,140	71%
Vineyard	West Yolo	55%	0	0	
	Capay	85%	0	0	
	Woodland	85%	280	238	
	East Yolo	70%	0	0	
	Colusa	70%	0	0	
	Cortina	50%	0	0	
	Arbuckle	60%	40	24	
			320	262	82%
Total irrigated	West Yolo	55%	260	143	
	Capay	85%	2,050	1,785	
	Woodland	85%	82,980	70,500	
	East Yolo	70%	101,930	71,300	
	Colusa	70%	342,890	210,000	
	Cortina	50%	2,100	1,050	
	Arbuckle	60%	26,150	15,700	
			558,360	400,478	72%

APPENDIX B

WEIGHTED AVERAGE WATER REQUIREMENTS IN CACHE CREEK SERVICE AREA

(From Department of Water Resources, Bulletin No. 20)

Crop		(1)* Acres	(2)† Farm delivery, acre-feet	(3) (1) × (2)
Alfalfa		24,380	3.5	85,000
Irrigated pasture		12,410	4.3	53,300
Truck crops	Tomatoes, Melons	11,450	2.7	31,000
Field crops	Sugar Beets, Beans, Milo, Corn	10,070	2.3	23,100
Deciduous orchard	Almonds, Apricots, Prunes, Walnuts, Peaches	8,350	2.6	21,600
Rice		17,870	9.0	160,800
		84,530		374,800

$$\text{Weighted average} = \frac{(3)}{(1)} = \frac{374{,}800}{84{,}530} = 4.42 \text{ ac. ft.}$$

* Column (1): Bulletin No. 58.
† Column (2): Bulletin No. 20.

STATEMENT BY LAKE COUNTY BOARD OF SUPERVISORS AND LAKE COUNTY WATER COMMISSION

Lakeport, California, November 9, 1958

Part I

The County of Lake submits to the above named State agencies jointly conducting this hearing the following points for their consideration:

1. This County wishes to compliment the State Department of Water Resources on the completion of this difficult and monumental project. It shows careful study, excellent planning and thorough consideration of the problems involved.

2. However, there are several points which we feel should be emphasized and brought to the attention of all agencies and parties concerned. The first of which is our feeling that the future history of this whole area will be greatly influenced by the findings of this hearing as they affect the final draft of Bulletin #58.

3. Knowing the importance of water we have been vitally interested in the water problems of our County for many years. This County already has a long range water development plan and completed a study of its water needs by a private agency as early as November 1957.

4. It is the differences and discrepancies between the above mentioned study together with your own observations and the findings in Bulletin #58 to which we wish to call attention. They are:

   (a) The sum total of ultimate needs for this County, according to Bulletin #58 show 305,000 Ac. Ft. Our estimate is 520,000 Ac. Ft. This is too great a difference, especially where both agencies qualify as experts in the field.

   (b) Lake County has 92,000 acres of irrigable land with a mean of 3 Ac. Ft. per acre. This would require 276,000 Ac. Ft. To use our minimum estimate of ultimate acreage at 72,000 acres it would still exceed the estimate of 203,000 Ac. Ft. in Bulletin #58.

   (c) Lake County is geographically located adjoining the vast metropolitan San Francisco Bay Area. When that area becomes saturated population-wise it will have an effect on Lake County far greater than on any other county in this investigation. Therefore we feel that the ultimate population will be greater than estimated in Bulletin #58.

   (d) Relative to needs for recreation areas it is a fact that at present recreation is one of our two principal resources. In the future, with proper water development, it will surpass agriculture. Therefore the estimate of 4,400 Ac. Ft. for recreation areas is too small. To it should be added 3,700 to care for recreation visitors in addition to the above. Lake County already has approximately 750,000 visitors days annually, which will ultimately become millions.

   (e) Lake and proposed reservoir evaporation (not including many reservoirs included in our long range water development plan) would require a minimum of 191,000 Ac. Ft. Bulletin #58 shows only 79,000 under the heading "Net Reservoir Evaporation." Clear Lake alone, with an area of 64 Sq. miles and using a mean evaporation of 3 feet would require a minimum of at least 125,000 Ac. Ft.

   (f) Lake County's only source for supplemental water is the Eel River. If future estimates peg our needs as lower than we feel we need then we should now reserve an additional 200,000 Ac. Ft. from that source. Bulletin #58 shows Lake Pillsbury as needing only 2,100 Ac. Ft.

   (g) In summary, Lake County feels that the estimate in Bulletin #58 is too low. We feel that the estimate arrived at by private agency more closely approximates our true ultimate need. That figure is 520,000 Ac. Ft.

Part II

Proposals and Recommendations to the State of California as represented by its agencies whether Legislative, Judicial, Executive or administrative, or in quasi form of any of the above. (If they have jurisdiction pertaining to water problems.)

1. That if and when Lake County mutually agrees with the authorized State agencies as to the amount of water needed for its ultimate development said amount of water will be reserved by the State for this County from waters originating within its boundaries.

2. If such amount is not available due to present export then the State will guarantee sufficient water to meet its ultimate needs.

3. If more water originates within its boundaries than is required for its ultimate needs according to the above agreed-upon estimate the State will reserve an additional 10% as a reserve for contingencies and error in estimate. All water above

this amount to be made immediately available for export to areas of need. Lake County will be forever estopped from claiming any of said water made available for such export.

4. If there be disagreement between Lake County and State agencies as to amount required for ultimate need the State will reserve as a safety measure the amount of water the County feels it will ultimately need.
5. Lake County will be required to submit an overall long range plan of water development which will be filed with the State. The State will recognize the plan and use it as a basis for reserving in perpetuity that amount of water.
6. Lake County will be required to show reasonable progress in carrying out its plan.
7. Nothing in the agreement shall prevent the loan for beneficial use by the State or Lake County of such reserved waters until such time as they will be needed by Lake County.
8. In summary: If the State will reserve in perpetuity the amount of water we need plus 10% for safety; Lake County will: (1) cooperate and release all claim to waters over and above the amount reserved; (2) agree to a loan of such reserved waters until needed; (3) submit a plan for the development of said reserved waters; (4) begin immediate work toward the completion of its water program subject as rapidly as its resources will permit.
9. The above points or a modification of them might meet the needs of other counties listed in Bulletin #58 and are considered as possibilities in helping to resolve our present stalemate in water problems of Northern California.

VERBAL COMMENTS

MR. COLIN HANDFORTH
Yuba County

Mr. Handforth: Gentlemen, I'm Colin Handforth, representing Yuba County. We don't have a specifically prepared statement. I didn't get word of this, personally, until too late to do that—dislocation in communication inside the county. However, we did prepare a brief summary for the Senate Interim Committee on prepared water projects, and I'd like to submit a copy of that as something in writing. Yuba County feels that, in the main, this Bulletin 58 is very good and agrees with almost all the information in it.

The County has taken exception to a couple of points and has presented some figures in this report which was submitted to the Senate Interim Committee which are in conflict with figures in Bulletin 58, not so much as to present authoritative figures differing with the bulletin as to point up the fact that a little bit different interpretation of a different point can result in quite different figures, and a couple of specific points which illustrate this are in the efficiencies involved in two specific areas, the Marysville and Challenge Areas, and the State has in Bulletin 58 allowed efficiencies of 75 and 80 percent, respectively, in those two areas. We feel that those are somewhat high.

Another point, we found that in dealing with the figures and tabulations in Bulletin 58, there was some difficulty in finding just exactly how those figures had been arrived at, not that we quarrel with the figures but we had a hard time in some cases tracing how those figures had been arrived at; and even on calling the Department of Water Resources and talking with the people who had assembled them, we still had difficulty in finding just where the figures had come from. Other than that, we have no objections, and we think it's a very commendable effort and certainly an exhaustive study.

MR. J. BERNELL HARLAN
Yolo County Flood Control and Water Conservation District

Mr. Harlan: We have a prepared statement with a few brief comments. We, too, want to commend the Commission and the Department for making this thorough investigation and feel that they have done an excellent job, and as Yuba has presented, we do have some reservations about the ultimate needs. In the first place, we as a board, and I refer to the board as the Yolo County Flood Control Water Conservation District, are reluctant, don't feel that we're qualified to say that we can accept an exact number of acre-feet as anything that will be our ultimate requirements or needs, that we feel that for comparative and planning purposes, why, this figure is quite fine, but when you come down to saying that, "This is all we'll ever need," we don't feel qualified to say that this is exactly the fact. We're inclined to believe that agriculture will intensify in the future as we have seen it do at the present time, and in Yolo County, why, there's a large number of fields at the present time undergoing major leveling operations, which indicates we're in that same trend, and also the fact that we're doing a lot of double-cropping in the face of all these surpluses. The tendency for double-cropping is increasing rather than decreasing, which you'd think the opposite would be true in these surplus conditions. Also, we're short of using our full energy on this, hoping to develop Cache Creek on the local interest basis, which will probably take care of the needs of Yolo County for 20-some years or better, and we feel that even though we're short on our ultimate needs in the County, that eventually by the time we actually have to have them, probably the North Coast Area or some other thing will be tapped, and we haven't filed on those future long distance deals, because actually where you're not going to do anything for such a long period of time, why, it just kind of clouds the issue and probably the Water Rights Board wouldn't appreciate it either.

I think that Bulletin 58 is, in essence, an attempt to see what are going to be the ultimate requirements of these counties, and then they can use that for purposes of planning and that sort of thing, and I think we're satisfied at the moment to let it go on that basis.

We're pretty familiar with your Cache Creek Program reports and have been studying them, and there is a little difference in the actual water requirements for the crops in that and in Bulletin 58, and your Cache Creek Program reports come more nearly agreeing with what we, on a practical basis, feel are the actual needs for the crops themselves.

And in addition, why, when we knew this hearing was going to come up, why, we asked the Extension Service to go out and make an immediate survey of what we were actually using in the County, and they did this, and they wrote to some 500 growers and compiled the results and weighted averages and have done a very, very excellent job, and this is also compiled in this written statment we have, so we've got a pretty good idea of what the actual farm practices at the moment are, and we feel that from a practical standpoint that, perhaps, in Bulletin 58 you're a little bit low; and again, as the people from Yuba County indicated, we weren't quite sure how they arrived at the actual figures, that we feel that it was more or less of a theoretical type of use than an actual multiplication, and we feel that the actual crop practice in our County tends to use more water and that, perhaps, the efficiencies are just a little bit high. We're not in substantial disagreement with the total acreage and total water requirements, however. It's some 2.9 acre-feet per year, per acre, for the irrigable acres; and we, as is pointed out in our written statement, have talked in terms of around three acre-feet, and so we're not in substantial disagreement. But again, we just don't believe it's quite practical to say, "We'll accept a figure and say this is the ultimate needs," and just in exact number of acre-feet; hence, to substantiate that, I think we have to view that there are shifts in agriculture, that there are changes in irrigation practice, and it may be that due to increased efficiency and that sort of thing that we can materially reduce the amount of water that will eventually be required.

Then, there's varietal developments in research by the University, and that sort of thing, which tends to have a difference in water requirements by the different crops. We may eventually have weather modification, we don't know. It's certainly a possibility, and there are probably many others.

So I think with this brief summary of what is in our written report, that that is the comments I have to make to this Committee, and I believe Mr. Gordon, another member of our board, may have a few brief comments. Thank you very much.

Mr. Hill: Thank you very much, Mr. Harlan, for your comments. We know that you people in Yolo County have done a tremendous amount of work on your own over there.

I would like to ask, in many areas that we've seen, there seems to be quite a tendency to use excessive amounts of water.

Mr. Harlan: I think that is going on in Yolo County in certain instances. I think there's no question about it.

Mr. Hill: Actually, to the detriment of the land, let alone excess use of water.

Mr. Harlan: That's right. I think you'll find in areas where the water is relatively cheap, that that does happen, that the cost of actual labor involved and cost of water is a matter and that you'll get an excessive use of water where water is quite cheap, rather than more supervision and labor to try to control that thing, because of the cost of water, and I think Yolo County is still pretty fortunate in their water situation. In fact, as I've indicated to the chairman and several others, that is one of our problems, that there's a little complacency in our County because we are so fortunate, and we have to look into the future, and I feel we probably can increase our efficiency quite a bit in the future. And as I say, some of these new crops and things will make a difference in the thing, but again I repeat, we're not in substantial disagreement with the ultimate figure on the thing; but on the practical basis, I think it amounts to 129,000 acre-feet, but that again is a theoretical figure. We haven't got the actual research behind that, but we did go to the trouble of sending out and getting what is the actual use of the present time, and I think that as you point out, that there are in some instances probably some excessive uses of water in that. Probably it will average out more nearly though because there's probably some of these because of penetration problems, land compaction, with this heavy machinery, and that sort of thing, which is going the other way. People think they're getting penetration when they actually aren't.

MR. CHARLES M. GORDON
Yolo County Flood Control and Water Conservation District

Mr. Gordon: Charles Gordon, another member of the board of Yolo County. I'd like to just make a statement that I feel that Bulletin 58 doesn't bring out possible economic changes that can take place, that can affect the future tremendously. For example, we'll say, one hundred years ago, Los Angeles City could solve its water problem by just adding another burro with a couple of jars tied on the side, and who at that time would dream that water was going to come from the Colorado River, and as far north latitude as the City of San Francisco, from the east side of the Sierras, and for us to say the absolute future of Yolo County water is just so much; for example, there's an economic trend going on in Yolo County that is possibly going on in others, but it's just in the last few years more and more farmers are double-cropping, and that means that they are using just that much more water. It will possibly be, if the returns warrant, there'll be even triple-cropping in some crops. The County is expected to grow tremendously in population, as you can see on the chart here, and what industries coming in can affect it.

We're not too far from San Francisco, with the port and with deep sea vessels coming into Sacramento area here, why, that will possibly affect the amount of water that Yolo County consumes, so I don't feel that that is covered as fully in Bulletin 58 as it might be, but it's looking into the future, into the crystal ball, that none of us can do very well.

MR. DAVID J. COX
Kelseyville, Lake County

Mr. Cox: Mr. Chairman, I don't know whether you would take time to read it [a prepared statement], or should I speak at this time and you can go over the items as I cover them?

Again, Lake County wishes to compliment those who are responsible for this investigation.

I'll not attempt to be repetitious of things that are in black and white on the first page of this statement, and in the second paragraph we make this statement:

"However, there are several points which we feel should be emphasized and brought to the attention of all agencies and parties concerned. The first of which is our feeling that the future history of this whole area will be greatly influenced by the findings of this hearing as they affect the final draft of Bulletin No. 58."

I'd like to speak on just one sentence on that, Mr. Chairman. As an illustration, Yolo County and Lake County are working now on intercounty agreement. That will, in part, be based upon what we feel our needs are in these two counties relative to that particular watershed, and I think that in the course of law and future hearings, whatever the final tab is relative to the amount of water needed is going to be used as evidence, and I think it is very important that the final amounts or the final decisions relative to those amounts should be pretty clearly put, because 50, 75, or 100 years from now, we may be a long way off and some of us might have agreed to certain amounts that are in error and will have to be corrected, and that is something that I'd rather make a statement that it's far better to use foresight than hindsight in these matters.

Statement No. 3, Paragraph No. 3:

"Knowing the importance of water we have been vitally interested in the water problems of our county for many years. This county already has a long range water development plan and completed a study of its water needs by a private agency as early as November 1957." And that is where Mr. Dewante will come in sometime during this recapitulation.

Number 4: "It is the differences and discrepencies between the above mentioned study together with your own observations and the findings in Bulletin No. 58 to which we wish to call attention."

First: "The sum total of ultimate needs for this County, according to Bulletin No. 58 show 305,000 ac.-ft. Our estimate is 520,000 ac.-ft. . . ."

The discrepancies or range that wide must be reconciled in some way or another. I think there is a possibility that they can be reconciled. To just make a bald statement that there is that much difference between the judgment of two sets of experts is really almost making a joke of it. There couldn't be that great a range, so there must be an explanation there somewhere.

Now, Lake County, as you know, is a rather hilly type of county. Those of you who have not been over there have missed something, because you ought to go over there. Lake County has 92,000 acres of irrigable land with a mean need of 3 acre-feet per acre, whether you use the Atmometric system—you gentlemen from the University of California and Utah State and others—or whether you use Blaney and Criddle and some of the other estimates that were used. Prior to that, I think a mean of 3 acre-feet wouldn't be too far off, plus or minus. I'm not going to quarrel with that, but we do have out of that 92,000 acres a strong possibility that ultimately we will actually put into operation through irrigation about 72,000 acres, and taking that again and multiplying it by three, roughly, you'd find some 203,000 acre-feet, that can come somewhere near the approximation in Bulletin 58, but we still think it is a little bit low. We're not quarreling too much with the estimates in Bulletin 58; on that matter, there's another point that we must consider a little later.

Now, another item that you have is various categories of our future population needs, recreation needs, and so on. Let me back up just a little bit and make this statement. Lake County is, I think, different from any other county in this whole Northeastern Counties Investigation for three or four reasons. In the first place, it is very close to the vast metropolitan San Francisco Bay Area. When Lake County population becomes saturated, one of the principal places of overflow is going to be in the adjoining county. The far counties in the north end are not affected by that. Secondly, we are in a peculiar situation in that we have a vast potential as well as present lake area or reservoir area that must be considered, and that is a very important point.

We feel that the population estimate in Bulletin 58 is considerably smaller. Our population will not increase immediately, for the simple reason that until that Bay region reaches approximately 15,000,000 people, which has been predicted, we will not have too much from there. We have Napa Valley, we have Sonoma Valley, we have the areas up and down the Sacramento River. All of those will be pretty well filled out before they decide they're going to live in Lake County and work somewhere in the Bay region. Of course, we do have situations there now, and a lot of them are semi-permanent as against purely a summer-resident type of individual.

The next point I would like to make—well, I can read it. "Relative to needs for recreation areas it is a fact that at present recreation is one of our two principal resources."

In Lake County, agriculture would be number one and recreation very close as number two.

"In the future, with proper water development, it will surpass agriculture," because of limited areas that can be devoted to agriculture. "Therefore the estimate of 4,400 ac.-ft. for recreation areas is too small."

Now, Mr. Dewante's report shows something else, but I think Mr. Dewante can explain that in just a moment, in that it pertains more to use for the areas themselves rather than lakes, ponds, and so on. At least, that is subject to Mr. Dewante's comments.

"Lake County already has approximately 750,000 visitors days annually," and eventually with the development of our water program, which we at present have already set up, we feel that the potential is just unlimited because of the possibilities in that County for recreation. It's a natural, and it certainly will surpass agriculture, in our estimation.

And here's another statement: "Lake and proposed reservoir evaporation (not including many reservoirs included in our long range water development plan) would require a minimum of 191,000 ac.-ft.," plus or minus, and that pretty closely approximates Mr. Dewante's statement, but we have a number of reservoirs planned at the present time in our recently formed Ultimate Development Plan that would exceed the area there, and so it very probably could go above that.

Bulletin 58 shows 79,000 acre-feet for evaporation, and you take again the mean in Lake County, whether you use one formula or another, is approximately 3 acre-feet per acre of surface evaporation there. I think the State authorities—and again I'm saying this with tongue in cheek—have gone as high on estimates as 3.5. Clear Lake estimates have been as low as 2.8, but the mean would be plus or minus 3 feet. Clear Lake alone, with an area of 64 square miles, which is roughly 41,000 acre-feet, per surface, and three times that would still give you one hundred twenty-some thousand acre-feet at the minimum, the very minimum. That doesn't include other reservoirs present, Lake Pillsbury and other reservoirs, small ones, but some of the proposed reservoirs, and those are not even listed in either Bulletin 58 as a potential or in Mr. Dewante's study, so we feel that there must be some explanation to that. In other words, does the 305,000 acre-feet exclude all of this evaporation? Certainly, we must reconcile that in some way or other, because that discrepancy is intolerable, in my estimation.

The next point, Lake County's only source for some supplemental water is the Eel River. If future estimates peg our need as lower than we feel we need, then we should now reserve an additional 200,000 acre-feet to make our future supplemental water supply safe, and I'm speaking now to the Water Commission and the State Department of Water Resources and all of California, as far as that goes, because there's no other place for us to get water. So if we make a mistake on this estimate and we accept it, we're sunk, that is all, or we're "blown" away, whichever you want to use.

"In summary, Lake County feels that the estimate in Bulletin 58 is too low. We feel that the estimate arrived at by private agency more closely approximates our true ultimate need. That figure is 520,000 ac. ft." That takes care of evaporation and everything else. That is the figure arrived at in Mr. Dewante's study.

This Part II is something I would like to hold until Mr. Dewante, if he has any statements on any of those comments. And again, Mr. Dewante, if I'm in error, I will bow to you as the expert. I am the layman.

And that is, in general, what the case is, that there's too large a discrepancy between what we feel is our estimate of need, by private engineering expert study as well as our own estimates, lay estimates, practical estimates, and that set up in Bulletin 58. . . .

I have one point I'd like to make under Number II. As I say, that possible explanation on Clear Lake and evaporation could very possibly be reconciled. . . .

Getting back to the point I made earlier, relative to the importance of this investigation and its potential in the future, we in our County have a statement here that is partly hypothetical, but it is still, I think, relevant to this situation, and it will take me just a minute to read it, and then I'll keep still from here on out. . . .

It's their proposals here, and those proposals are based entirely on Lake County's viewpoint. In other words, we want to get before the Legislators and the various State agencies our thinking and possibly what might come out of this, and I'm speaking specifically for Lake County. If anyone else wants to kick those things around, that would be up to them.

This Part II, I'll read verbatim.

"Proposals and Recommendations to the State of California as represented by its agencies whether Legislative, Judicial, Executive or administrative, or in quasi form of any of the above." So that pertains to the whole State hierarchy of officials and agencies, providing, "they have jurisdiction pertaining to water problems.

"1. That if and when Lake County mutually agrees with the authorized State agencies as to the amount of water needed for its ultimate development said amount of water will be reserved by the State for this County from waters originating within its boundaries.

"2. If such amount is not available due to present export then the State will guarantee sufficient water to meet its ultimate needs."

In the case of Lake County, it would be the Eel River. That is our only possible supplemental source.

"3. If more water originates within its boundaries than is required for its ultimate needs according to the above agreed-upon estimate the State will reserve an additional 10 percent as a reserve for contingencies and error in estimate. All water above this amount to be made immediately available for export to areas of need. Lake County will be forever stopped from claiming any of said water made available for such export."

That is a pretty strong statement, but see how strongly this whole document may affect the future of our County and possibly some of the others.

"4. If there be disagreement between Lake County and State agencies"—that is the point I'm bringing up here now—"as to amount required for ultimate need the State will reserve as a safety measure the amount of water the County feels it will ultimately need."

520,000 acre-feet, plus or minus, depending on that evaporation factor.

"5. Lake County will be required to submit an over-all long range plan of water development which will be filed with the State. The State will recognize the plan and use it as a basis for reserving in perpetuity that amount of water.

"6. Lake County will be required to show reasonable progress in carrying out its plan.

"7. Nothing in the agreement shall prevent the loan for beneficial use by the State or Lake County of such reserved waters until such time as they will be needed by Lake County.

"8. In summary: If the State will reserve in perpetuity the amount of water we need plus 10 percent for safety; Lake County will: (1) cooperate and release all claim to waters over and above the amount reserved; (2) agree to a loan of such reserved waters until needed; (3) submit a plan for the development of said reserved waters; (4) begin immediate work toward the completion of its water program subject as rapidly as its resources will permit" and need, of course. That is a typographical error on that; my apology for that.

"9. The above points or modification of them might meet the needs of other counties listed in Bulletin No. 58 and are considered as possibilities in helping to resolve our present stalemate in water problems of Northern California."

Well, gentlemen, I want to apologize in that I've not closely examined your duties and functions, and I apologize for that. It may be that you have recommendatory power. It may be that other State agencies will ask your opinions, if you want to refer to Lake County. We're not putting it on the line. It is just some of our own thinking, and we'd be willing to go along with something equivalent to that if the State authorities say, "Well, what is your recommendation?"—the California Water Commission. At least, that is our thinking, and someone else might want to use the same or a variation of it.

Thanks for taking that extra time, Mr. Chairman, but we feel that it is a very important point.

MR. RANDOLPH DEWANTE
Consulting Civil Engineer, Sacramento

Mr. Dewante: Well, actually, I really did not intend to go into a detailed discussion of the discrepancy in these figures. I don't think that, perhaps, this is the time or place to do that. The actual difference between the figure is composed of a number of items involving unit values, areas of land, assumptions as to water consumption, water efficiences, and numerous other items, the sum total of which accounts for the difference; and as I say, I think that it would be a little bit too involved to go into a detailed discussion at this time. I think that is a matter more for discussion at this time. I think that is a matter more for discussion between our people, engineers of our organization and engineers of the Department of Water Resources, concerning some of these specific items.

A lot of the difference might be explained simply in the definition of water supply and water requirements, because, particularly in the case of evaporation, it depends on the evaporation that is included in the water supply, what figure you use for a water requirement. In other words, the two are interrelated, and that again is a rather involved subject which I think should be discussed between engineers of the State and our staffs.

I'd be glad to answer any questions that anybody may have, but I'm not prepared to go into a detailed, technical discussion of these matters at this time.

. . . Another item which, of course, accounts for a sizable amount—it doesn't bring the figures right in line—but one item which we have included is a contingency reserve of 10 per cent. Now, in other words, we take the position that the estimate of water requirement is much like the estimate of cost of a project or any other estimate. It's subject to error, and, of course, the tendency is to underestimate, because you don't realize there are so many things which you don't expect to develop. You certainly take care of all the things which you know are going to happen or think are going to happen; if you err, it is going to be on the low side, just as if you were making an estimate of the cost of a house, so we have included a 10 per cent contingency to allow for such possible errors we feel are proper.

Now, that alone in this case accounts for 47,000 acre-feet. I mean, it's a sizable item, but that is what I mean when I say that the discrepancy is actually made up of a number of items, some due to different assumptions, some due to different definitions, no doubt. A lot of the basic land classification data, though, I think should be in fairly close agreement, because we discussed that with the State people, State Department of Water Resources people, during the program of our investigation.

MR. GEORGE MITCHELL
County Supervisor, Lake County

Mr. Mitchell: I didn't have any prepared statement, but I want to go on record as believing that we shouldn't make any firm commitment at this time until further study is made into our water needs in Lake County.

MR. KURT SCHAMBER
Clear Lake Highlands, Lake County

Mr. Schamber: I'm not the spokesman. We agreed that George Mitchell will do our talking; but yet when I sit here, I can't help but boil once in awhile, and I want to say a few things. I want to compliment Mrs. Davis on her statement in regard to our water requirements and our commitments. Have you folks any picture of Lake County? I mean a horizontal picture of our lake up there which is made by rainfall entirely and some springs in it, and we have approximately 64 square miles of lake water.

Now, that flows into Cache Creek, in through the dam, and down the Cache Creek, and Yolo County at this time is getting our surplus waters already, and has a right to them, which they have filed back in 1912, as I understand it. I think it was deeded to them, you might say, when they got the water right.

Now, comes North Fork of the Cache Creek, which at this time Lake County isn't using to any great extent, perhaps, at the sources. Now, Wilson Valley Dam is proposed there, and that would be impounded. And then certain statements here said that Clear Lake will stabilize that lake. We can't afford to stabilize any lake.

At this time, we have three feet of water above zero on the Rumsey Gauge.

Now, again back to the picture. You have a lake there——

Mr. Hill: We're quite familiar with it. We've all been up there and we're quite familiar with your geographical situation.

Mr. Schamber: You know that?

Mr. Hill: Yes, sir; and we've been through those hearings on that, and we're familiar with that situation there, the outlet to Clear Lake.

Mr. Schamber: When our water is at zero on the Rumsey Gauge, it's pretty darn low water, and that is when people really start raising a rumpus up there. When it's high, then the other side starts in yelling when they get flooded out. They've built on low tide, you might say, and even against the advice of people up there, but they would build on low water because they wanted to be able to throw their fishline out and catch fish through the back window. Now, those people, I don't think, should have too much consideration in regard to floodwater, because there's plenty of high land there they can build on; and if they built low, let them put a jack under it and jack the house up; but we feel we cannot afford any water. Our potential is twice as great, or greater, than our intake in that lake. We figure here we have 422,000 acre-feet coming into that lake every year. Our needs, according to this gentleman there, Mr. Dewante, I believe, are 459,000 acre-feet. Now, how can you give any water away. But we already are giving our surplus away. And how can you give any more?

And anyway, I want to say this, there's a lot of water flowing down the Sacramento River going in the San Francisco Bay, and you can pump it out of there for Yolo County and the rest of them.

MR. W. A. BARR
County Supervisor, Siskiyou County

Mr. Barr: Mr. Chairman, I won't take much of your time. We've already had our hearing and made a presentation. I was instructed to come down here by the Board of Supervisors, simply to reiterate our position in regard to the allocation of waters in Siskiyou County. I have a little additional information here, and I'll present this to the Chairman. As stated in that, of which you have a previous copy from my Water Board there, we feel that the allocation of water is insufficient in most every category. Our Farm Adviser comes up with a little further information here that you didn't have before on a variation of a flow of water throughout the years. You may have it and you may not, I don't know, but I'd like to give it to you anyhow.

The Klamath River on an average from 1920 to 1954 varied from a high of 1,428,000 acre-feet to 800,000 acre-feet, and the Shasta River near Yreka varied from a high of 261,000 to 101,000, and the Scotts River near Fort Jones varied from a high of 832,000 acre-feet to 92,000 acre-feet. Now the question that comes to our mind, what condition are you going to allocate that water under? Most certainly, you can't give people in that country sufficient water if you allocate the water on a minimum flow. Now, who knows how much water is going to fall, what our precipitation is going to be any one year? It seems to me there must be some arrangement arrived at to determine under what conditions these allocations are going to be made. And as I said, you already have our presentation, Mr. Banks has a letter from myself on this meeting, and I haven't anything further to say except to repeat that we wish to keep our position before this body.

Mr. Hill: Thank you very much, Mr. Barr. I note in your paper you handed me two statements. "Further studies be carried on to determine more accurately the consumptive needs of water and total water requirements for our crops."

I believe that Mr. Banks and others have asked that those studies be carried on, not only in Siskiyou county but State-wide to get better information that is available, and it's been pointed out that it does take considerable time. And I gather from your last statement here: "No move be made to determine total water requirements or amount of surplus water until further studies have been made." I presume by that, you are stating, if I read it right, that if reservations are made, that they shall be general reservations instead of specific reservations, based on your first statement that you think that you feel you have more requirements than his studies show?

Mr. Barr: That is right, and there's one little thing I would like to add to this, and that is the fact that there's 13,000,000 acre-feet of water going to waste on the Klamath River all the time, and they're battling over taking water from Lake County to Yolo County, and this county and another. There you've got 13,000,000 acre-feet of water going to waste in the foreseeable future, and according to the best information that I can get, there never will be any use for it in that particular country up there after it passes Somnes Bar, so it seems to me that in view of the fact that the population and wealth of Southern California has increased to the point that it has, I don't believe it would cost them but very little more per capita to get from Klamath River more water now than it did when we perpetuated it on Owens Valley.

ADDITIONAL WRITTEN COMMENTS

State of California
Department of Natural Resources
Sacramento 14, California, June 2, 1958

Mr. Harvey O. Banks
Director, Department of Water Resources
Public Works Building
Sacramento, California

Subject: Bulletin No. 58, Northeastern Counties Investigation

Dear Mr. Banks:

Thank you for submitting subject to this office for our information and review. Our Divisions of Beaches and Parks, Forestry, and Soil Conservation have reviewed the report and have submitted the following comments:

Beaches and Parks

"The report is informative and of great interest to this division, and the wealth of information set forth will furnish background information for any investigations that may be undertaken in any of the counties covered by the bulletin.

"I am sure we will find the information on land use, rainfall, topography, recreation and associated subjects most useful in the future."

Forestry

"We are particularly pleased that the bulletin gives full recognition of the timber resource in the northeastern counties since it is the mainstay of the economy in most of the area. Similarly, we are pleased that the Department of Water Resources saw fit to isolate the water requirements for the forest products industry from other uses. The estimates of probable ultimate mean seasonal water requirements for this industry took into consideration the recently completed pulp and paper study sponsored by the State Water Pollution Control Board and appear to be reasonable.

"One item we failed to find in the report is mention of the importance of watershed protection and management in maintaining optimum water quality and yield. The State spends a good share of its 18 million dollar annual forest and watershed fire protection budget in these counties. On page 108 of the bulletin there is listed various factors of water quality impairment. We feel that erosion and flood run-off caused by improper protection and management of the watersheds are important considerations in water quality and quantity planning.

"One rather small point we would like to comment on is a statement made on pages 31-32, in discussing timber in Lassen County. The last sentence says: 'The overcutting will remove the mature and overripe trees and promote increased growth.' In our opinion this is not quite true. What is meant is that the conversion of stagnant old-growth stands into thrifty young stands by harvesting will increase growth.

"We have previously discussed these points with Assistant Director William Fairbank of the Department of Water Resources.

"On the whole the report is good and it provides much valuable data for use in water planning and development. We appreciate the credit the division received for its cooperation in the acknowledgment."

Soil Conservation

"The bulletin represents a rather comprehensive compendium of basic data on both water resources and requirements for the study counties. . . . The bulletin contains a wealth of basic information and may be useful in future work in this division."

DEWITT NELSON, Director
BY: EDWARD F. DOLDER
Deputy Director

TULELAKE IRRIGATION DISTRICT
TULELAKE, CALIFORNIA, May 25, 1959

MR. HARVEY O. BANKS, *Director*
Department of Water Resources
401 Public Works Building
P.O. Box 1079, Sacramento 5, California

DEAR MR. BANKS:

We have read and reviewed with interest a copy of your bulletin #58, showing the water requirements for the Northeastern counties area. We generally believe that the report shows a satisfactory analysis of the needs and requirements of the area. I would like to suggest that as future reports such as this are drafted that they be specifically circulated to the agencies specifically concerned with water development with a request for study and comment.

One comment which we would like to make and suggest for change in the Tulelake Irrigation District is to show that Tulelake comprising some 13,200 acres will probably be drained in the near future and converted into irrigable land. There would then remain about 600 acres in the present refuge which we would expect to be converted into a balancing reservoir. We believe that the ultimate use should show 30,000 acres of present public land would become irrigated private land rather than for use as a waterfowl sanctuary.

Similarly with regard to the storage reservoir at Clear Lake Reservoir of approximately 527,000 acre-feet and embracing approximately 25,000 acres, it is our plan coordinate with the Bureau of Reclamation that this be turned into a jointly used waterfowl refuge comprising irrigated land and a small balancing reservoir of approximately 25,000 acre-feet. We would then propose at the boundary site or near Clear Lake that an irrigation flood control, and power reservoir of approximately 100,000 acre-feet would be constructed. This plan we believe would provide land desirable for waterfowl use and would reduce markedly the evaporation losses at Clear Lake Reservoir.

Respectfully yours,

/s/ MAURICE K. STRANTZ, Manager

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LOCATION OF
THE NORTHEASTERN COUNTIES
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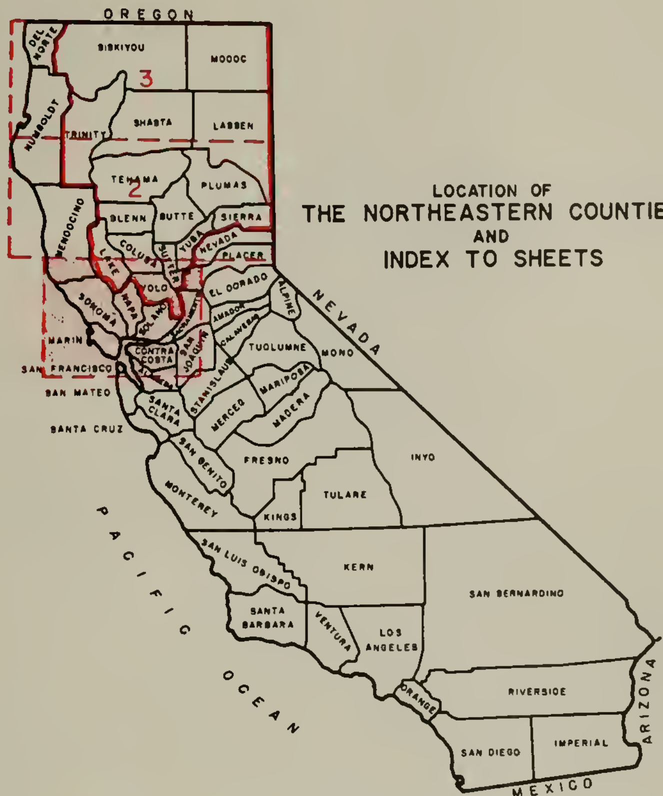
INDEX TO SHEETS



LEGEND

Qal RECENT AND SOME OLDER ALLUVIUM, ALLUVIAL FANS AND TERRACE DEPOSITS
LARGELY FLUVIAL BUT INCLUDES PLAYA LAKE DEPOSITS, MARSH DEPOSITS, PLEISTOCENE LAKE BEDS, AND GLACIAL MORAINES AND DRIFT. CONSISTS OF GRAVEL, SAND, (SOME TUFFACEOUS), SILT, CLAY, AND LACUSTRINE MARL, AND CLAY. THE AREAS OF Qal ARE IN GENERAL GROUND WATER BASINS IN MODOC, SISKIYOU AND LASSEN COUNTIES THE GROUND WATER BASINS INCLUDE SOME RECENT WATER-BEARING VOLCANICS

TQ UNDIFFERENTIATED PLIOCENE AND SOME PLEISTOCENE NON-MARINE SEDIMENTS OF VARIABLE LITHOLOGY
INCLUDES CACHE, TEHAMA AND TUSCAN FORMATIONS WATER-BEARING IN PART

T UNDIFFERENTIATED OLDER TERTIARY (MOSTLY EOCENE OR PALEOCENE), MARINE AND NON-MARINE SEDIMENTS OF VARIABLE LITHOLOGY
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MOSTLY NONWATER-BEARING, BUT SOME BASALT FLOWS ARE VERY HIGHLY WATER-BEARING

JK UNDIFFERENTIATED JURASSIC AND CRETACEOUS SEDIMENTARY, VOLCANIC, METASEDIMENTARY, AND METAVOLCANIC ROCKS
INCLUDES THE KNOXVILLE AND FOREMAN FORMATIONS, SHASTA SERIES AND THE FRANCISCAN GROUP. GENERALLY NONWATER-BEARING, BUT LOCALLY CONTAIN CONNATE WATER.

bc BASEMENT COMPLEX
INCLUDES METAMORPHIC AND INTRUSIVE IGNEOUS ROCKS CRETACEOUS AND OLDER. GENERALLY NONWATER-BEARING

STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
DIVISION OF RESOURCES PLANNING
NORTHEASTERN COUNTIES INVESTIGATION

GENERALIZED GEOLOGIC MAP OF THE NORTHEASTERN COUNTIES

SCALE OF MILES

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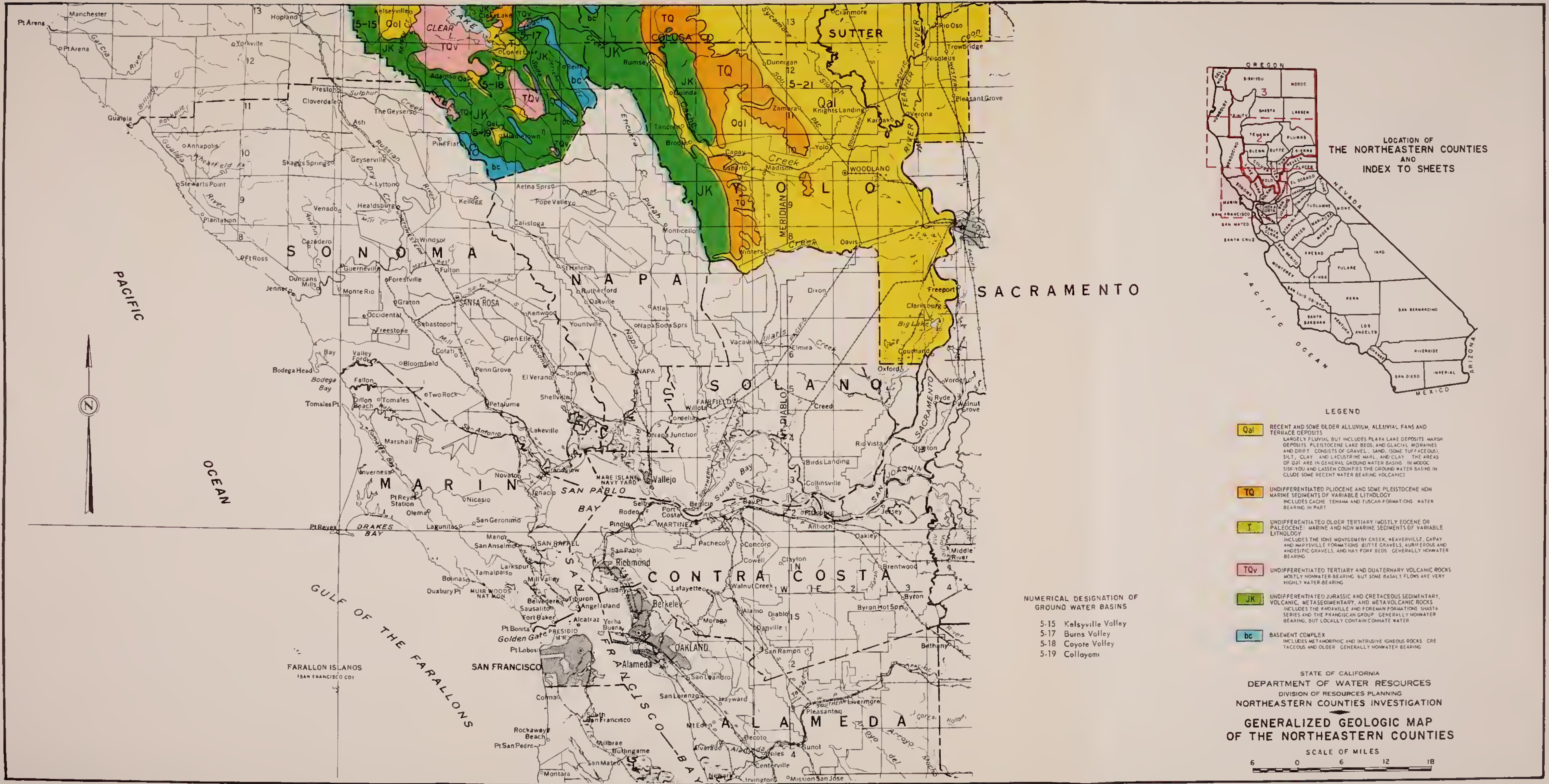
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5-17 Burns Valley
5-18 Coyote Valley
5-19 Collayomi
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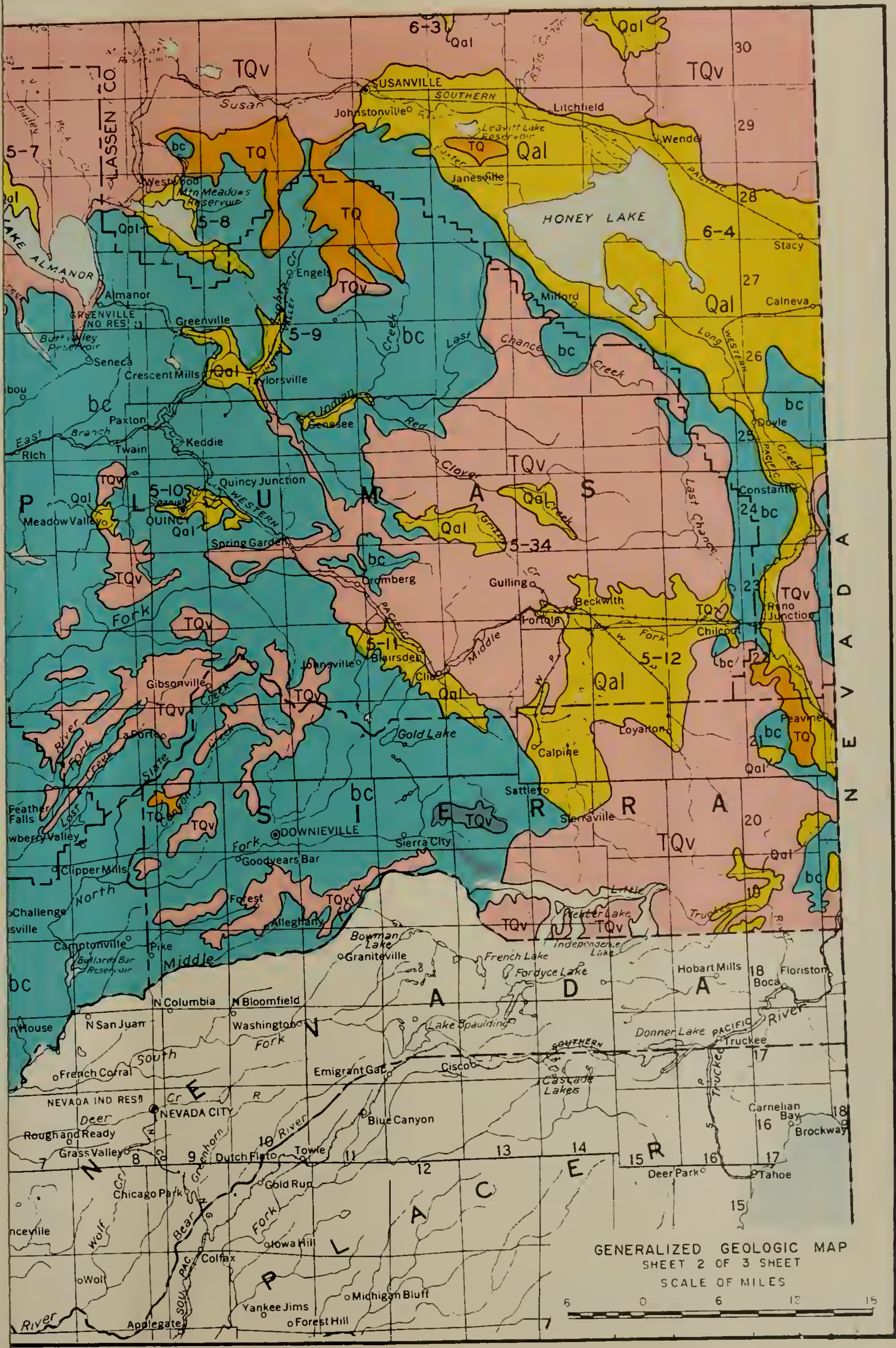
OF THE NORTHEASTERN COUNTIES
SCALE OF MILES
6 0 6 12 18
SONOMA
NAPA
YOLO
SOLANO
SACRAMENTO
MARIN
CONTRA COSTA
ALAMEDA
COLUSA
SUTTER
PACIFIC OCEAN
SAN FRANCISCO
OAKLAND
SAN PABLO BAY
SUISUN BAY
GULF OF THE FARALLONS
DRAKES BAY
FARALLON ISLANDS



GENERALIZED GEOLOGIC MAP
SHEET 2 OF 3 SHEET
SCALE OF MILES
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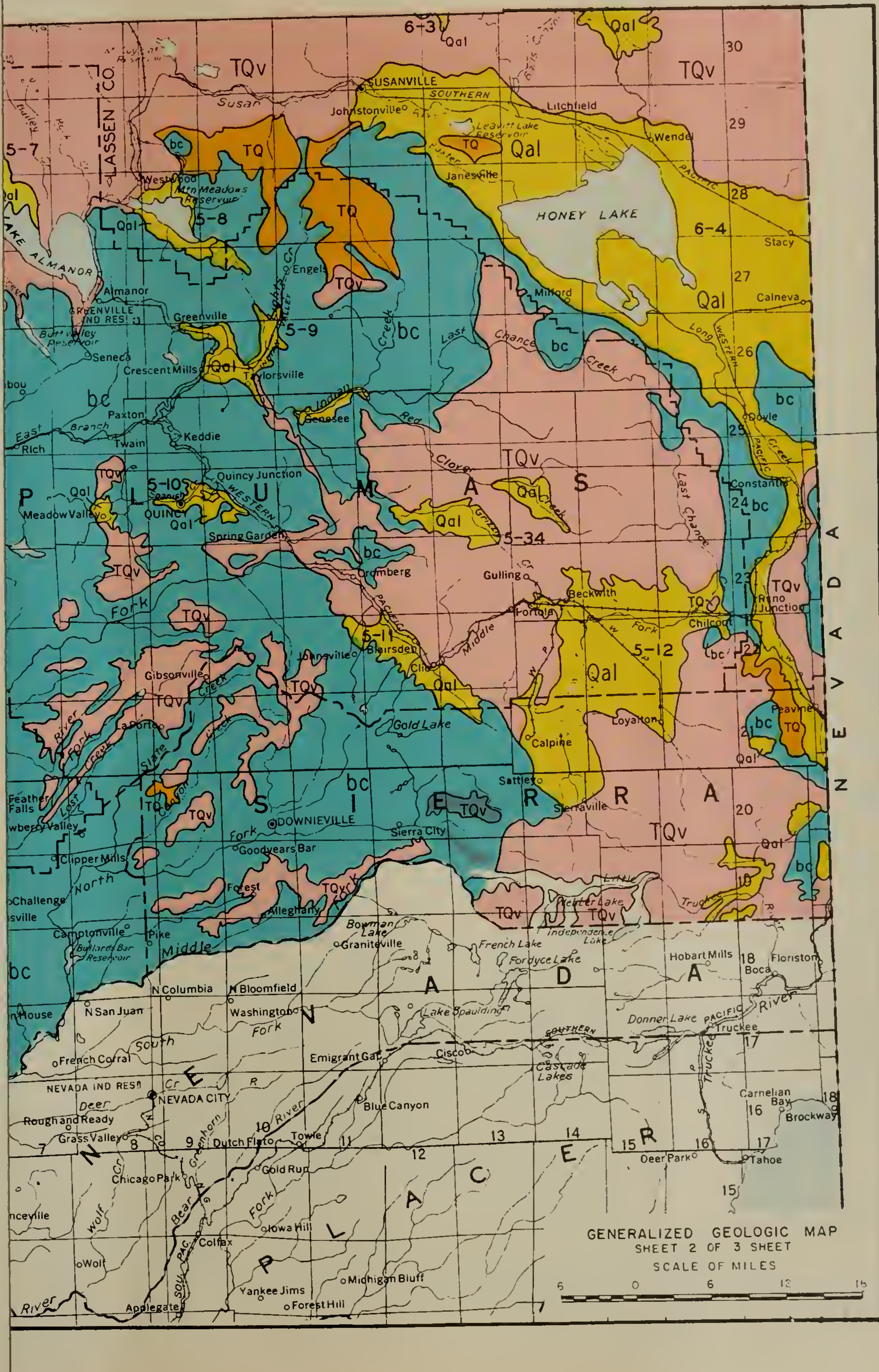

GENERALIZED GEOLOGIC MAP
SHEET 2 OF 3 SHEET
SCALE OF MILES
6 0 6 12 18

NUMERICAL DESIGNATION OF
GROUND WATER BASINS

- 5-6 Redding Basin
- 5-7 Lake Almanor Valley
- 5-8 Mountain Meadows Valley
- 5-9 Indian Valley
- 5-10 American Valley
- 5-1 Mohawk Valley
- 5-12 Sierra Valley
- 5-13 Upper Lake Valley
- 5-14 Scotts Vl
- 5-15 Kelseyville Valley
- 5-16 High Valley
- 5-21 Sacramento Valley
- 5-34 Grizzly Valley
- 6-3 Willow Creek

LEGEND

Qal — RECENT AND SOME OLDER ALLUVIUM, ALLUVIAL FANS AND TERRACE DEPOSITS

TQ — UNDIFFERENTIATED PLIOCENE AND SOME PLEISTOCENE NON-MARINE SEDIMENTS OF VARIABLE LITHOLOGY

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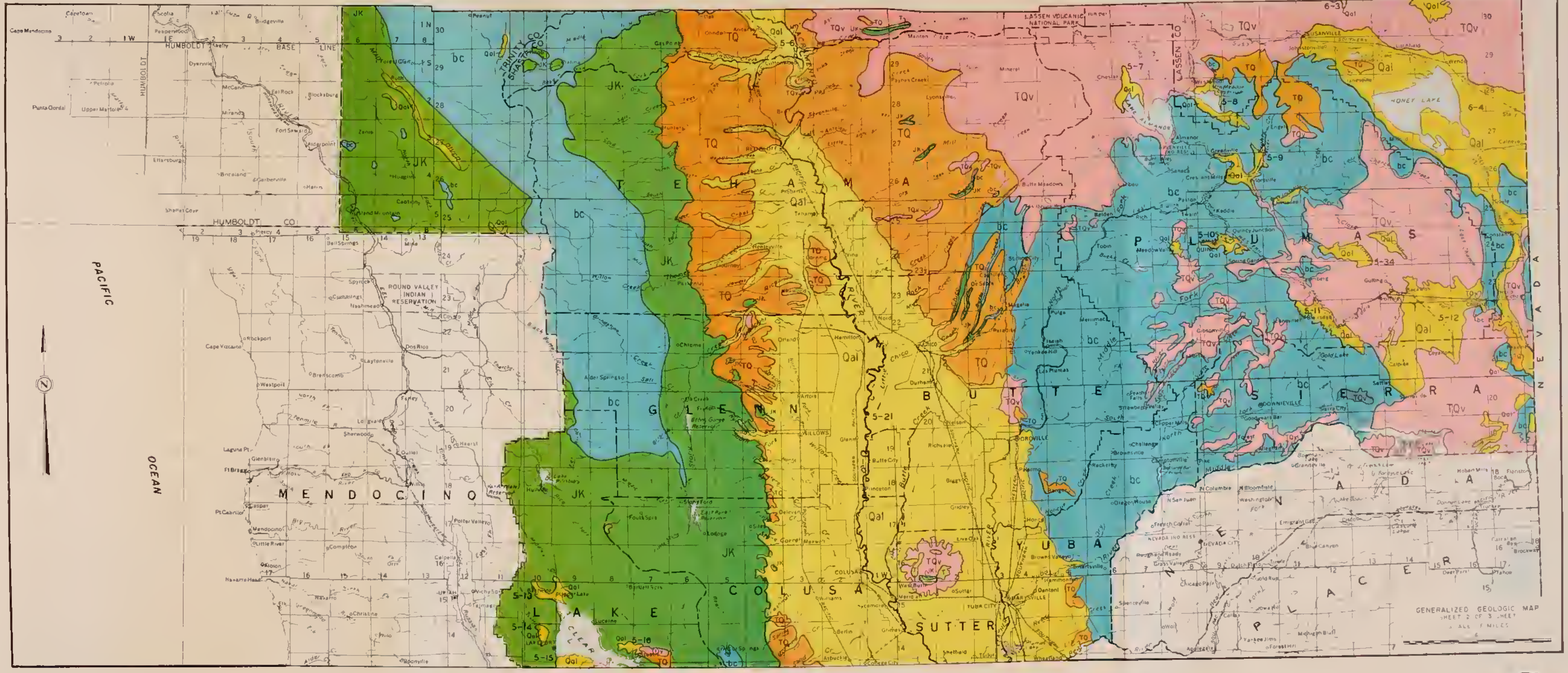
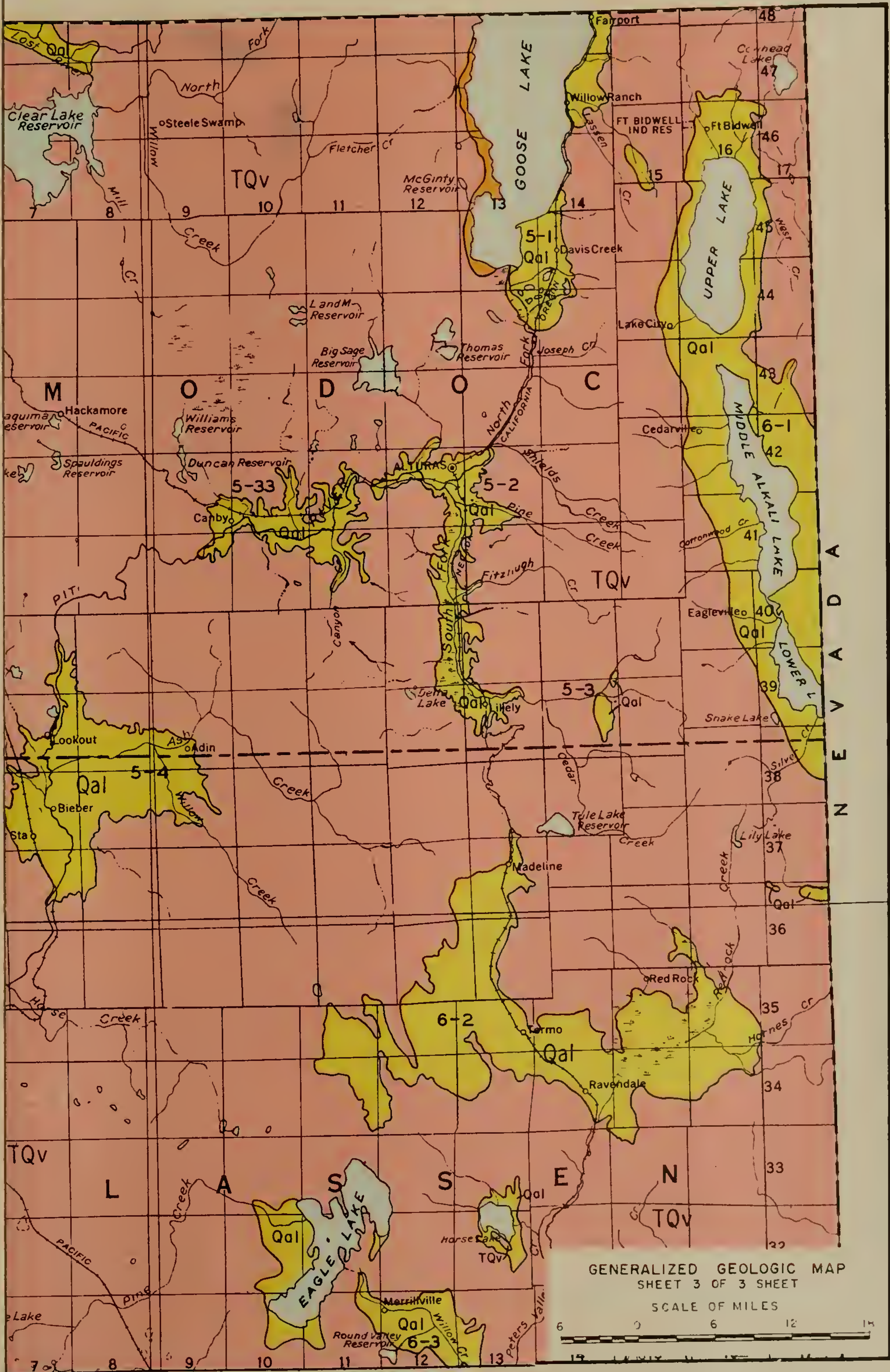
bc — BASEMENT COMPLEX




Goose Lake
Upper Lake
Middle Alkali Lake
Lower L
Eagle Lake
Clear Lake Reservoir
MODOC
LASSEN
NEVADA
Alturas
Cedarville
Fort Bidwell
Davis Creek
Lake City
Eagleville
Canby
Likely
Lookout
Adin
Bieber
Madeline
Termo
Ravendale
Red Rock
Merrillville
Hackamore
Fairport
Willow Ranch
Qal
TQv
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5-2
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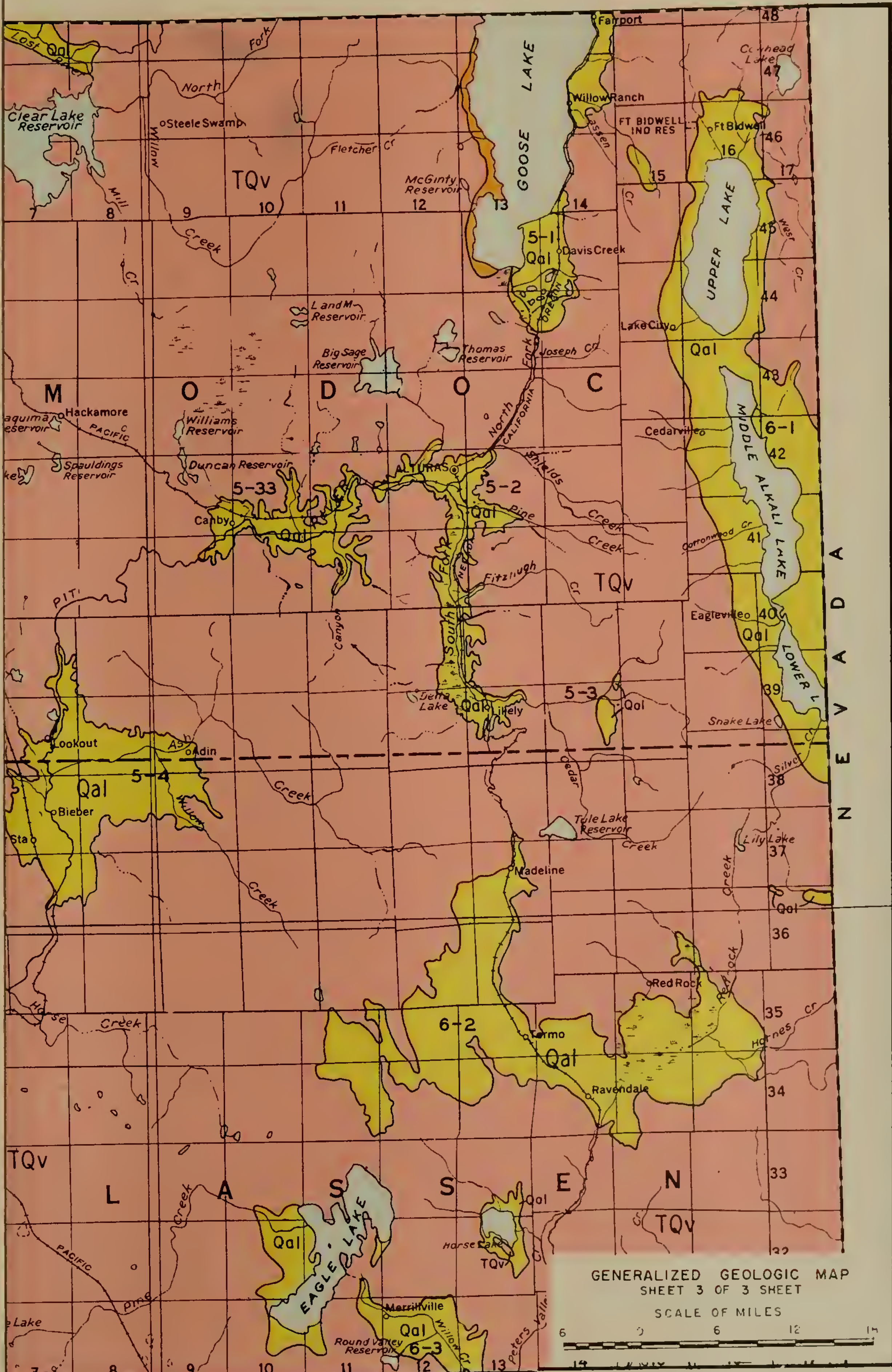
5-4
5-33
6-1
6-2
6-3
GENERALIZED GEOLOGIC MAP
SHEET 3 OF 3 SHEET
SCALE OF MILES



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Fairport
Willow Ranch
FT BIDWELL IND RES
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Davis Creek
Lake City
Cedarville
Eagleville
Alturas
Canby
Hackamore
Likely
Lookout
Adin
Bieber
Madeline
Red Rock
Termo
Ravendale
Merrillville
Clear Lake Reservoir
Steele Swamp
McGinty Reservoir
L and M Reservoir
Big Sage Reservoir
Thomas Reservoir
Williams Reservoir
Duncan Reservoir
Spauldings Reservoir
Tule Lake Reservoir
Round Valley Reservoir
Snake Lake
Lily Lake
Horse Lake
Cowhead Lake
Pit
Fletcher Cr
Joseph Cr
Pine Creek
Shields Creek
Fitzhugh Cr
Cottonwood Cr
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SCALE OF MILES

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Shasta Valley
Scott Valley
1-6 Hayfork Valley
Goose Lake Valley
South Fork Pit River Valley
Jess Valley
5-4 Big Valley
5-5 Fall River Valley
5-6 Redding Basin
Warm Springs Valley
6-1 Surprise Valley
6-2 Madeline Plains Basin
6-3 Willow Creek

LEGEND

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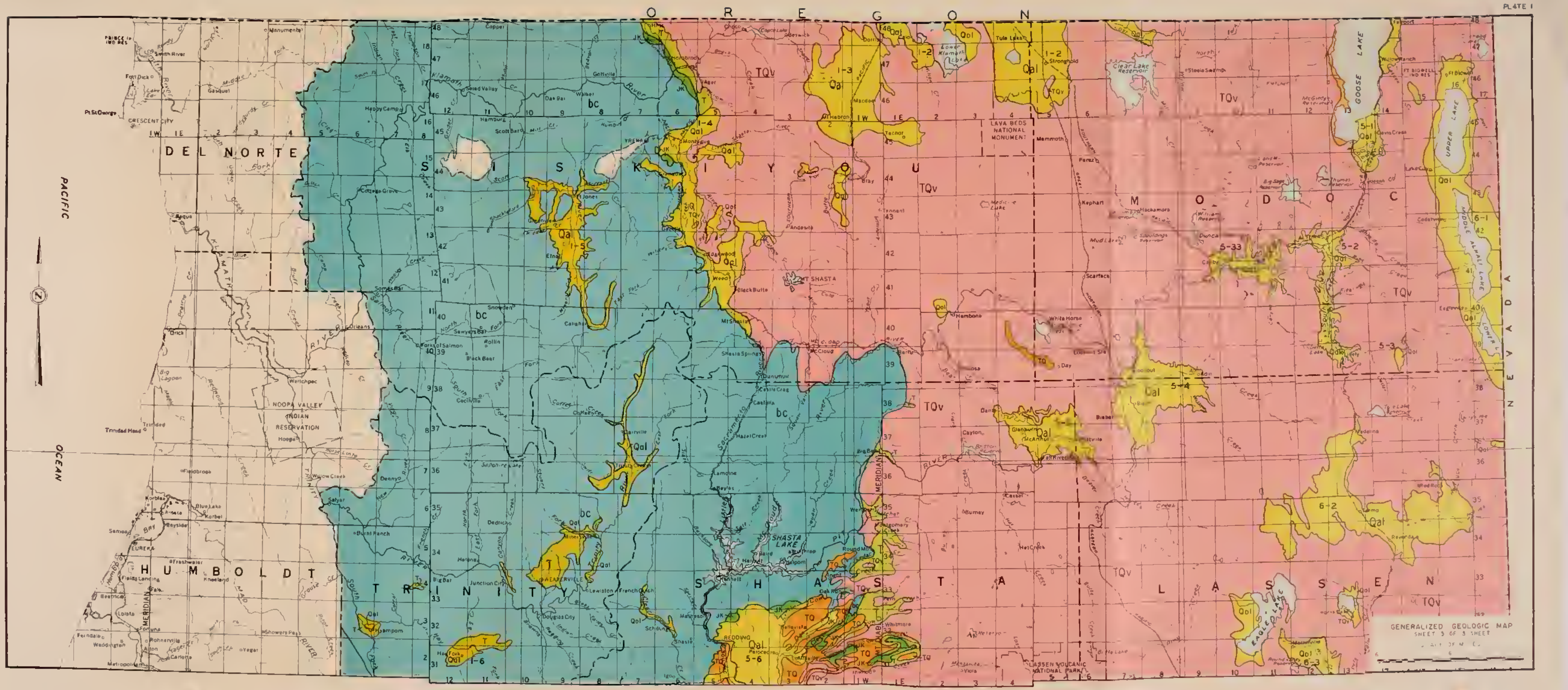

HYDROGRAPHIC UNITS

NORTH COASTAL DRAINAGE BASIN

1 Tulelake
2 Butte Valley
3 Klamath River
4 Shasta Valley
5 Scott Valley
6 Salmon River
7 Upper Trinity River
8 Lower Trinity River
9 South Fork Trinity River
10 Southern Trinity County
11 Lake Pillsbury

CENTRAL VALLEY DRAINAGE BASIN

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13 Jess Valley
14 Alturas
15 Big Valley
16 McArthur
17 Hat Creek
18 Montgomery Creek
19 McCloud River
20 Dunsmuir
21 Shasta Lake
22 Clear Creek
23 Keswick
24 Cottonwood Creek
25 Olinda
26 Redbank Creek
27 Elder Creek
28 Thomes Creek
29 Stony Creek
30 Clear Lake
31 Middletown
32 Stillwater Plains
33 Cow Creek
34 Bear Creek
35 Battle Creek
36 Paynes Creek
37 Antelope Creek
38 Mill Creek
39 Deer Creek
40 Chico Creek
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42 North Fork Feather River
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46 South Fork Feather River
47 North Yuba River
48 Challenge
49 Wyandotte
50 Anderson
51 Corning
52 Los Molinos
53 Fruto
54 Orland
55 Durham
56 Colusa
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58 Browns Valley
59 Cortina
60 Arbuckle
61 Sutter
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69 Madeline Plains
70 Eagle Lake
71 Willow Creek
72 Secret Valley
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75 Little Truckee River

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BOUNDARY OF MAJOR DRAINAGE BASINS
BOUNDARY OF HYDROGRAPHIC UNIT WITHIN MAJOR DRAINAGE BASINS

STATE OF CALIFORNIA
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HYDROGRAPHIC UNITS WITHIN THE NORTHEASTERN COUNTIES

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67 East Yolo

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BOUNDARY OF HYDROGRAPHIC UNIT WITHIN MAJOR DRAINAGE BASINS

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BOUNDARY OF MAJOR DRAINAGE BASINS
BOUNDARY OF HYDROGRAPHIC UNIT WITHIN MAJOR DRAINAGE BASINS

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HYDROGRAPHIC UNITS WITHIN THE NORTHEASTERN COUNTIES

SCALE OF MILES
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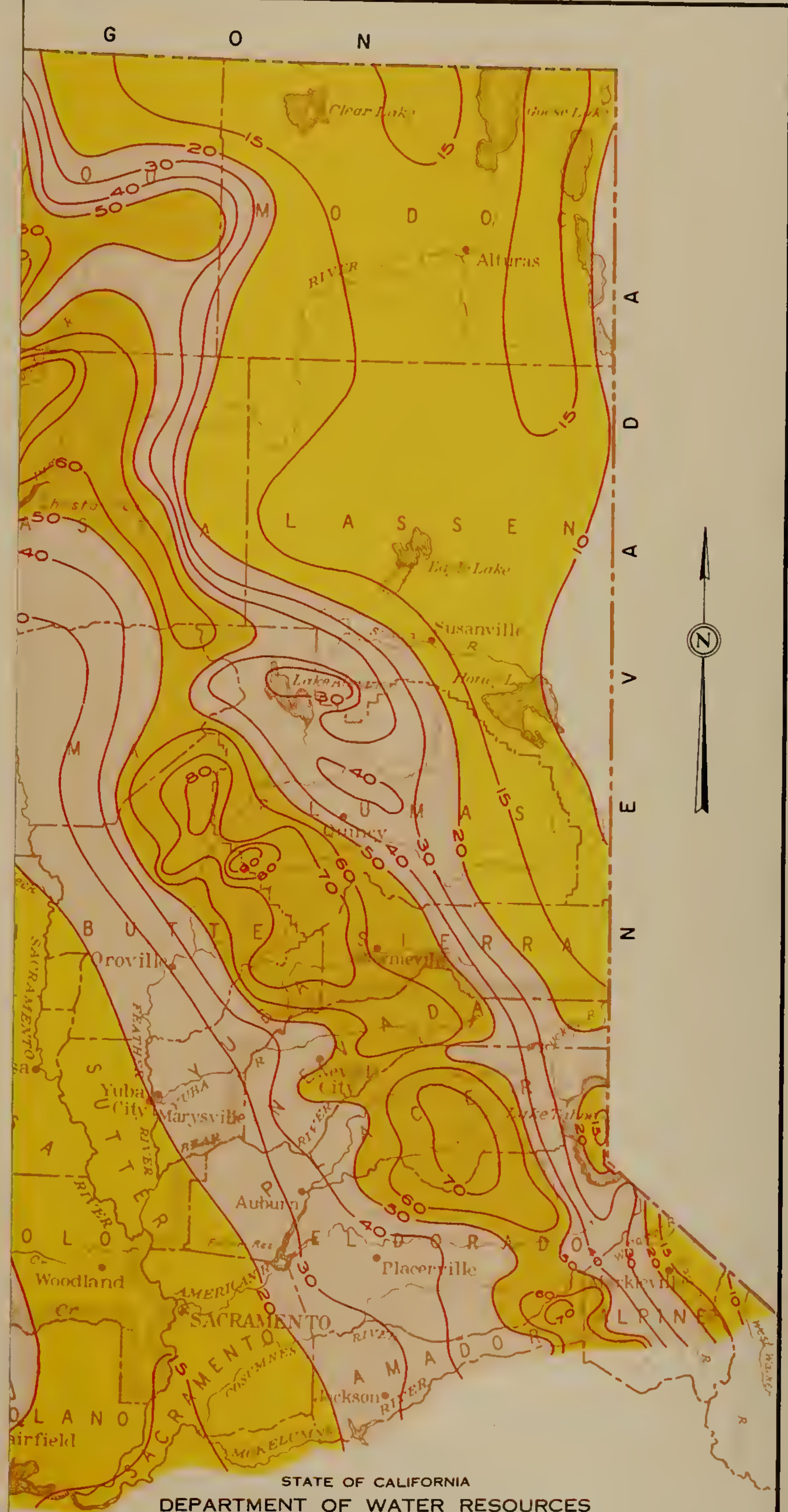
PLATE 3



STATE OF CALIFORNIA
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DIVISION OF RESOURCES PLANNING
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EOGRAPHICAL DISTRIBUTION OF PRECIPITATION
IN NORTHERN CALIFORNIA

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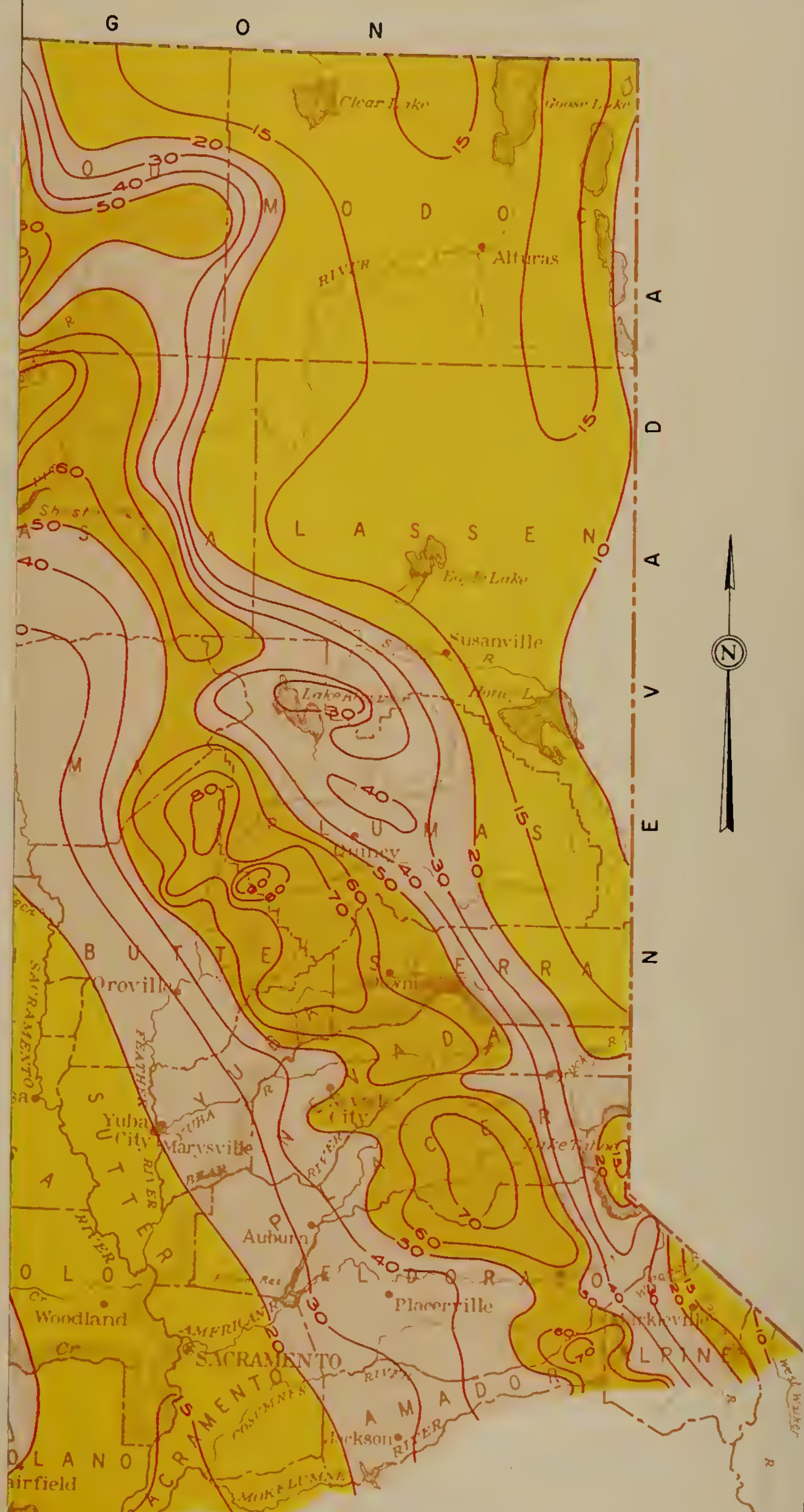


STATE OF CALIFORNIA

DEPARTMENT OF WATER RESOURCES

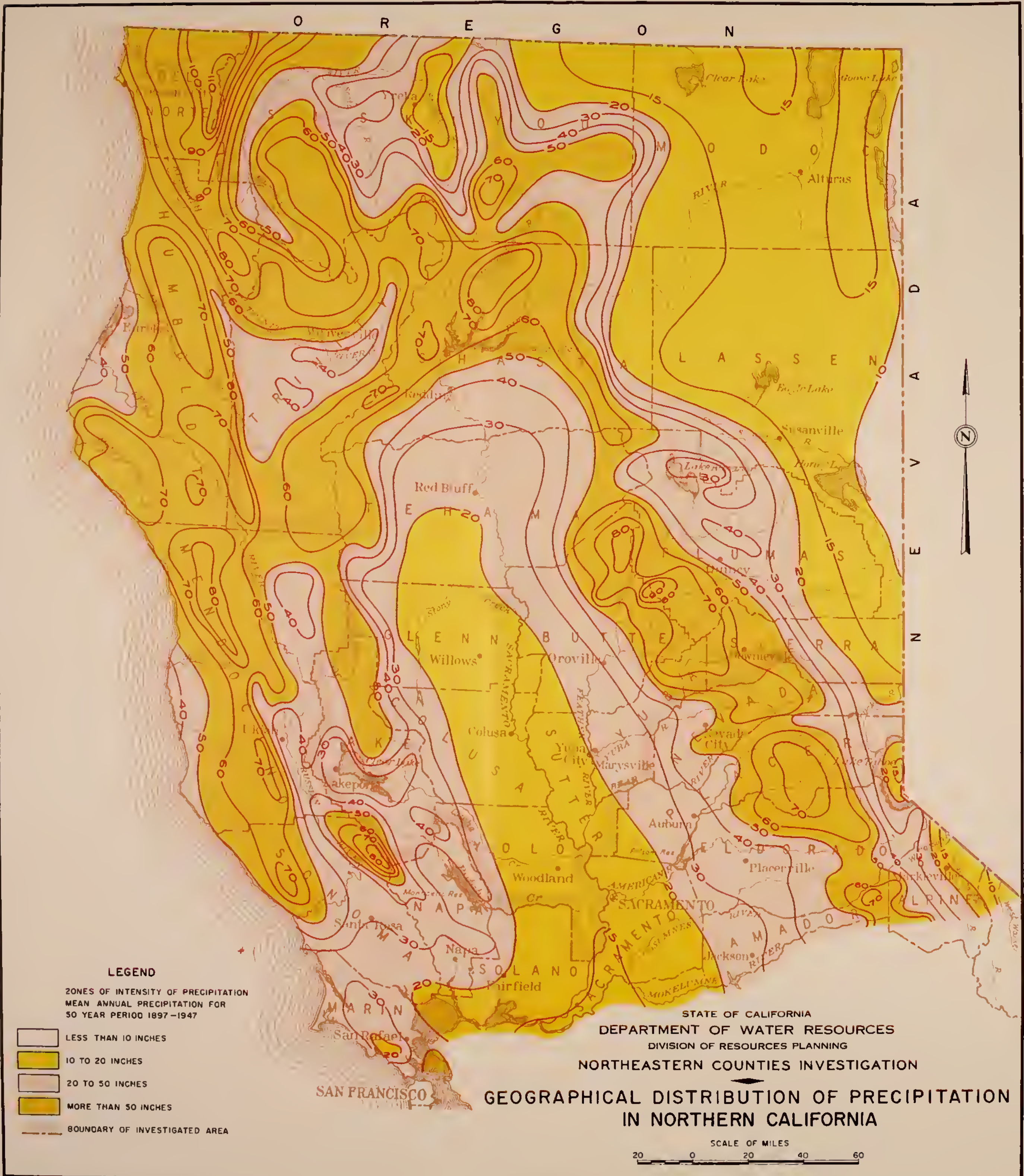
DIVISION OF RESOURCES PLANNING

NORTHEASTERN COUNTIES INVESTIGATION

EOGRAPHICAL DISTRIBUTION OF PRECIPITATION IN NORTHERN CALIFORNIA

SCALE OF MILES

20 0 20 40 60



LEGEND

ZONES OF INTENSITY OF PRECIPITATION
MEAN ANNUAL PRECIPITATION FOR
50 YEAR PERIOD 1897 – 1947

- LESS THAN 10 INCHES
- 10 TO 20 INCHES
- 20 TO 50 INCHES
- MORE THAN 50 INCHES
- BOUNDARY OF INVESTIGATED AREA

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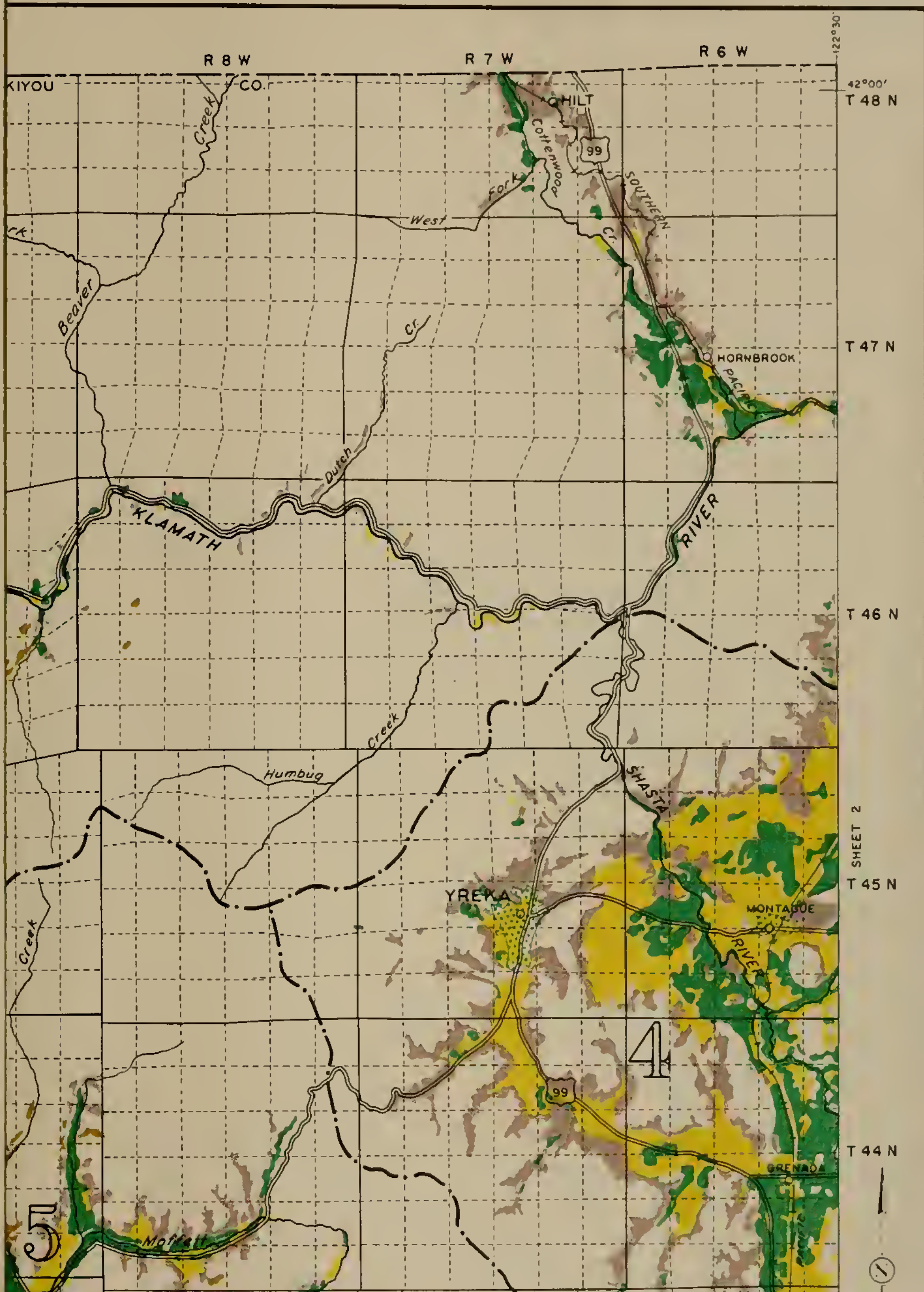
NORTHEASTERN COUNTIES INVESTIGATION

GEOGRAPHICAL DISTRIBUTION OF PRECIPITATION IN NORTHERN CALIFORNIA

SCALE OF MILES
20 0 20 40 60

DEPARTMENT OF WATER RESOURCES 1957



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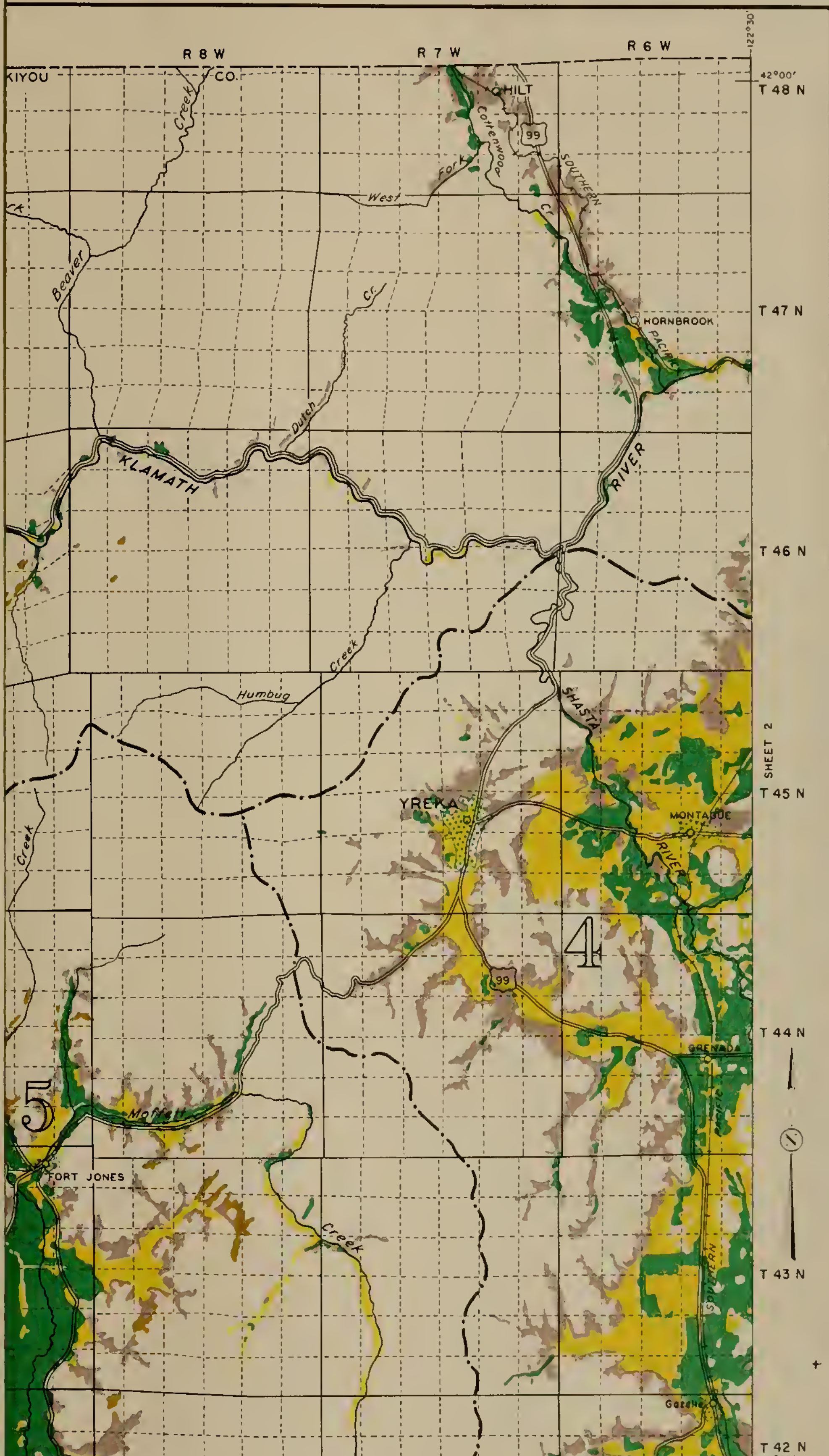

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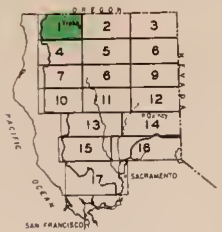

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3 Klamath River
4 Shasta Valley
5 Scott Valley
6 Salmon River
7 Upper Trinity River
8 Lower Trinity River
9 South Fork Trinity River
10 Southern Trinity County
11 Lake Pillsbury

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15 Big Valley
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23 Keswick
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72 Secret Valley
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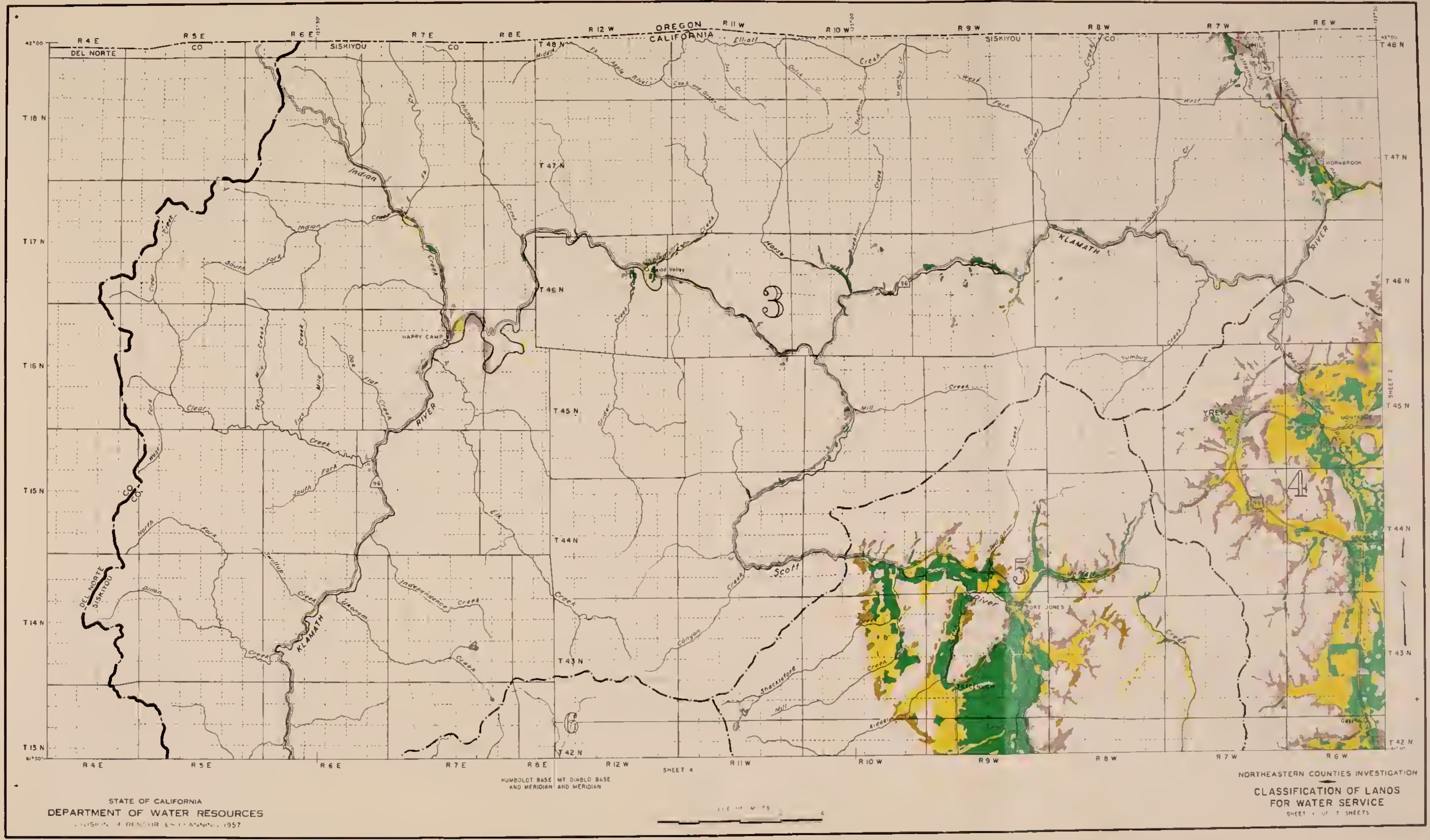

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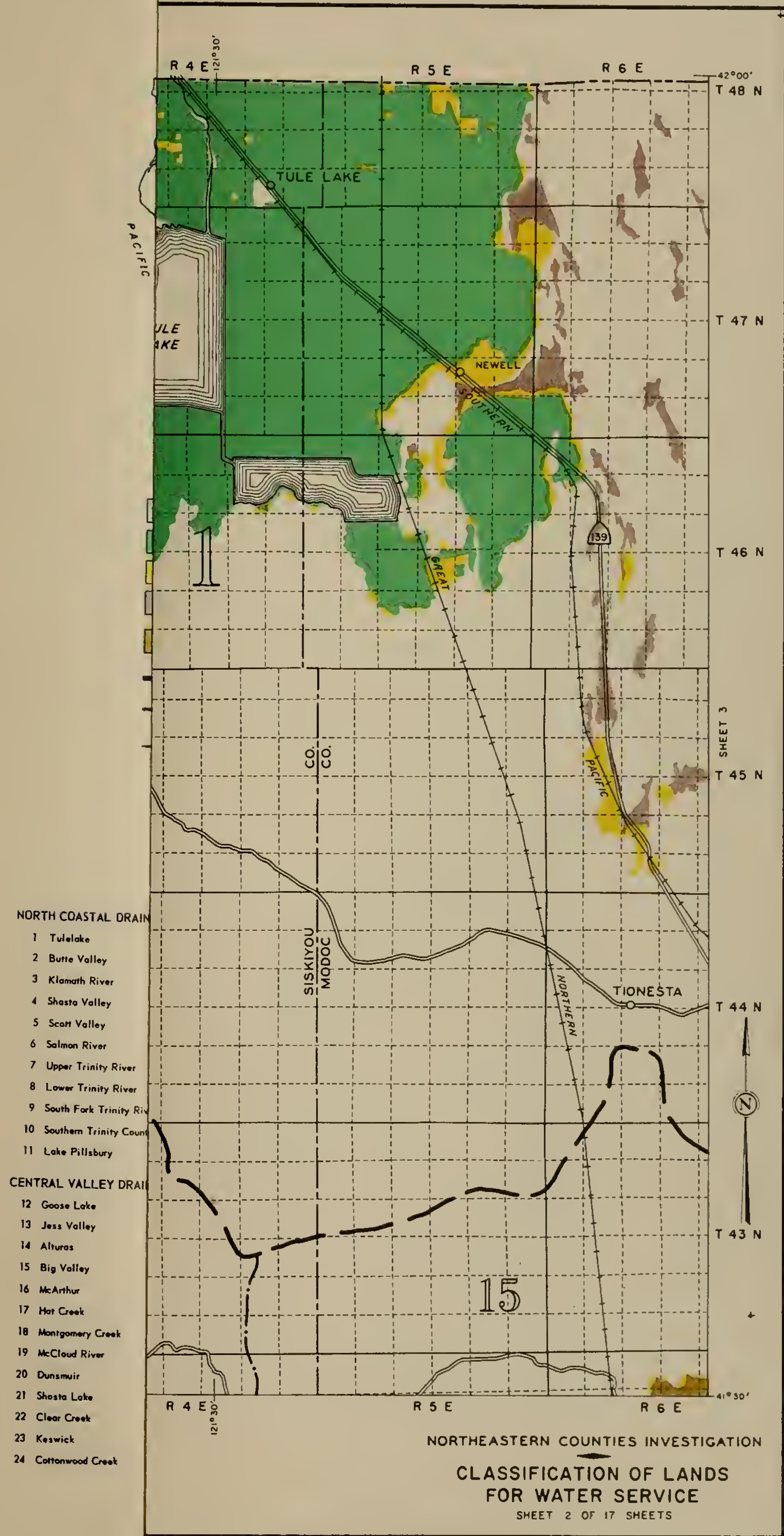

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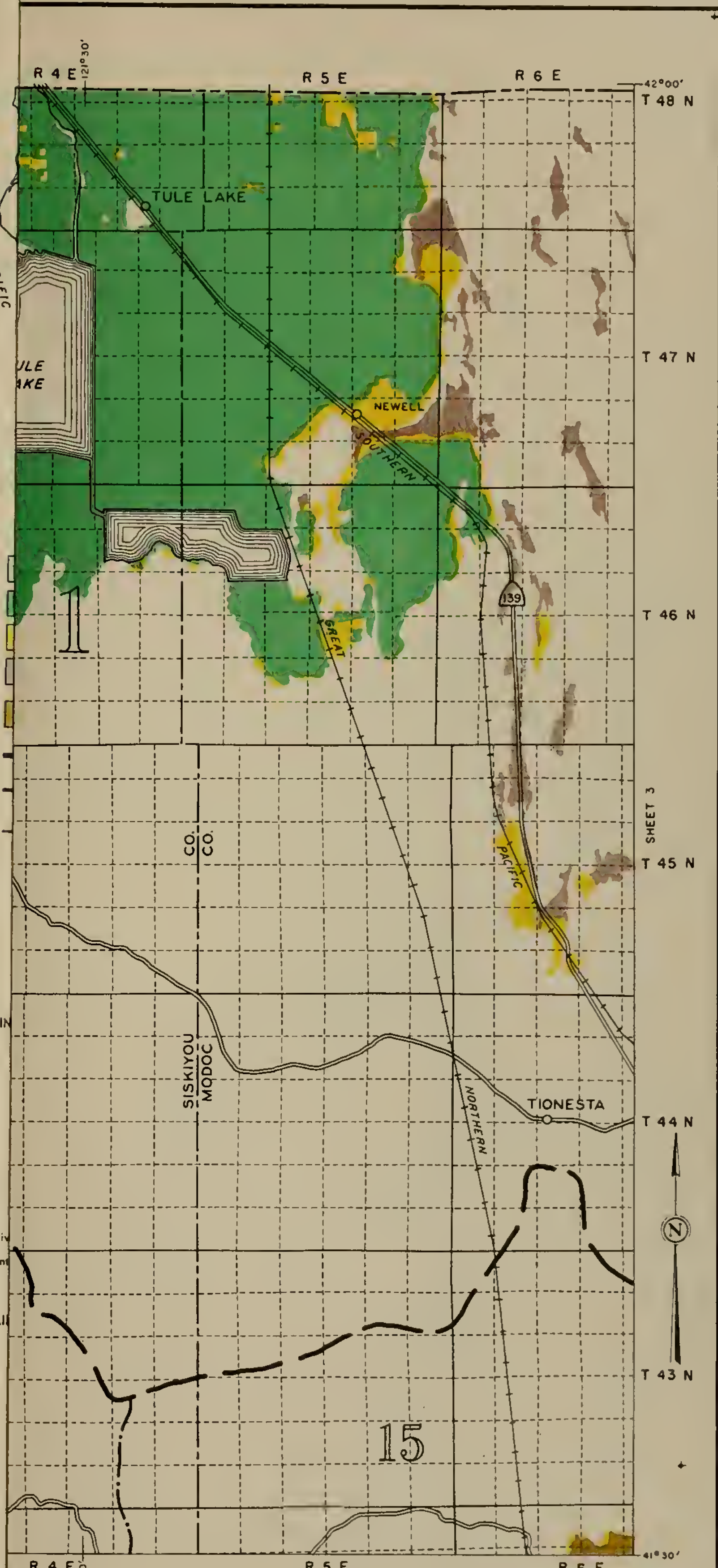

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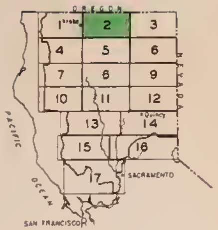

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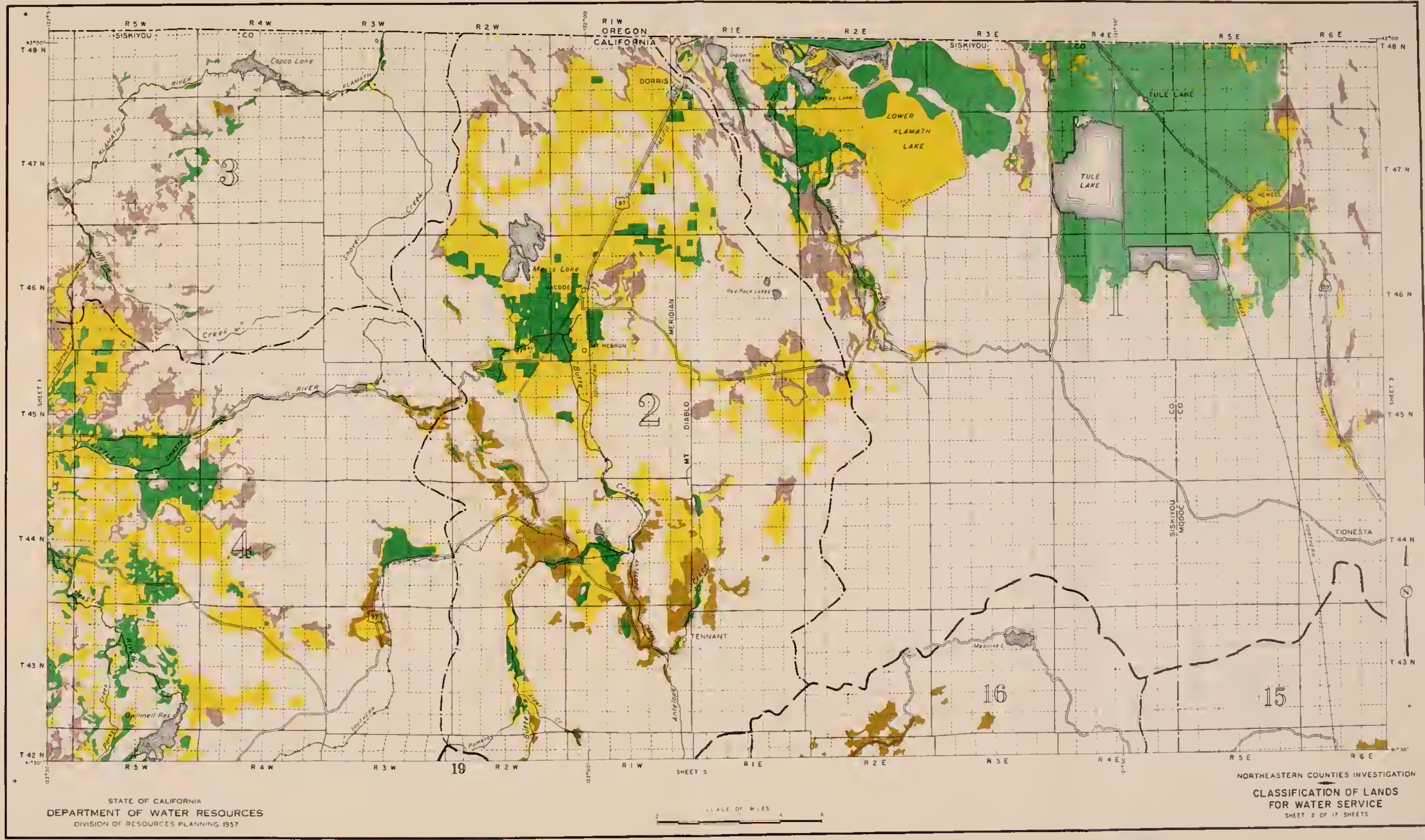

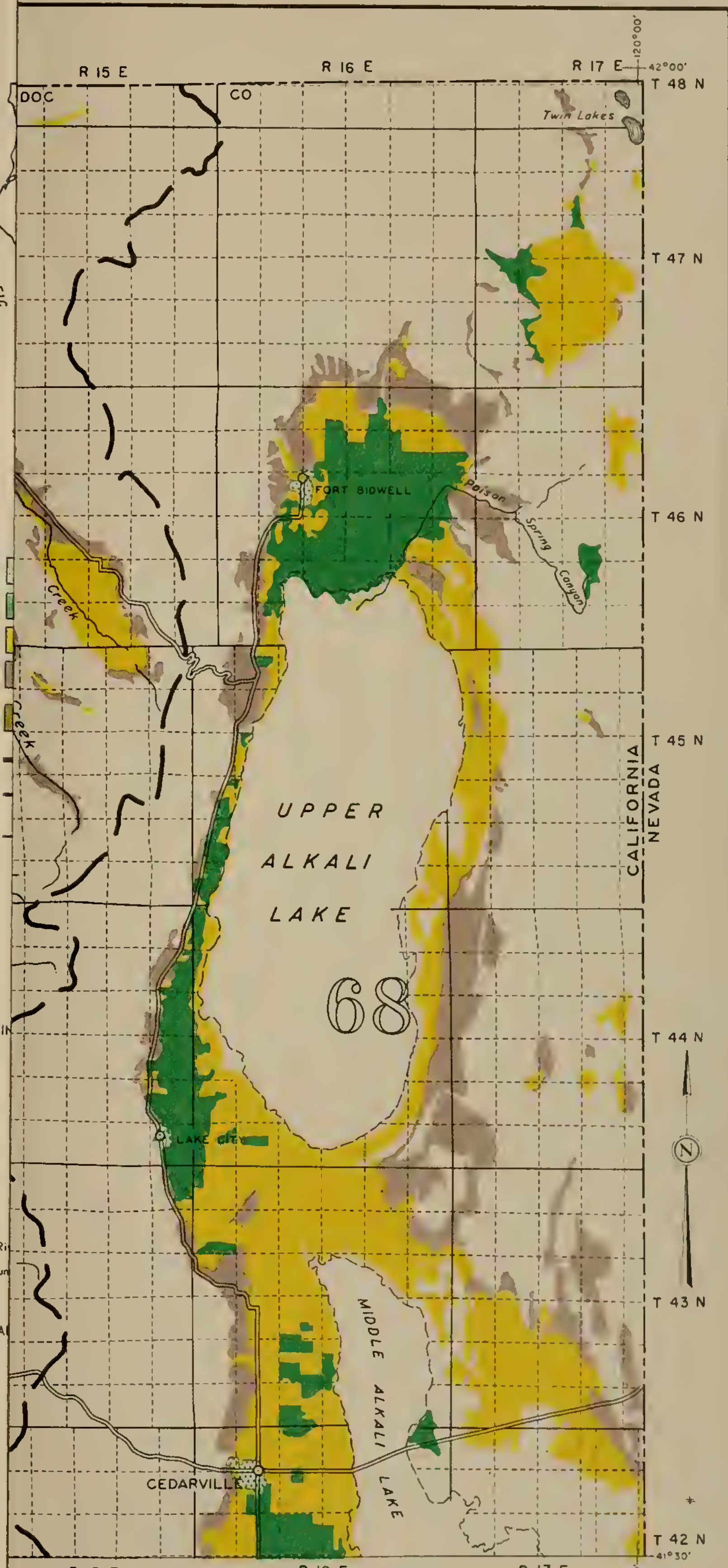

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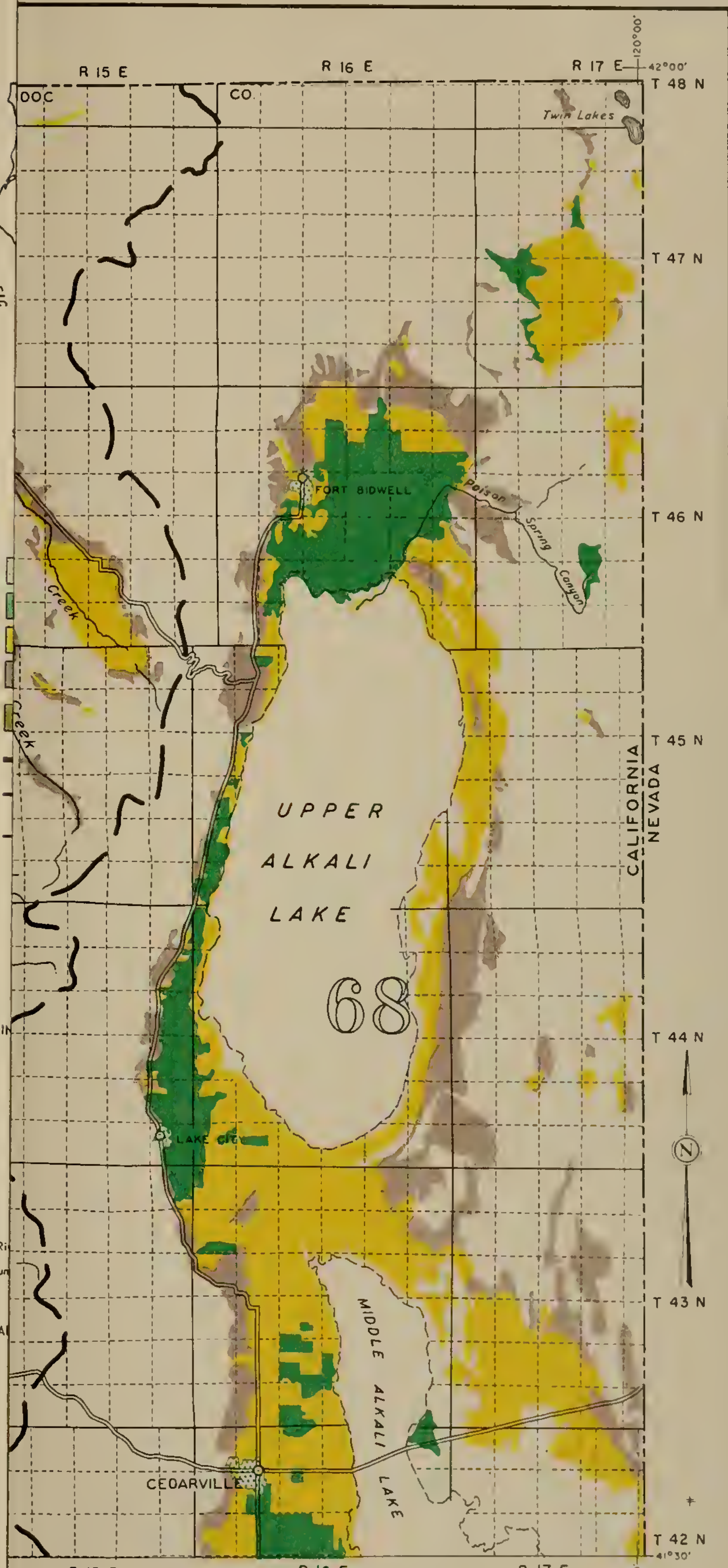

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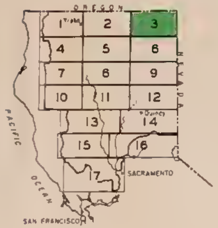

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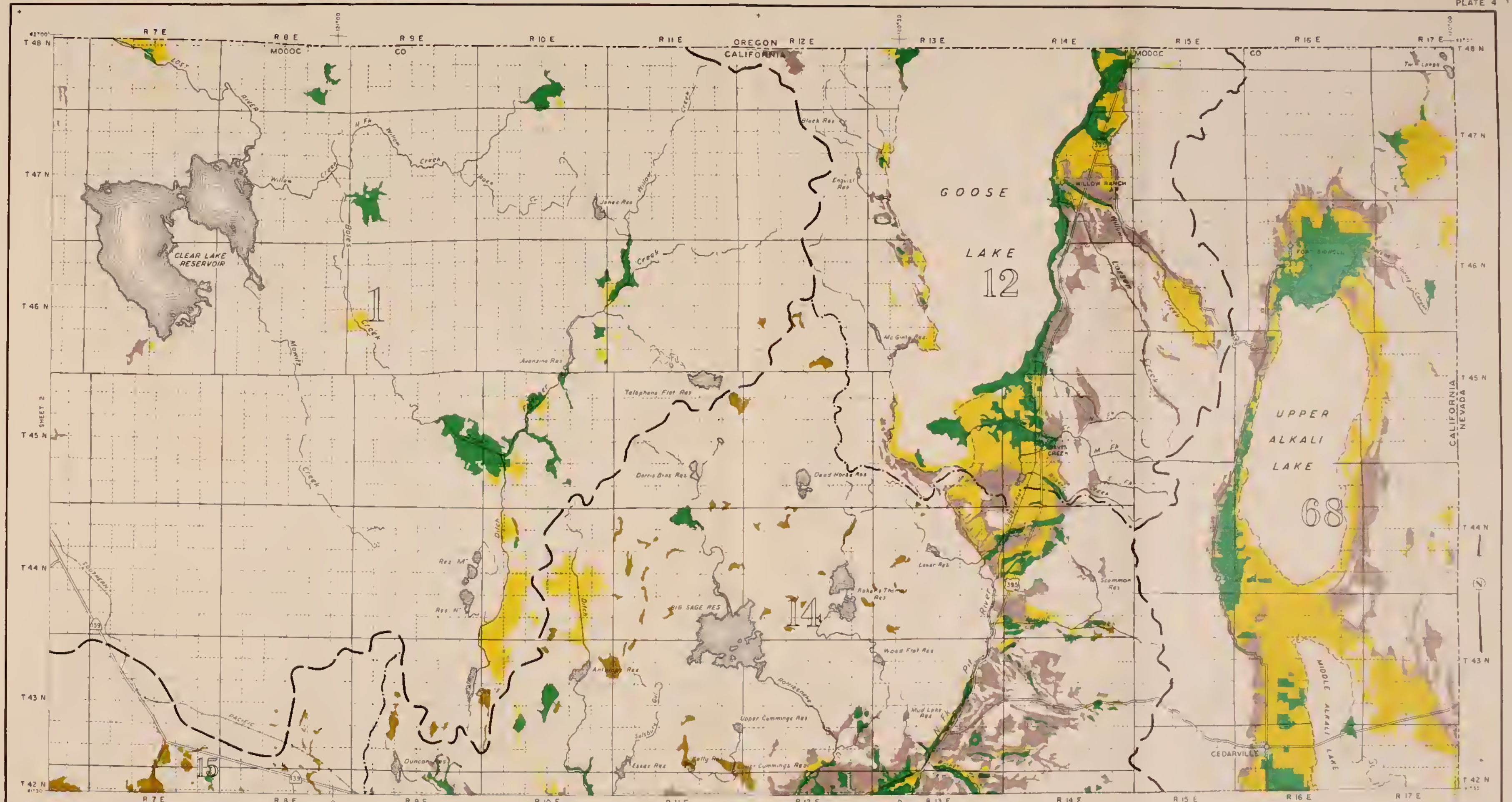

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SCALE OF MILES

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CLASSIFICATION OF LANDS FOR WATER SERVICE

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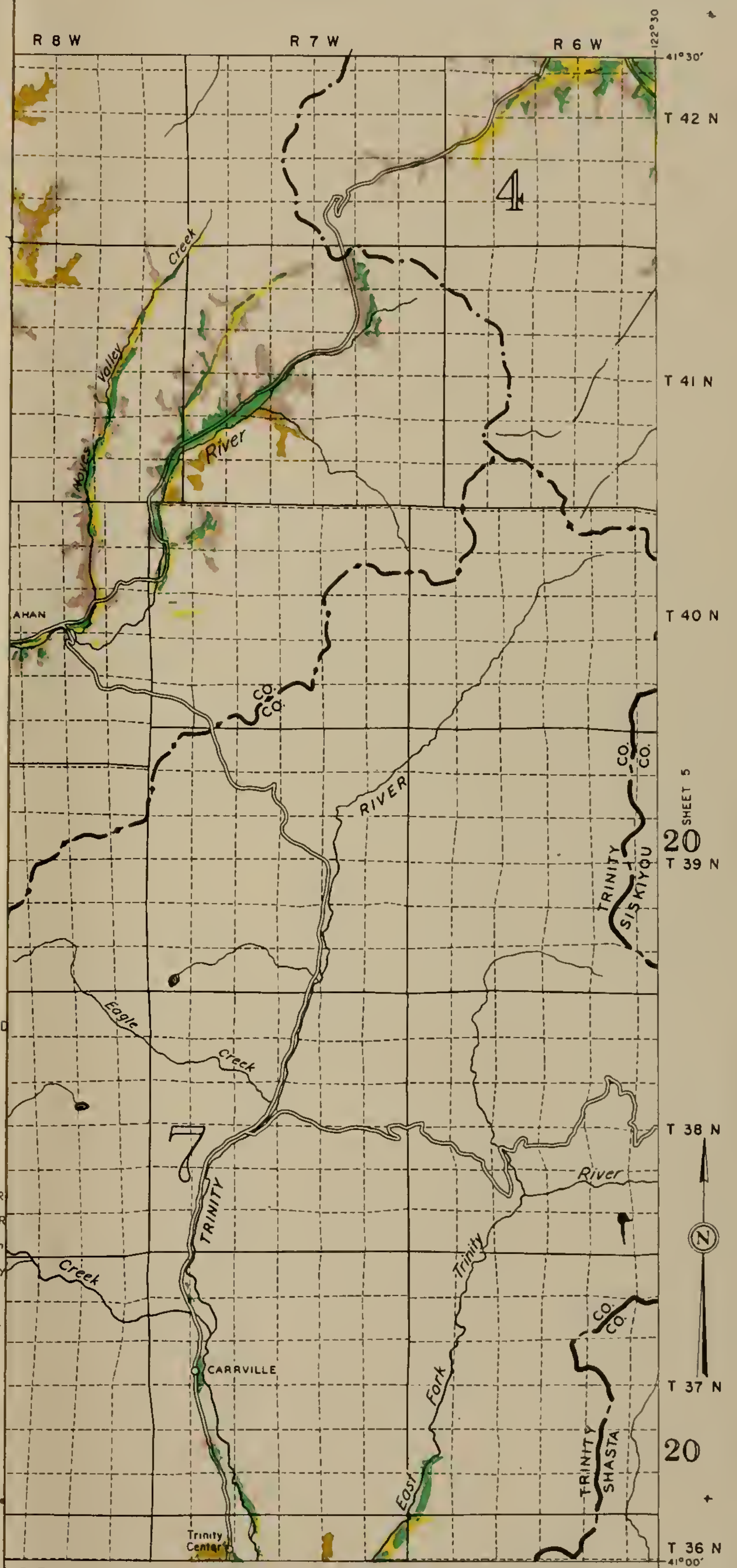

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CLASSIFICATION OF LANDS FOR WATER SERVICE

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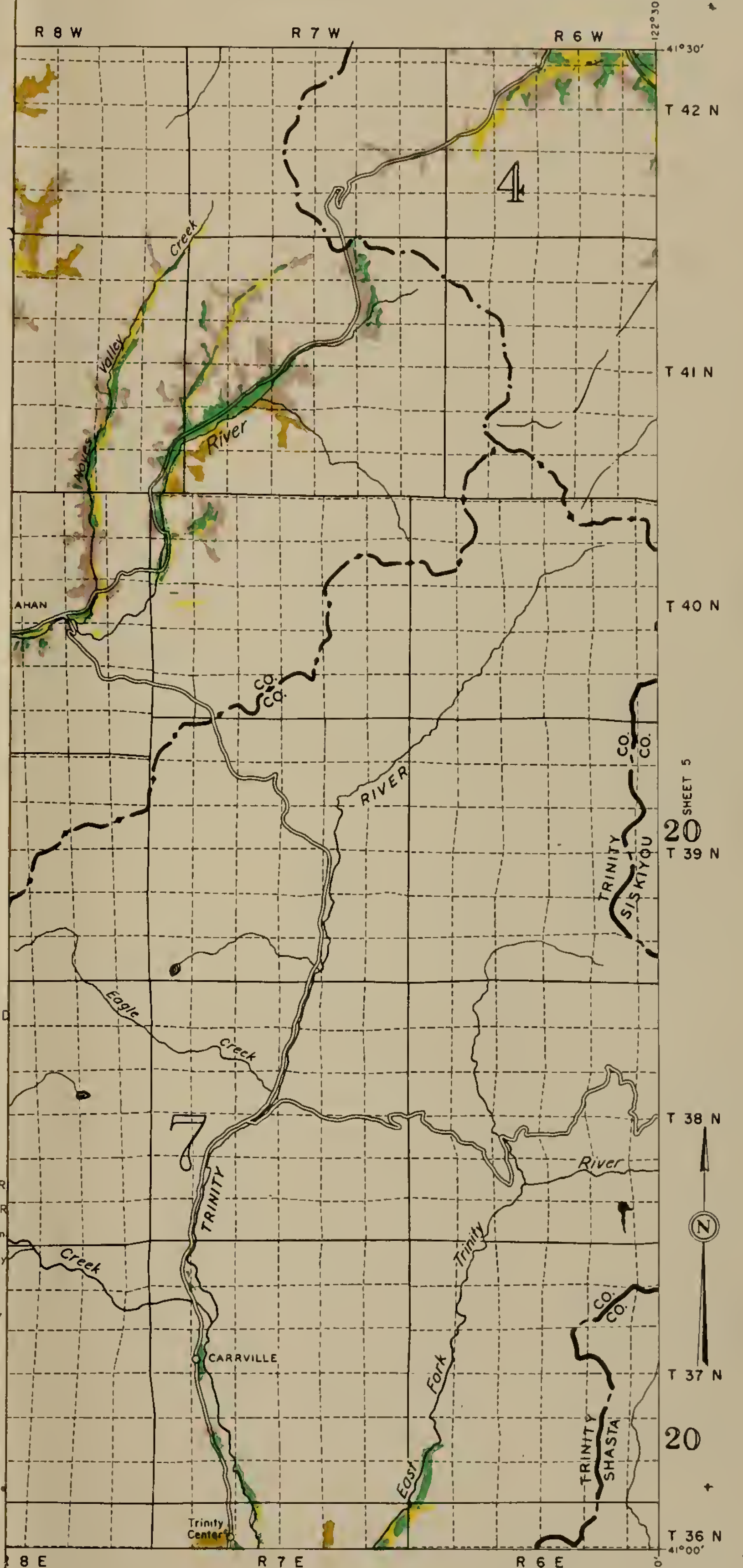

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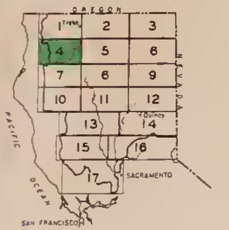

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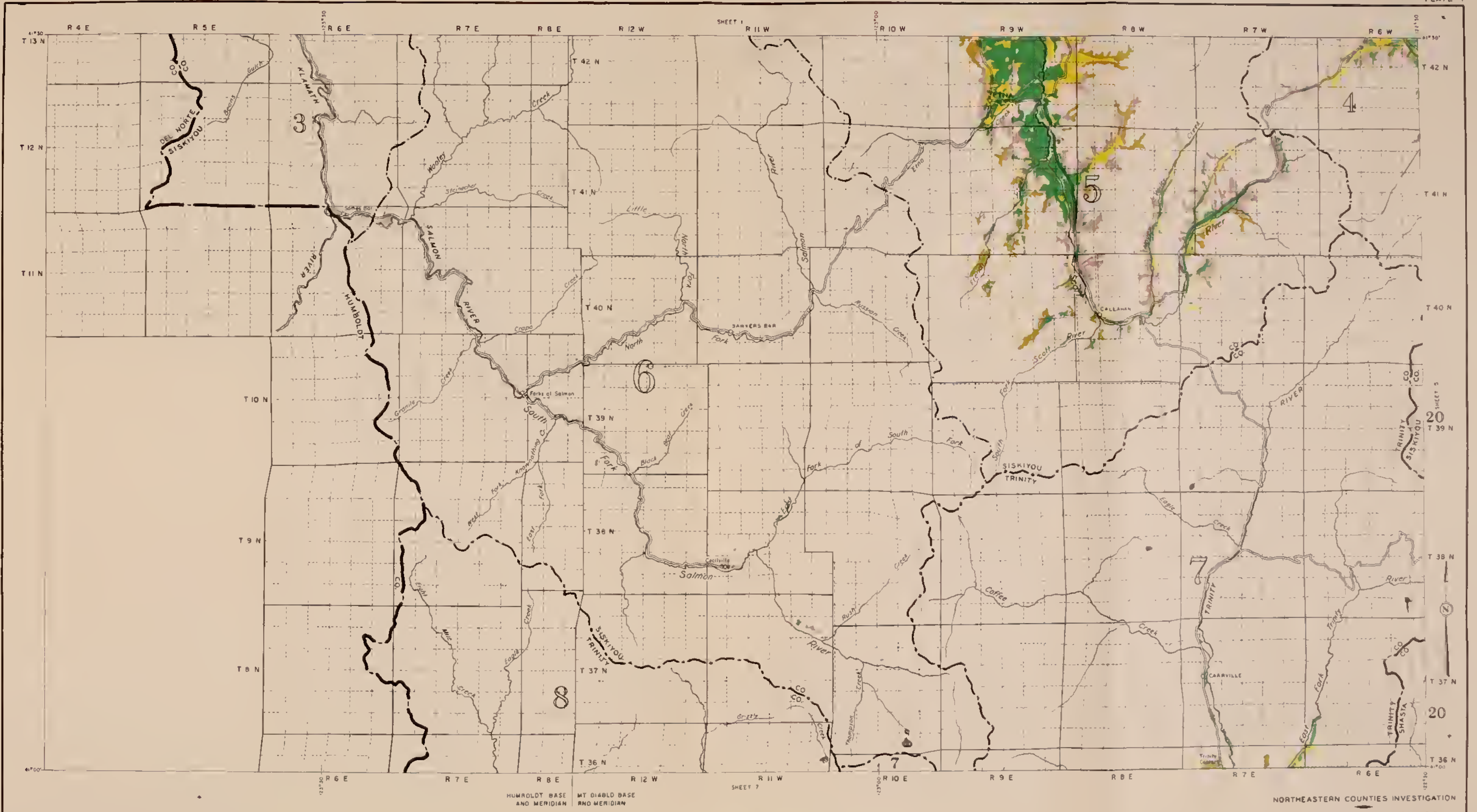

HUMBOLDT BASE AND MERIDIAN

MT. DIABLO BASE AND MERIDIAN

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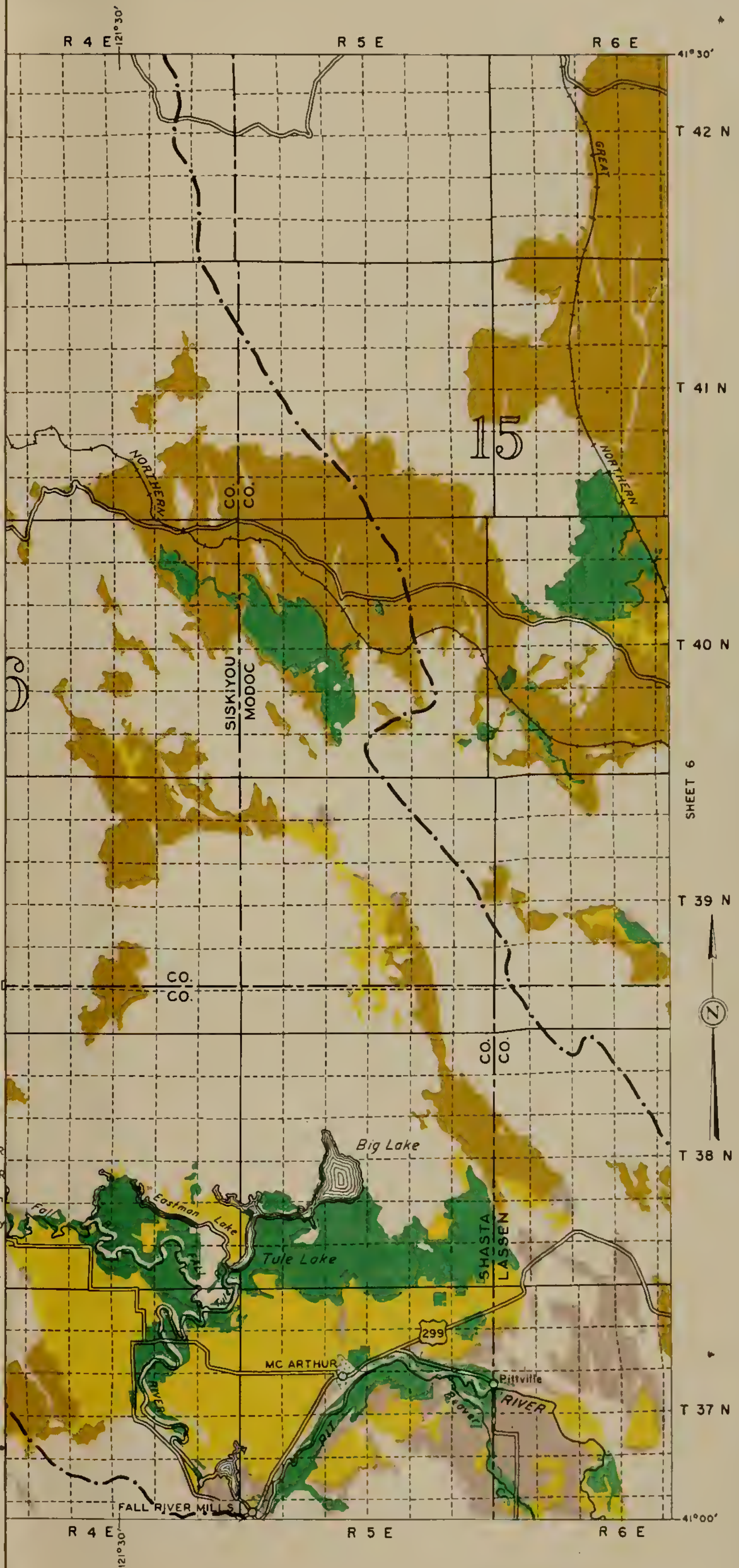

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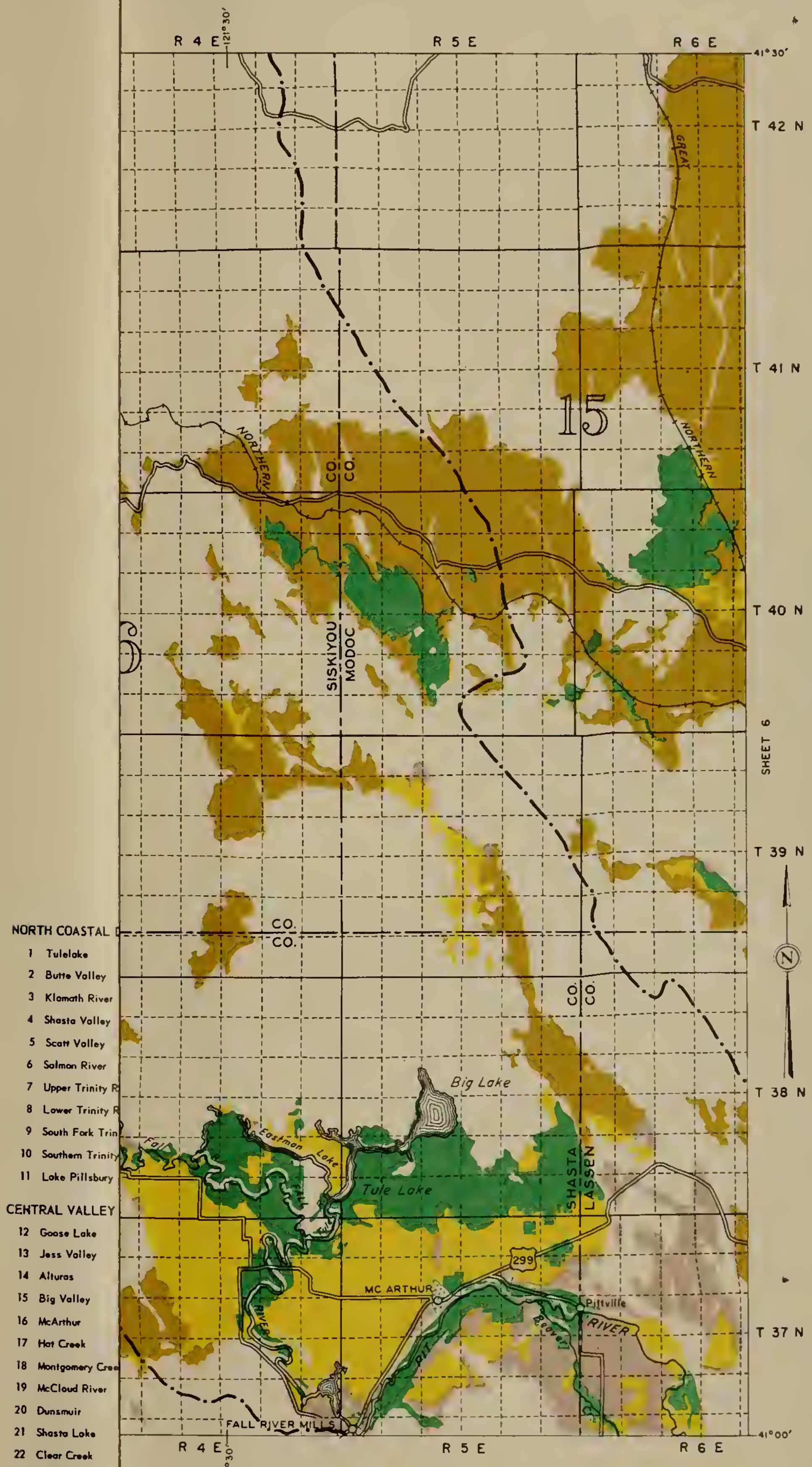

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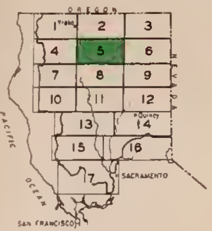

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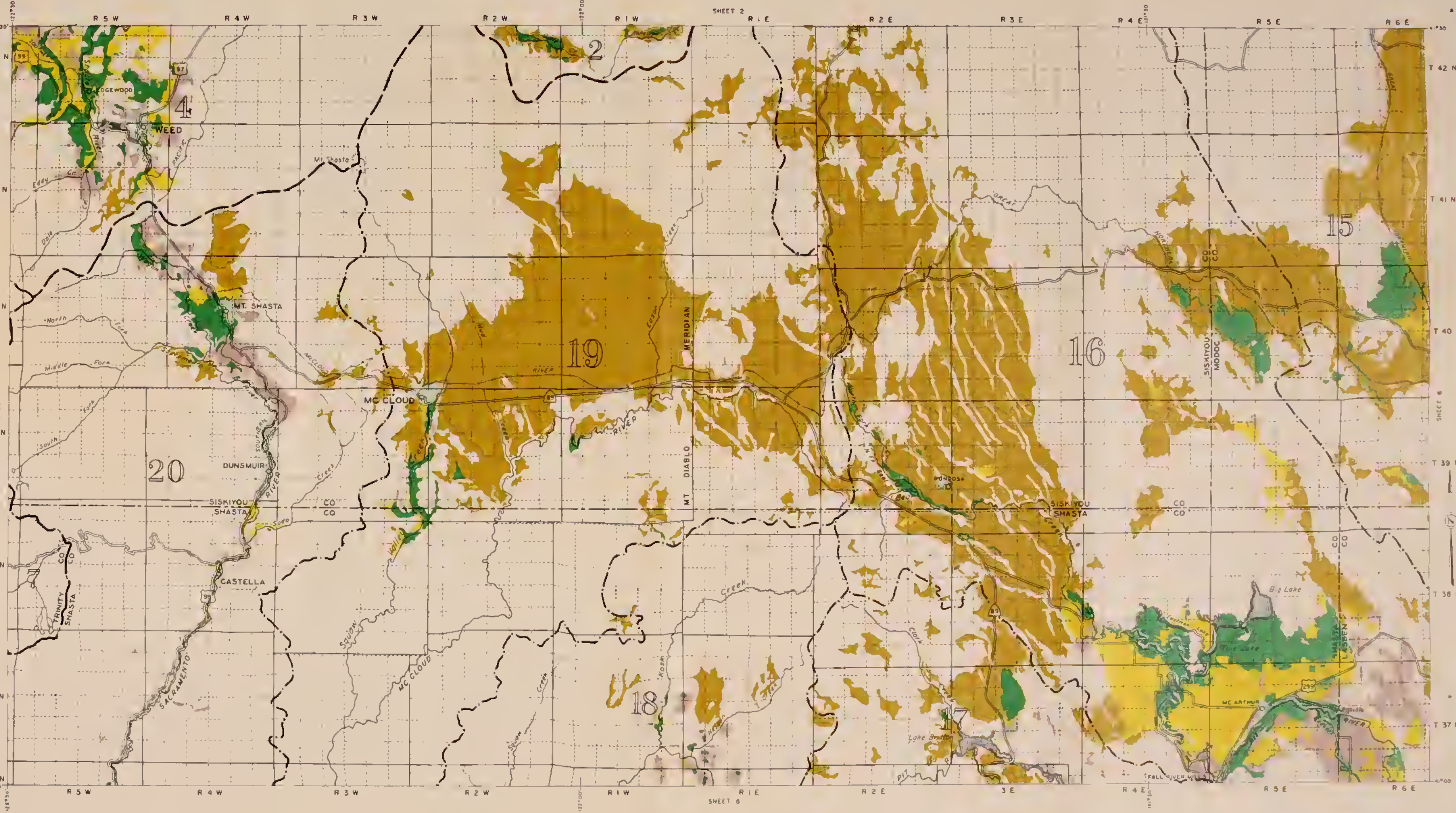

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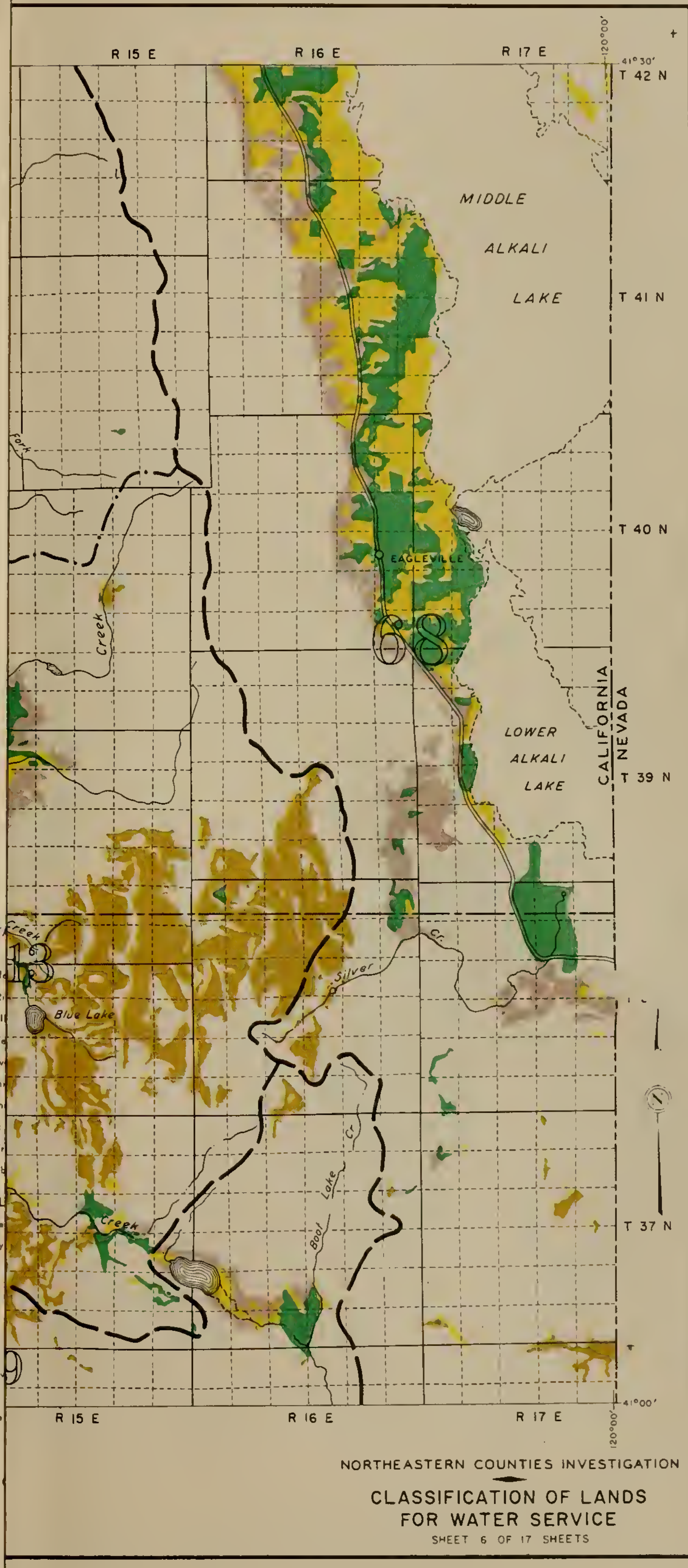

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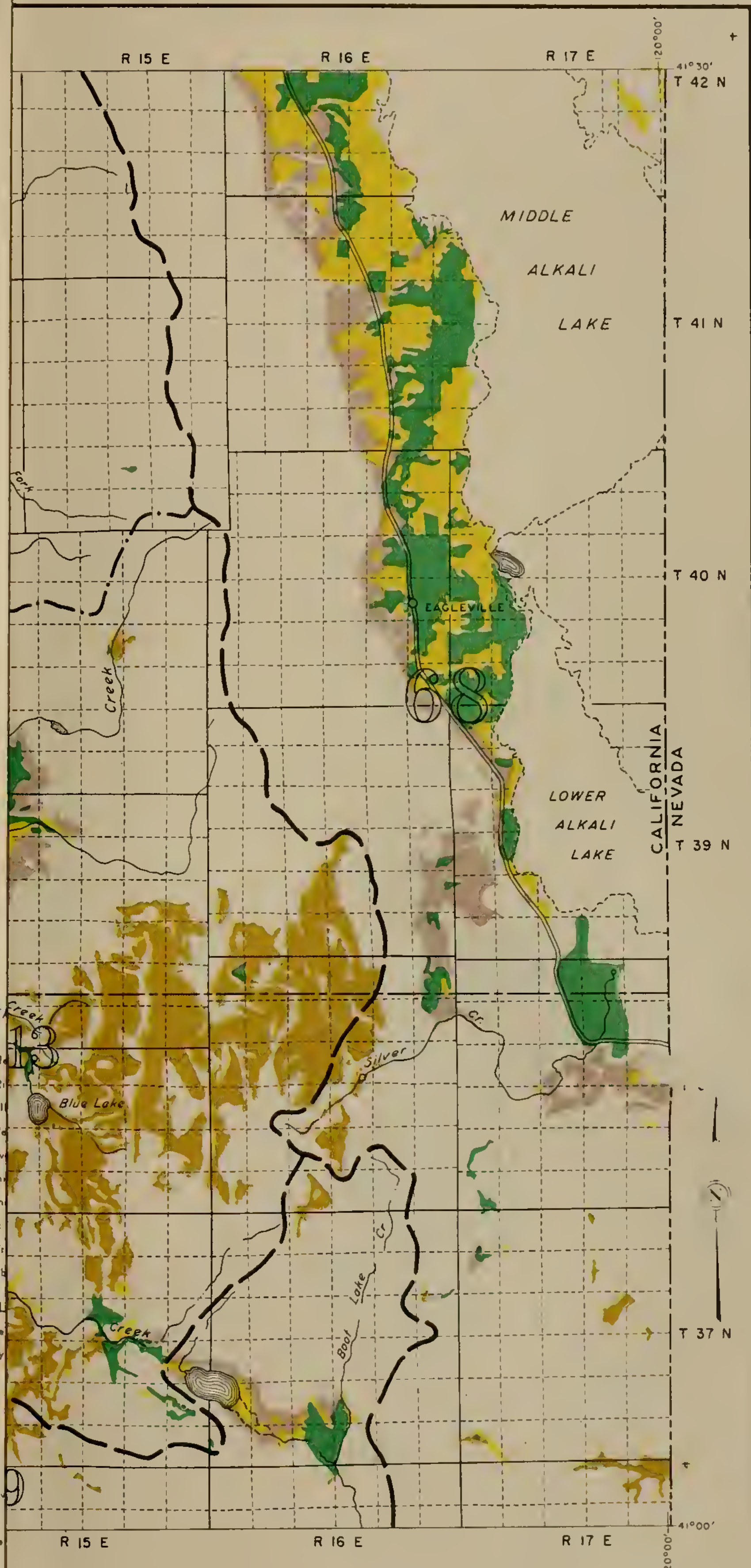

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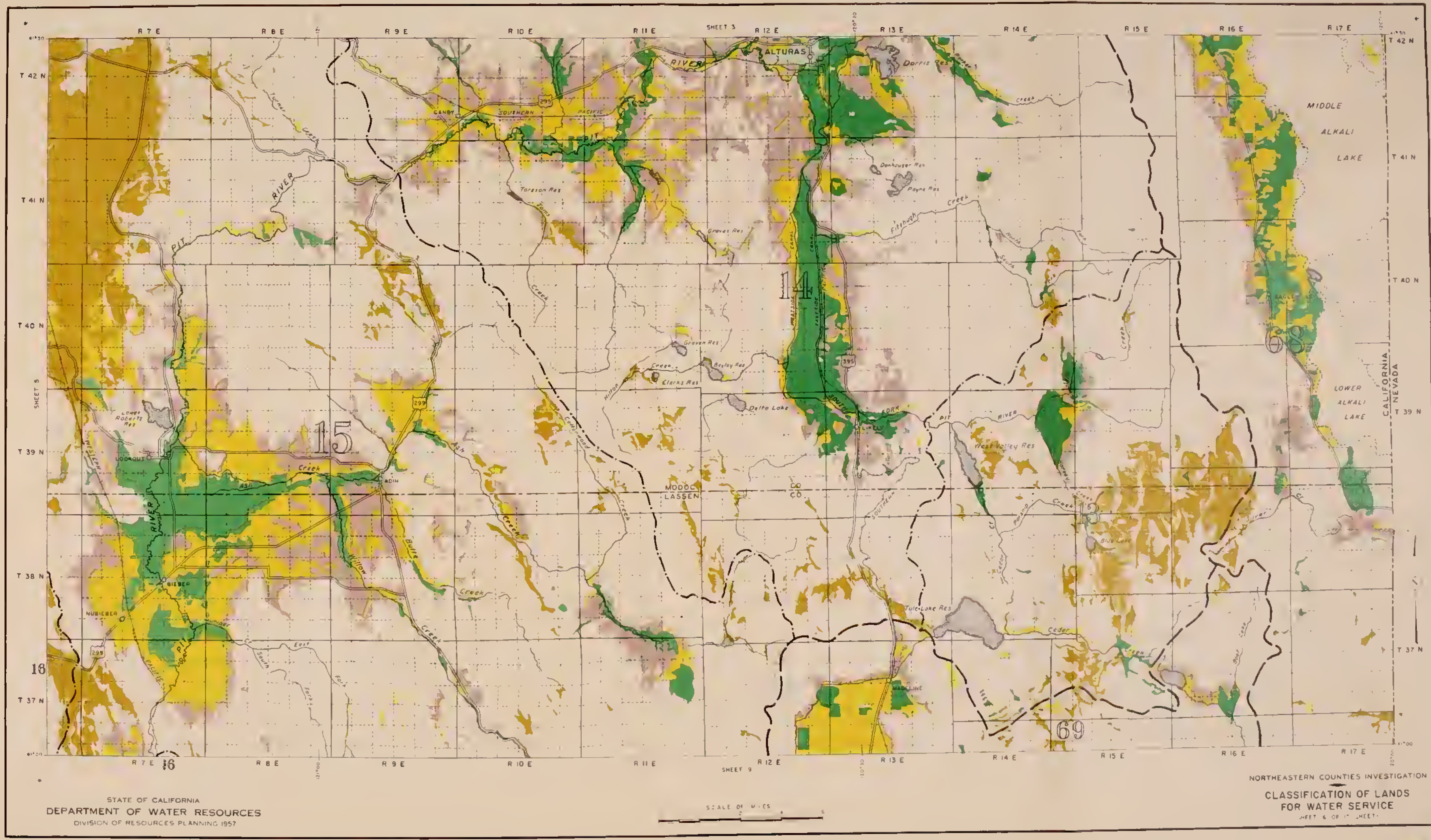


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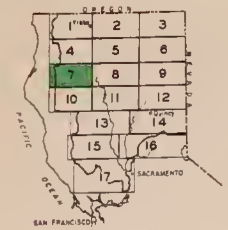

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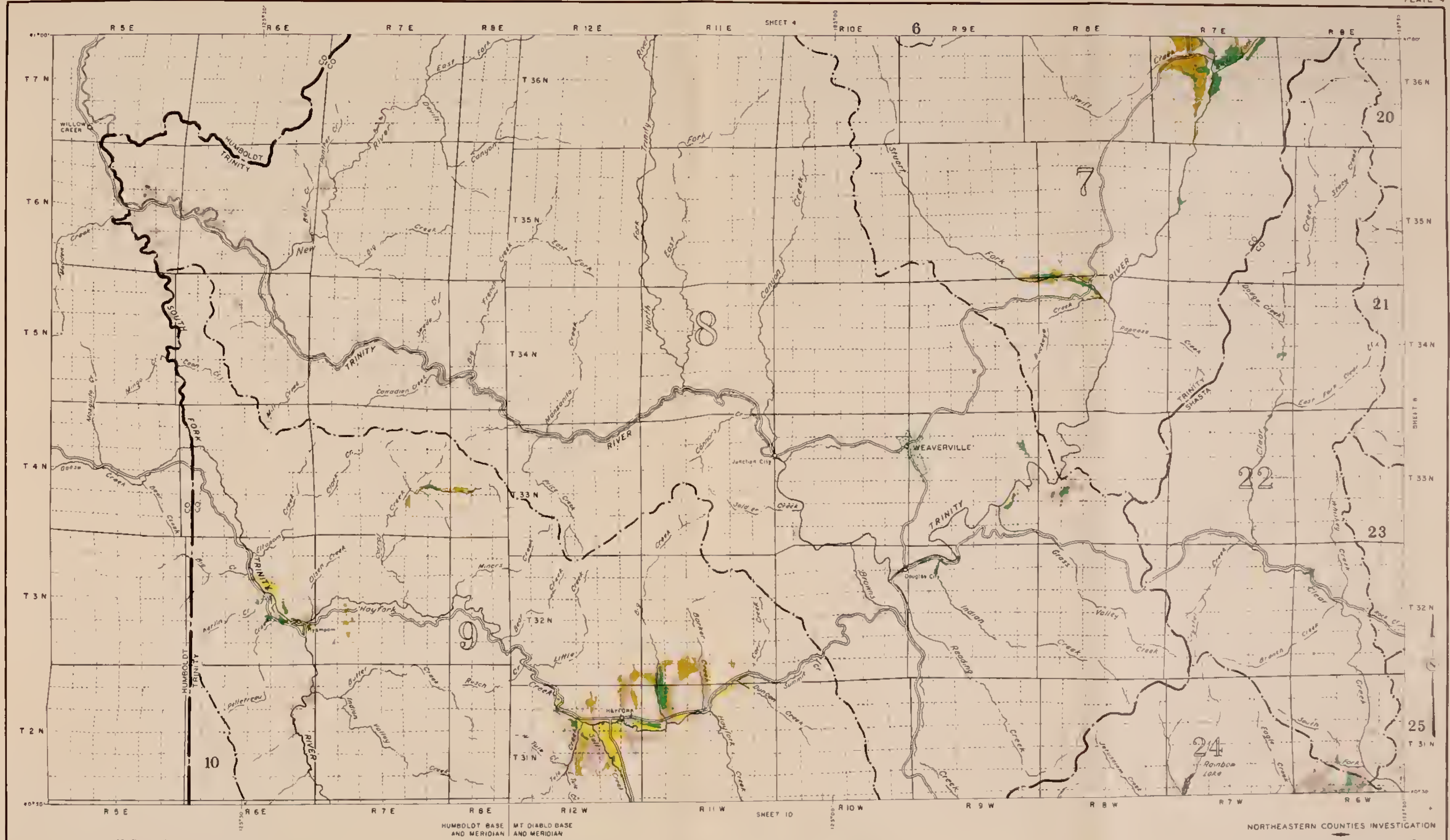

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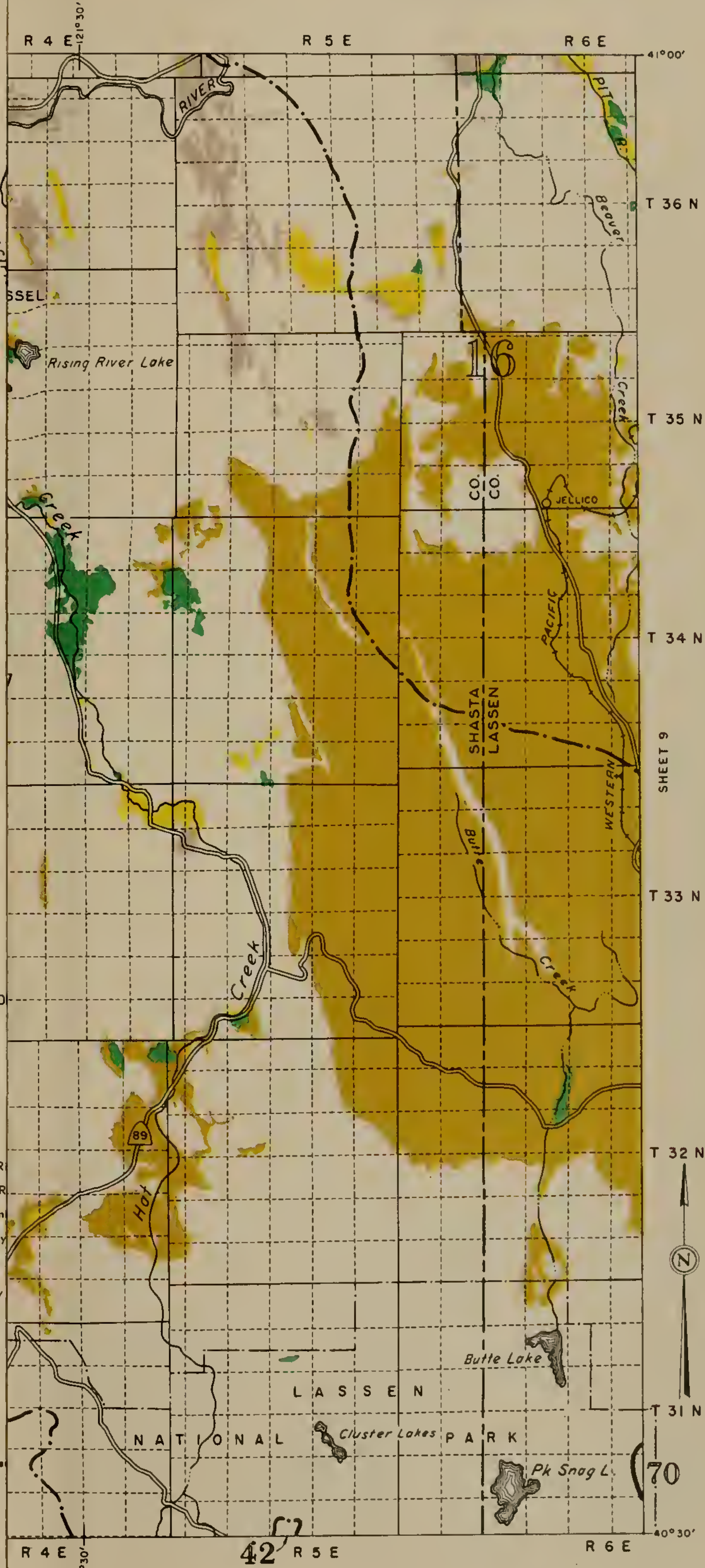

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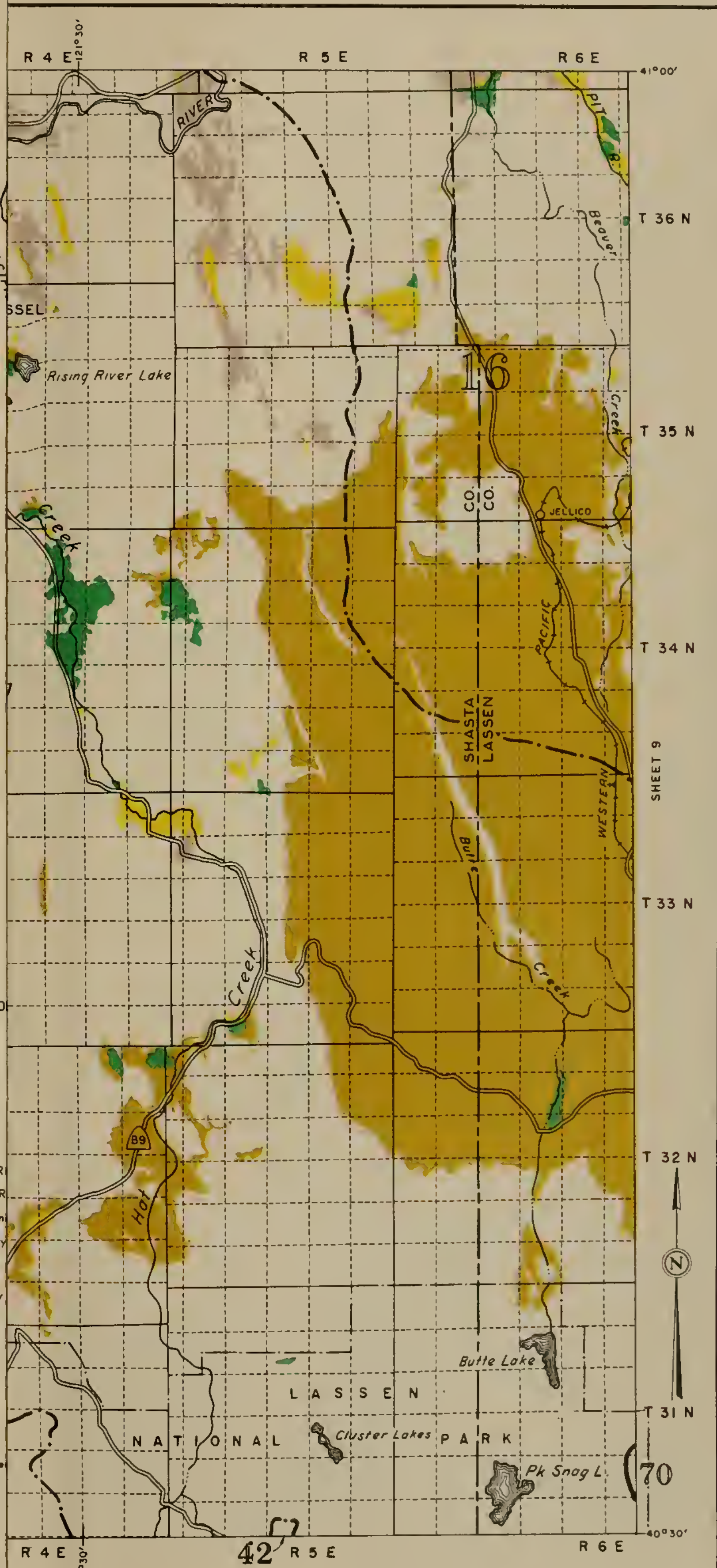

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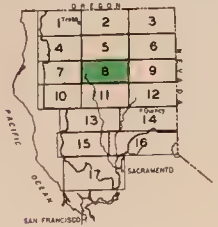

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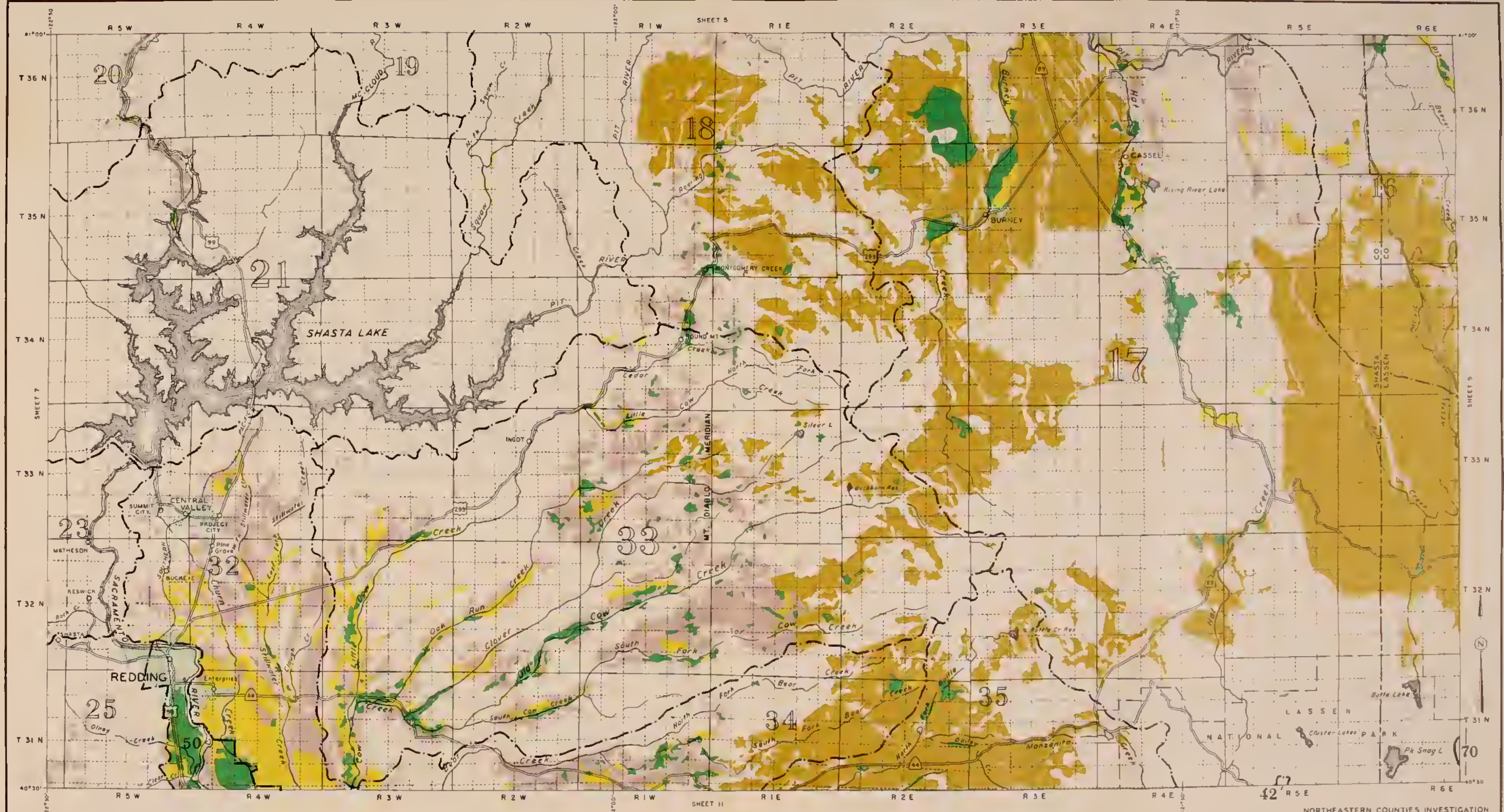

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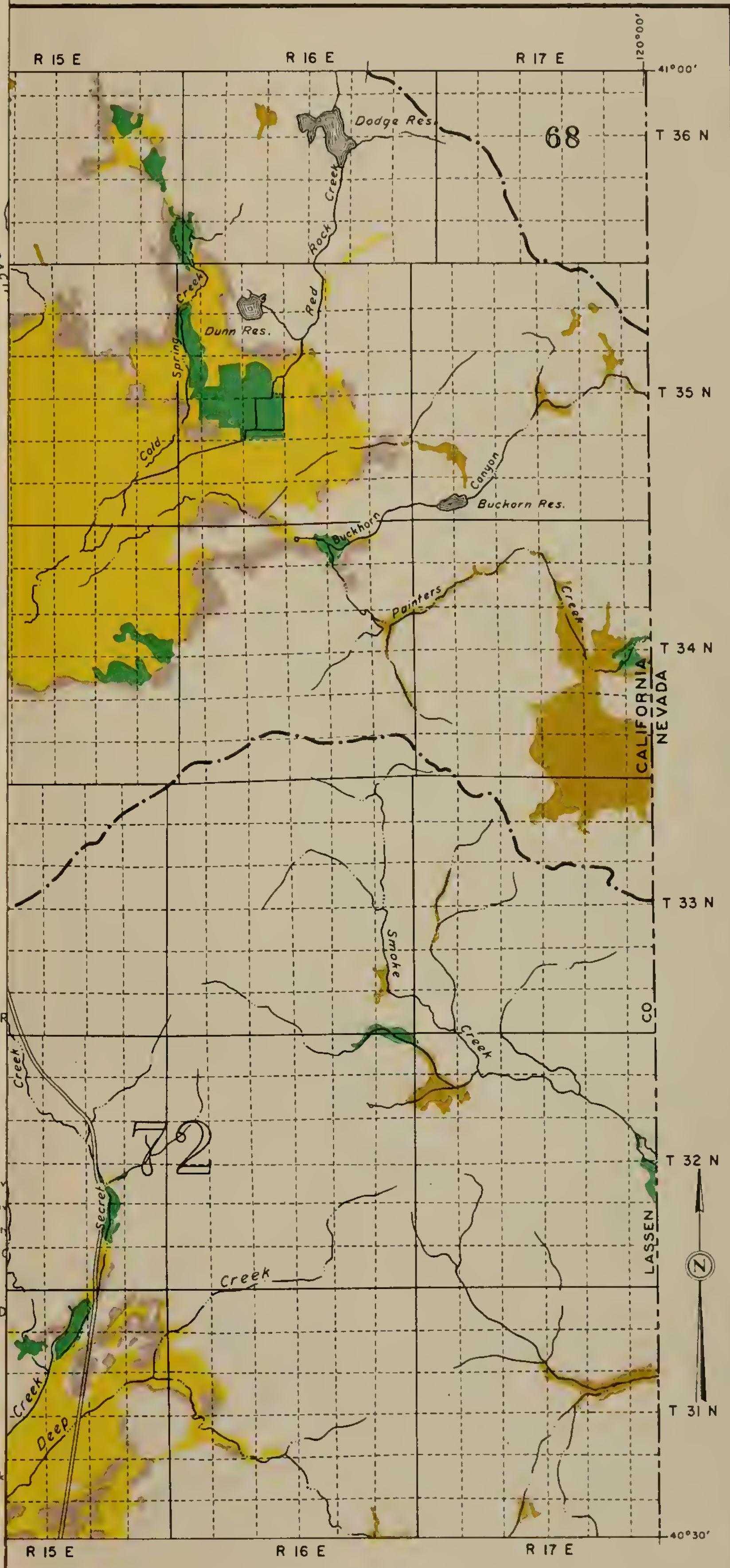

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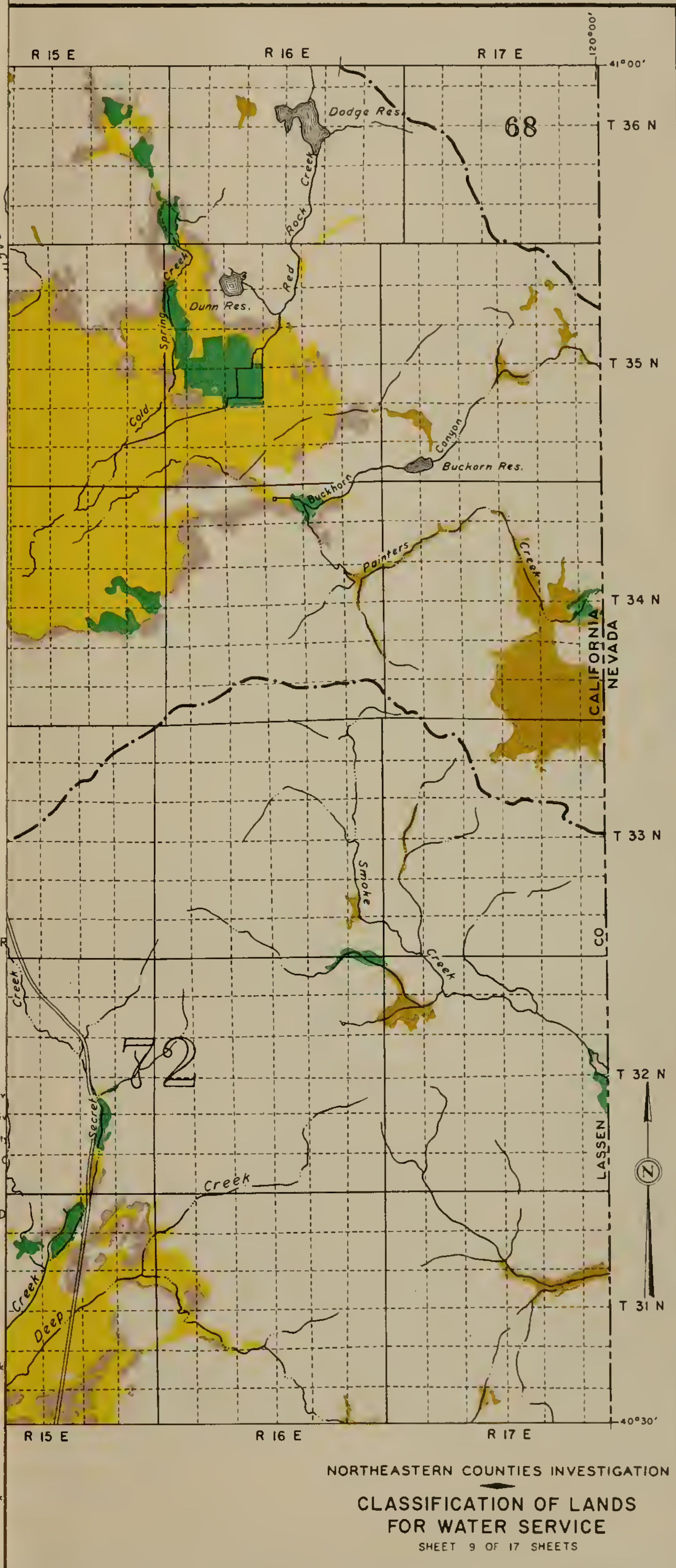

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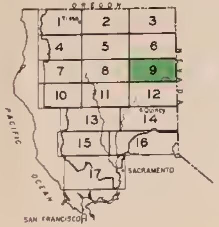

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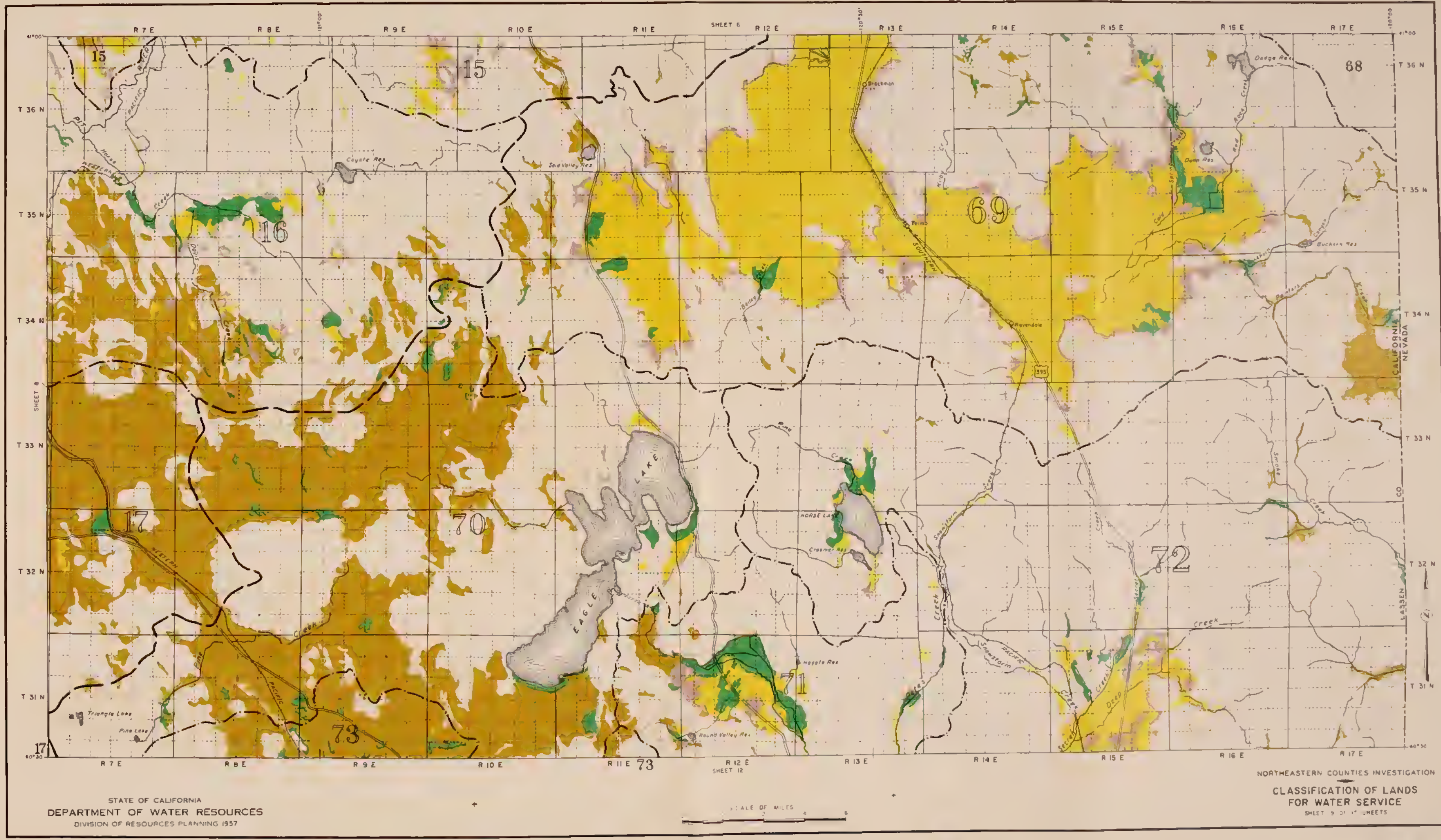

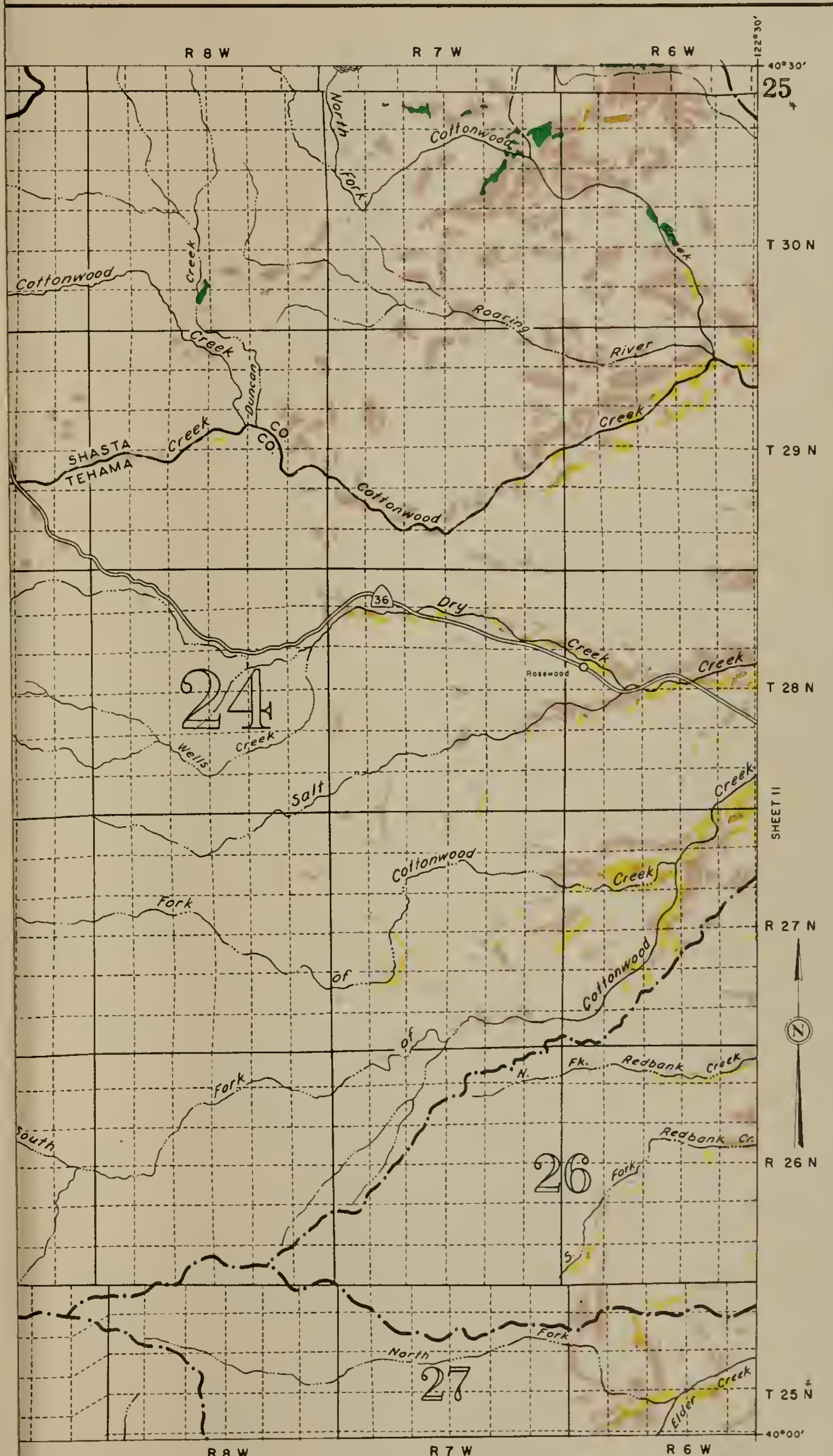

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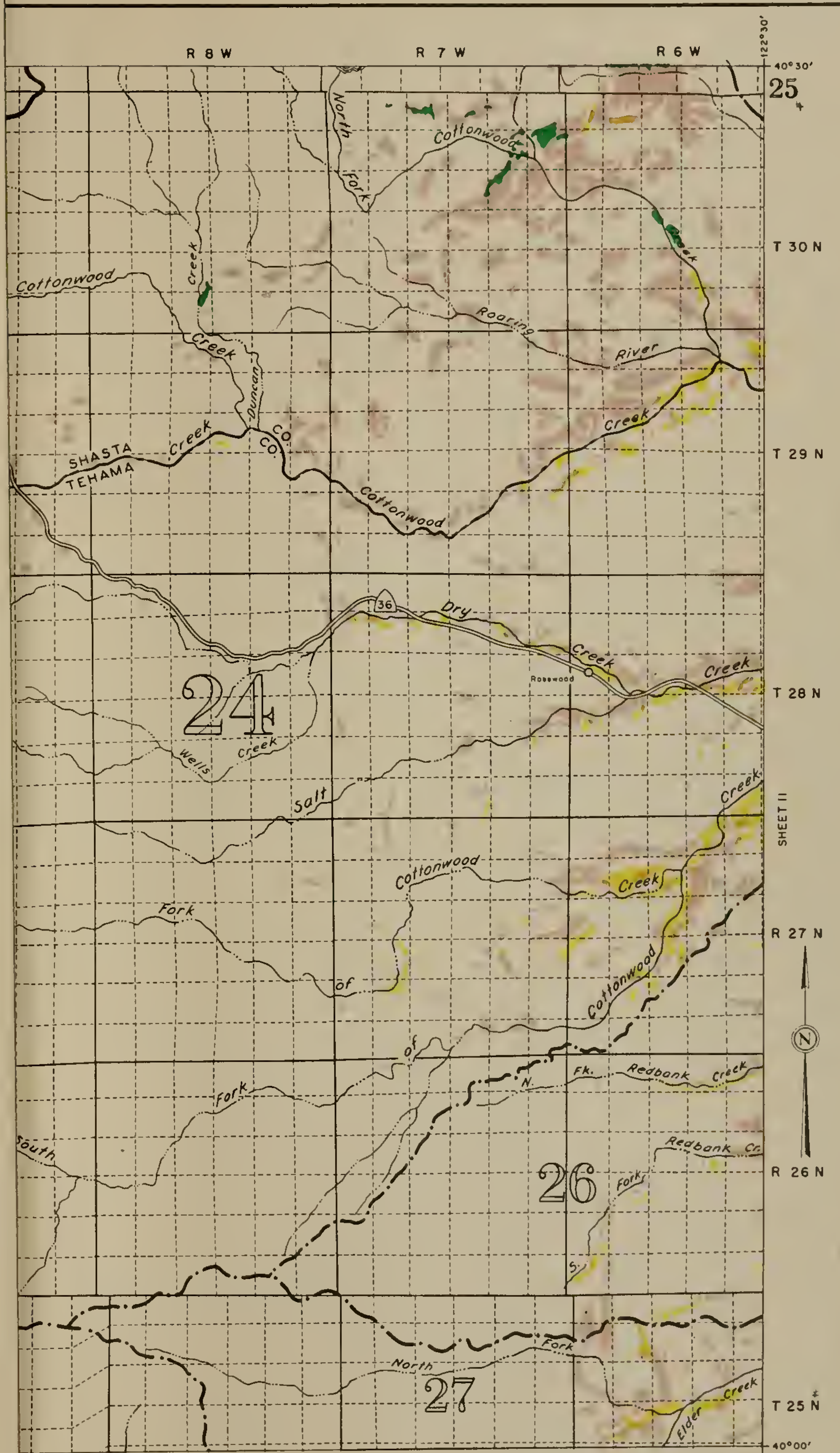

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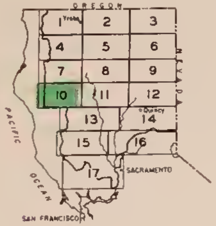

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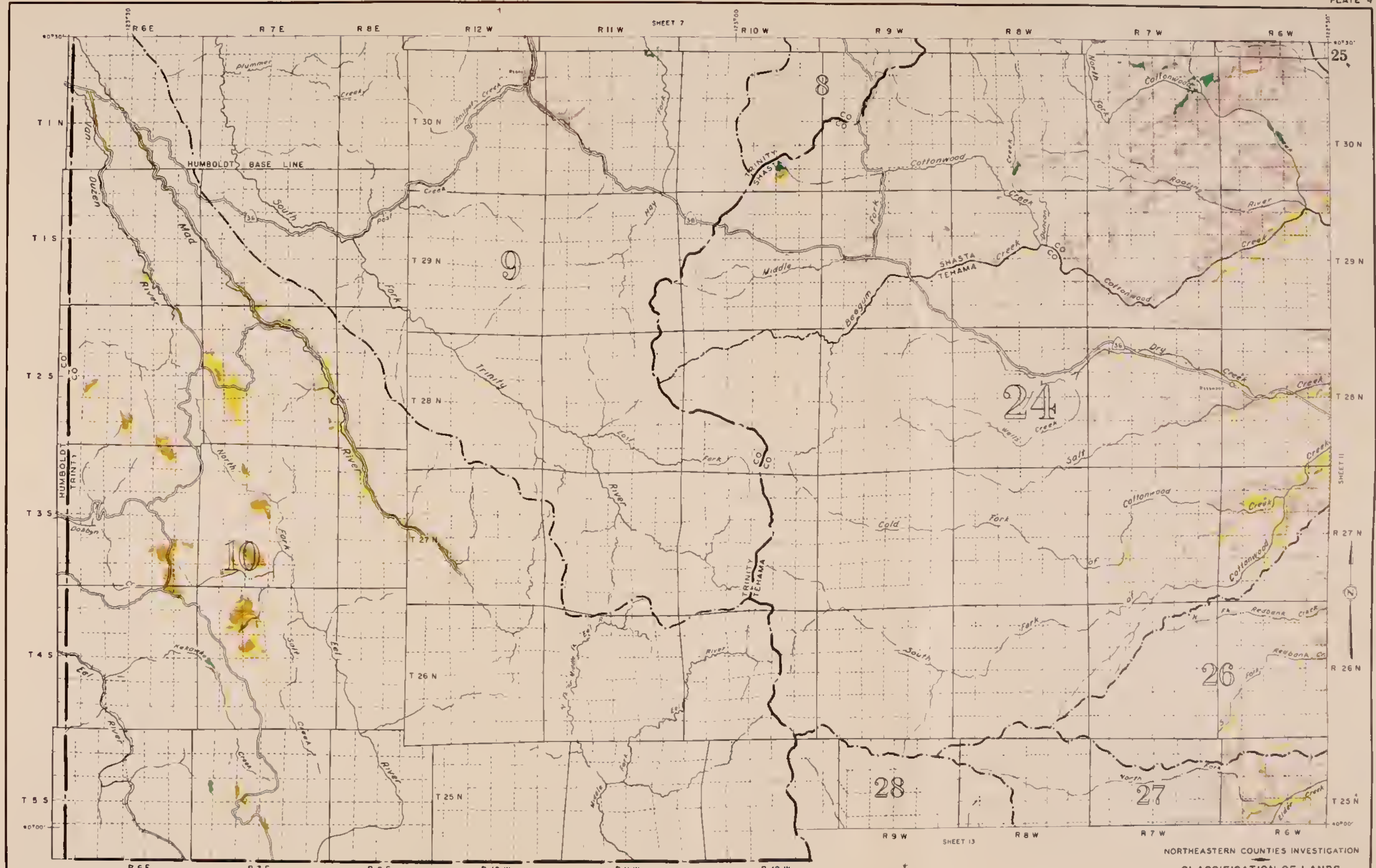

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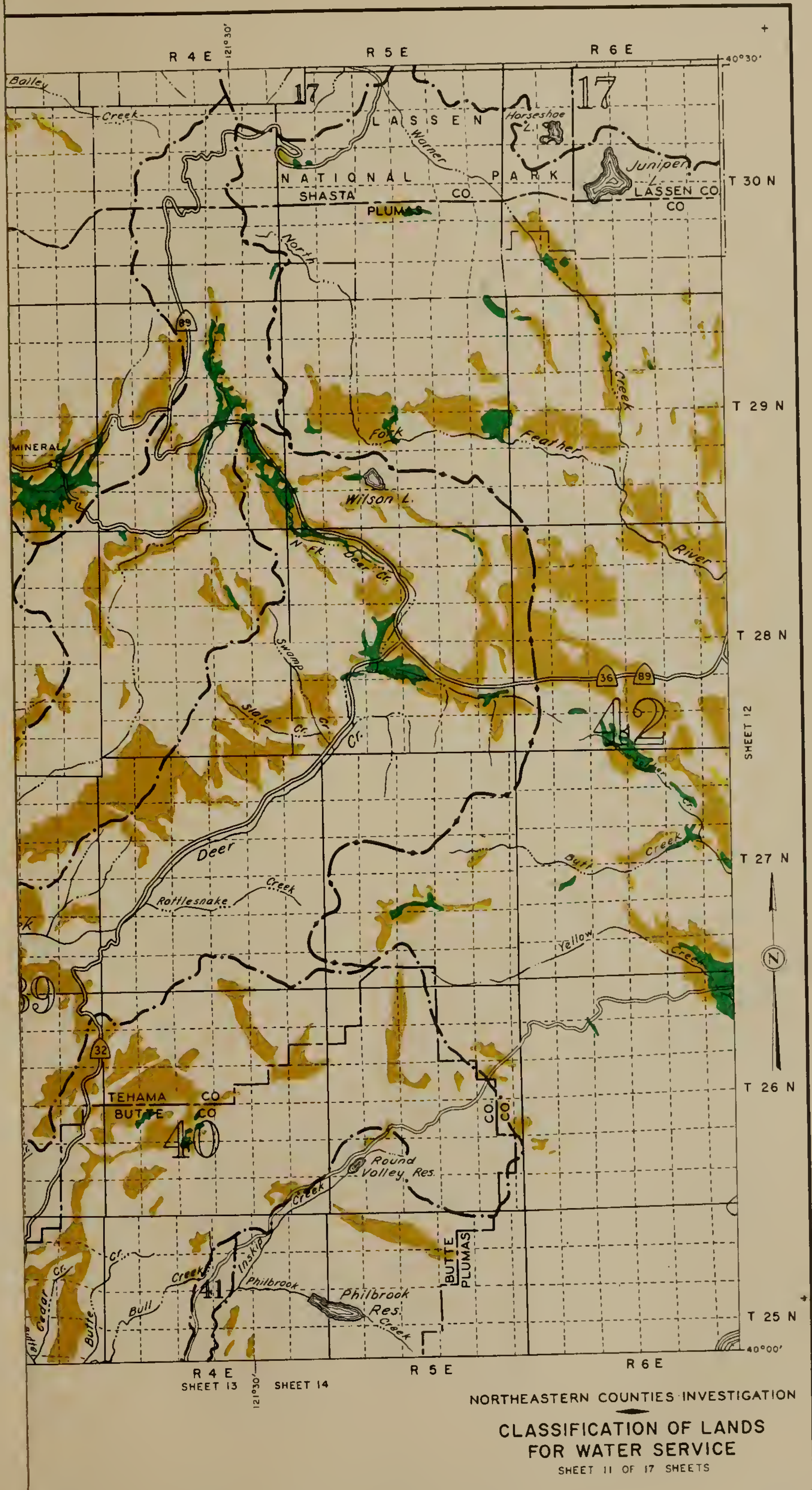
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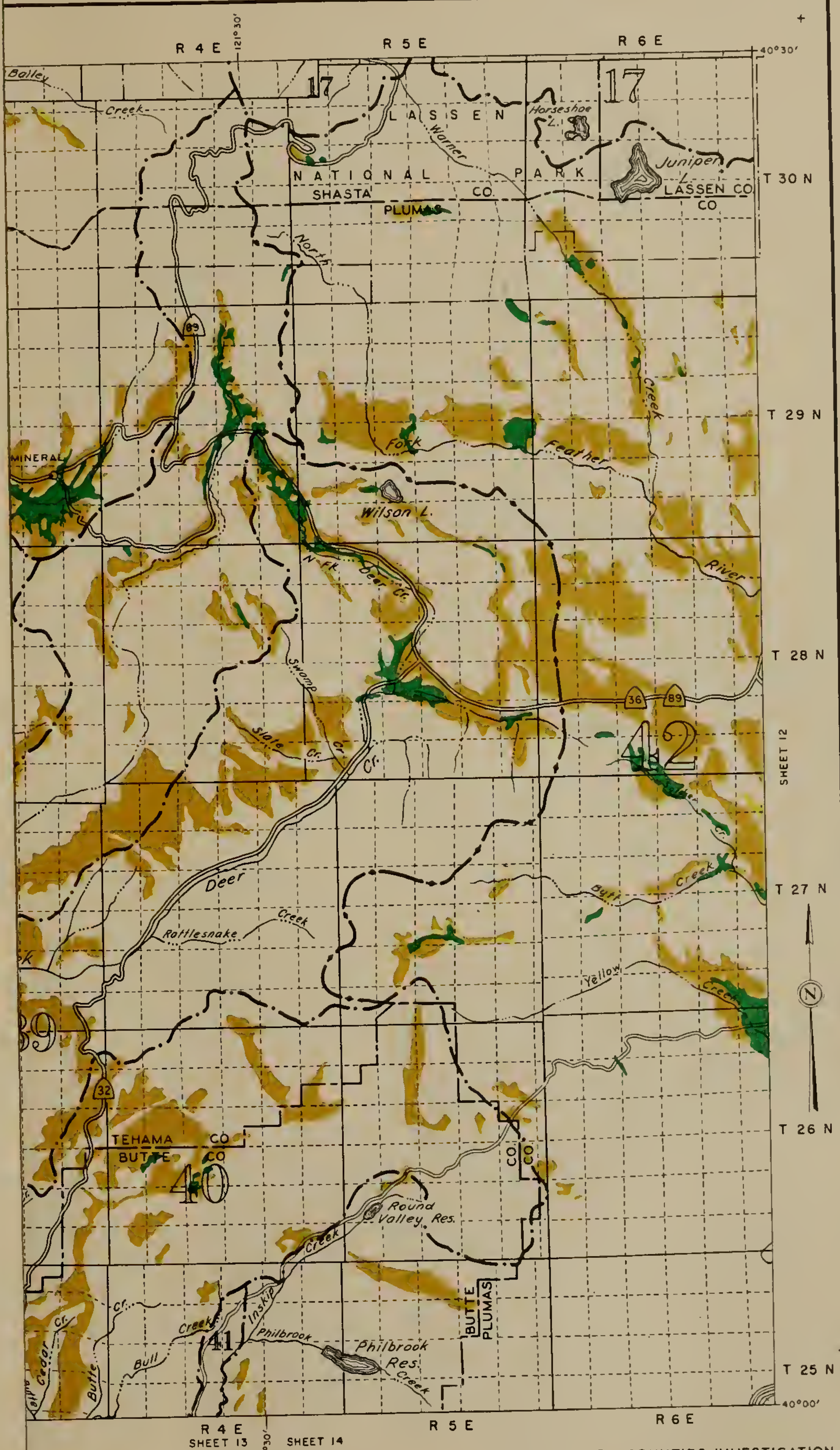

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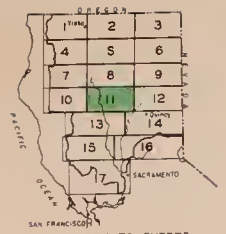

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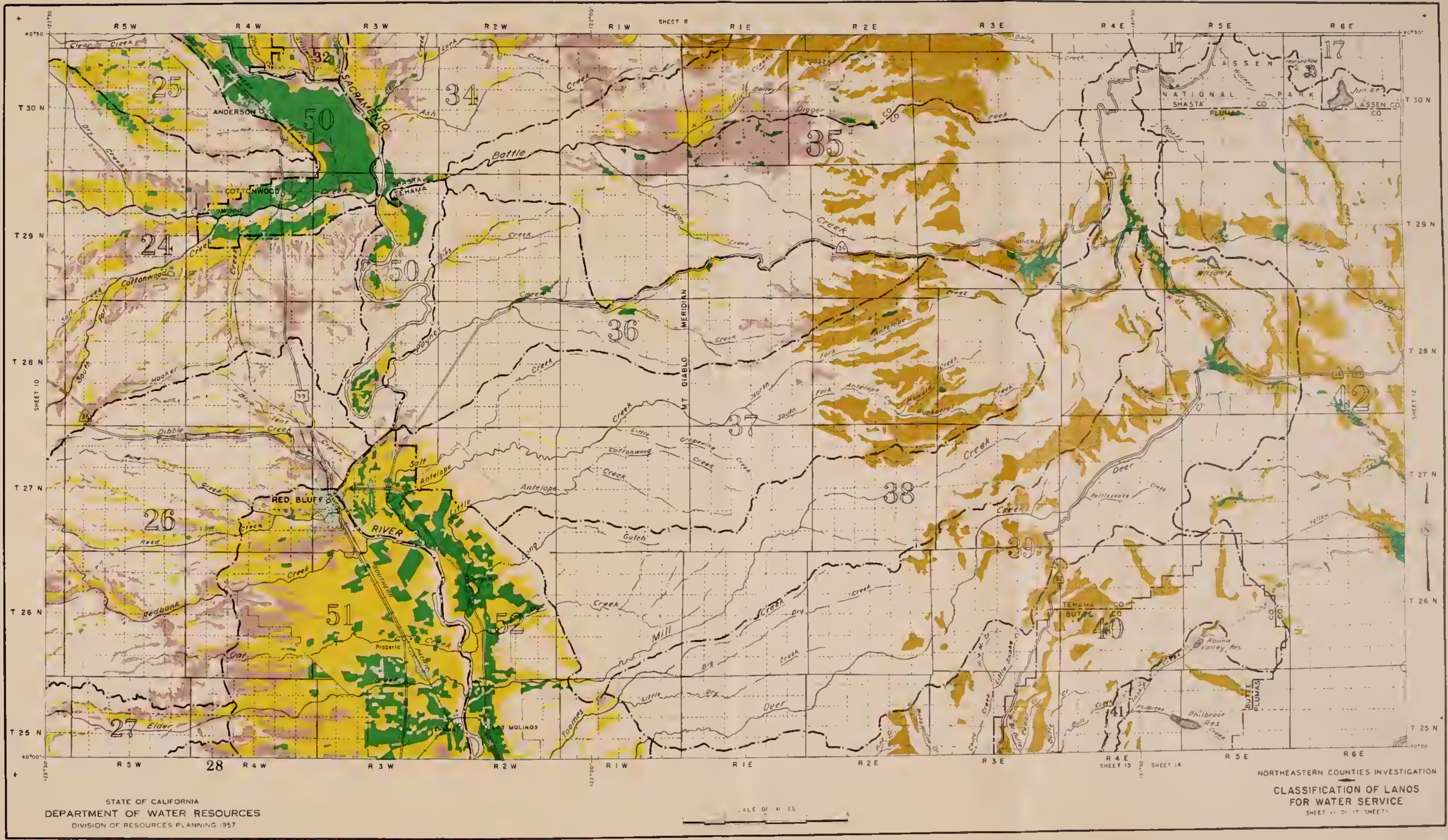

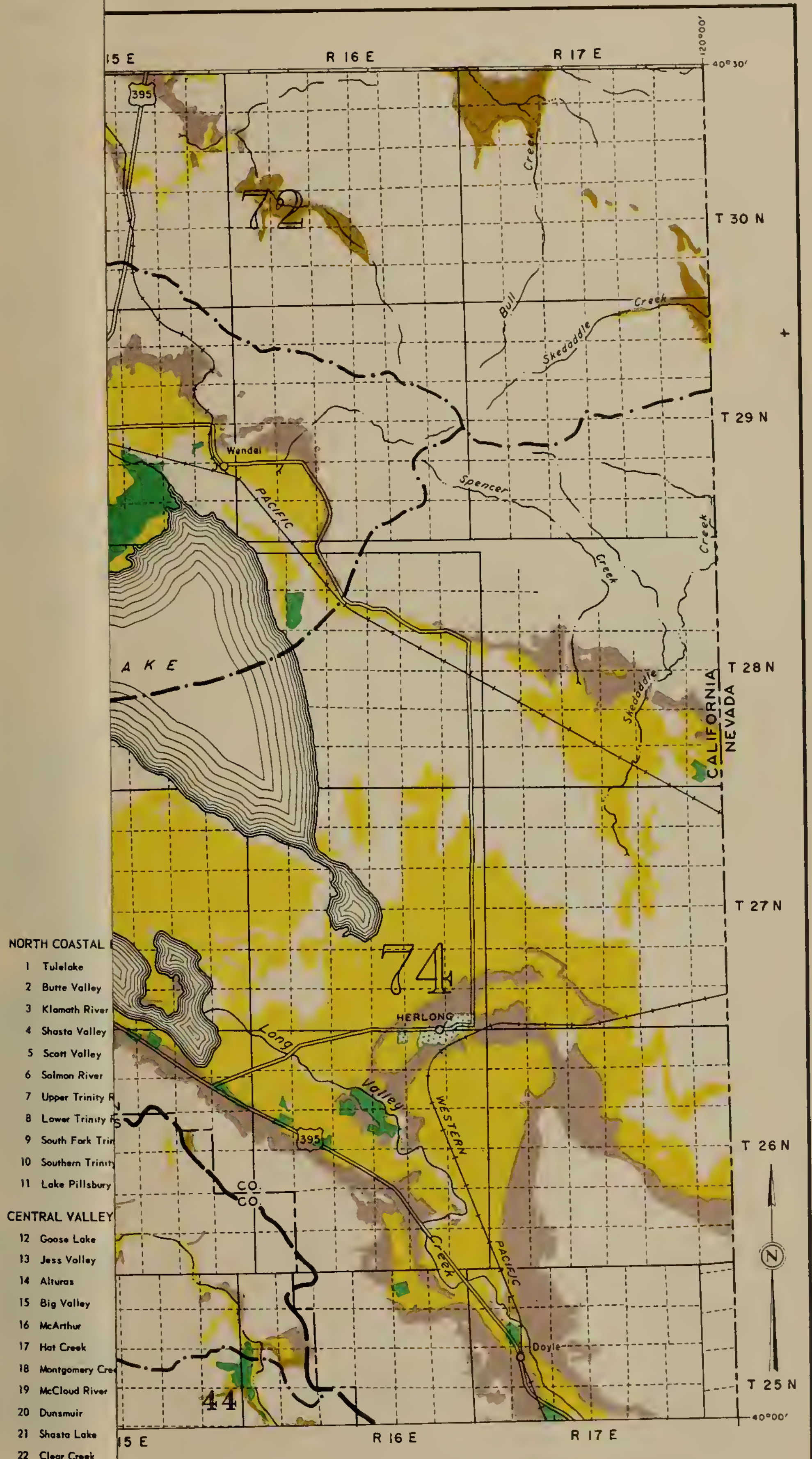

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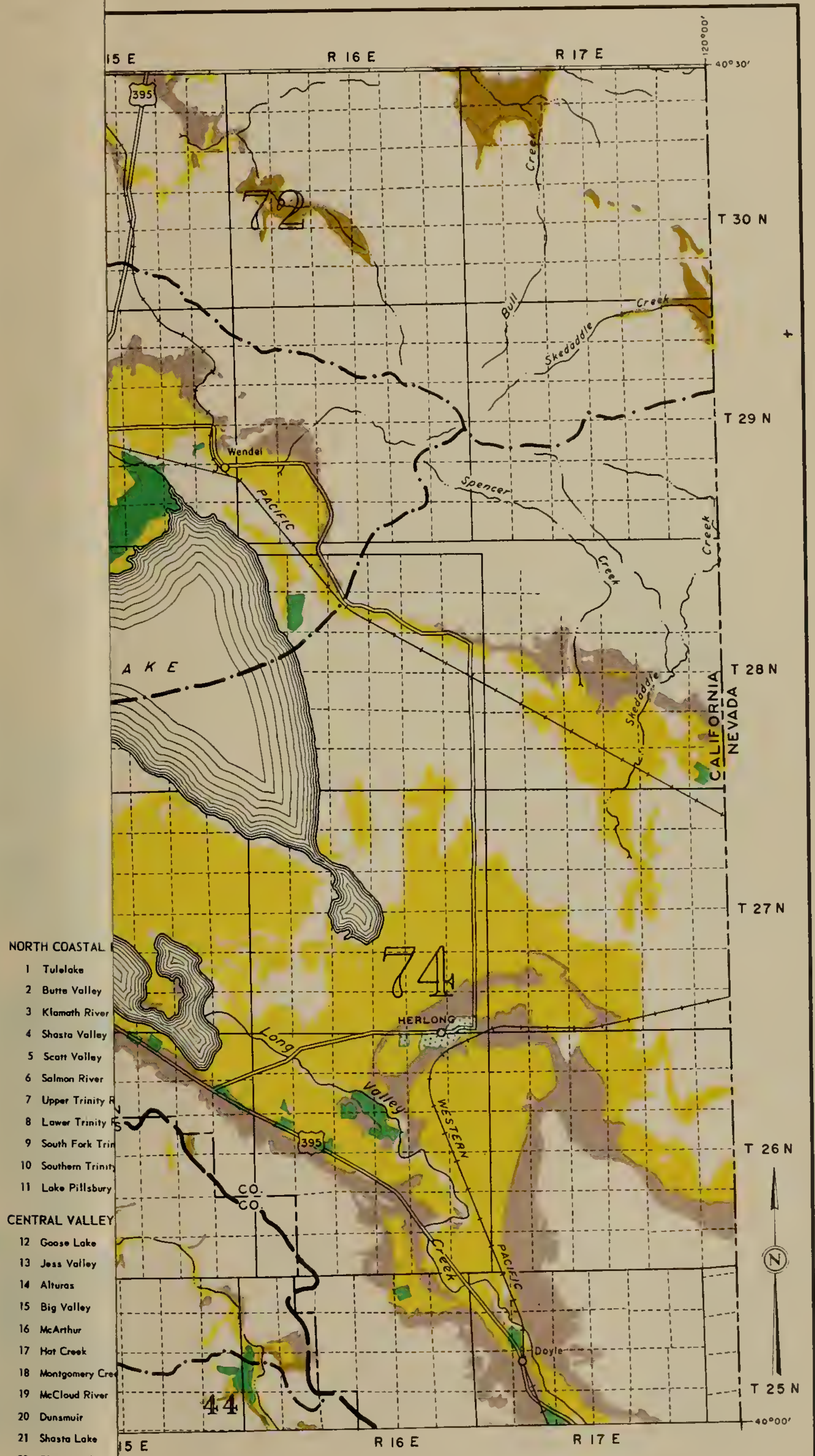

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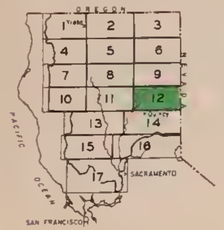

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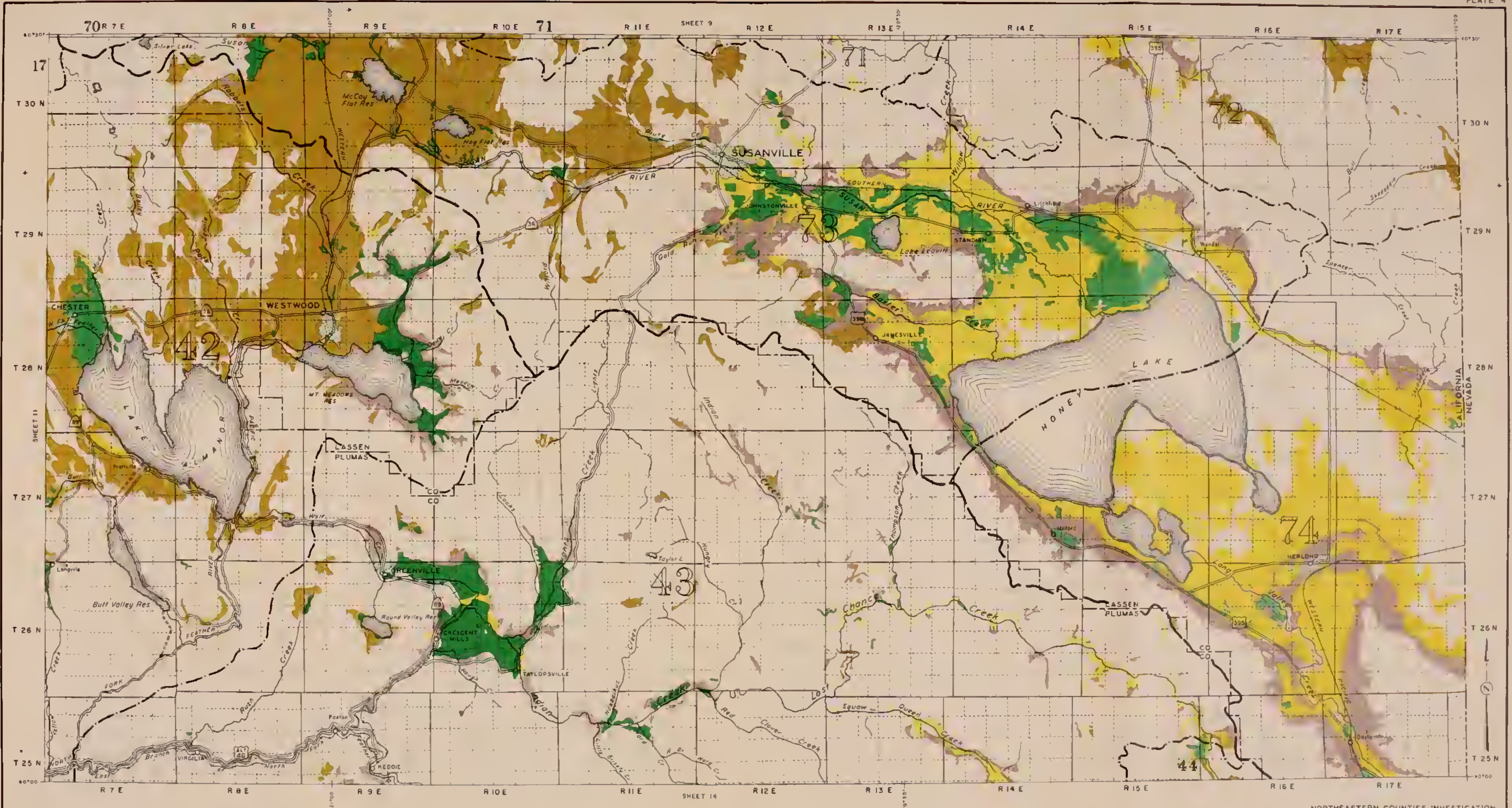

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SCALE OF MILES

NORTHEASTERN COUNTIES INVESTIGATION

CLASSIFICATION OF LANDS FOR WATER SERVICE

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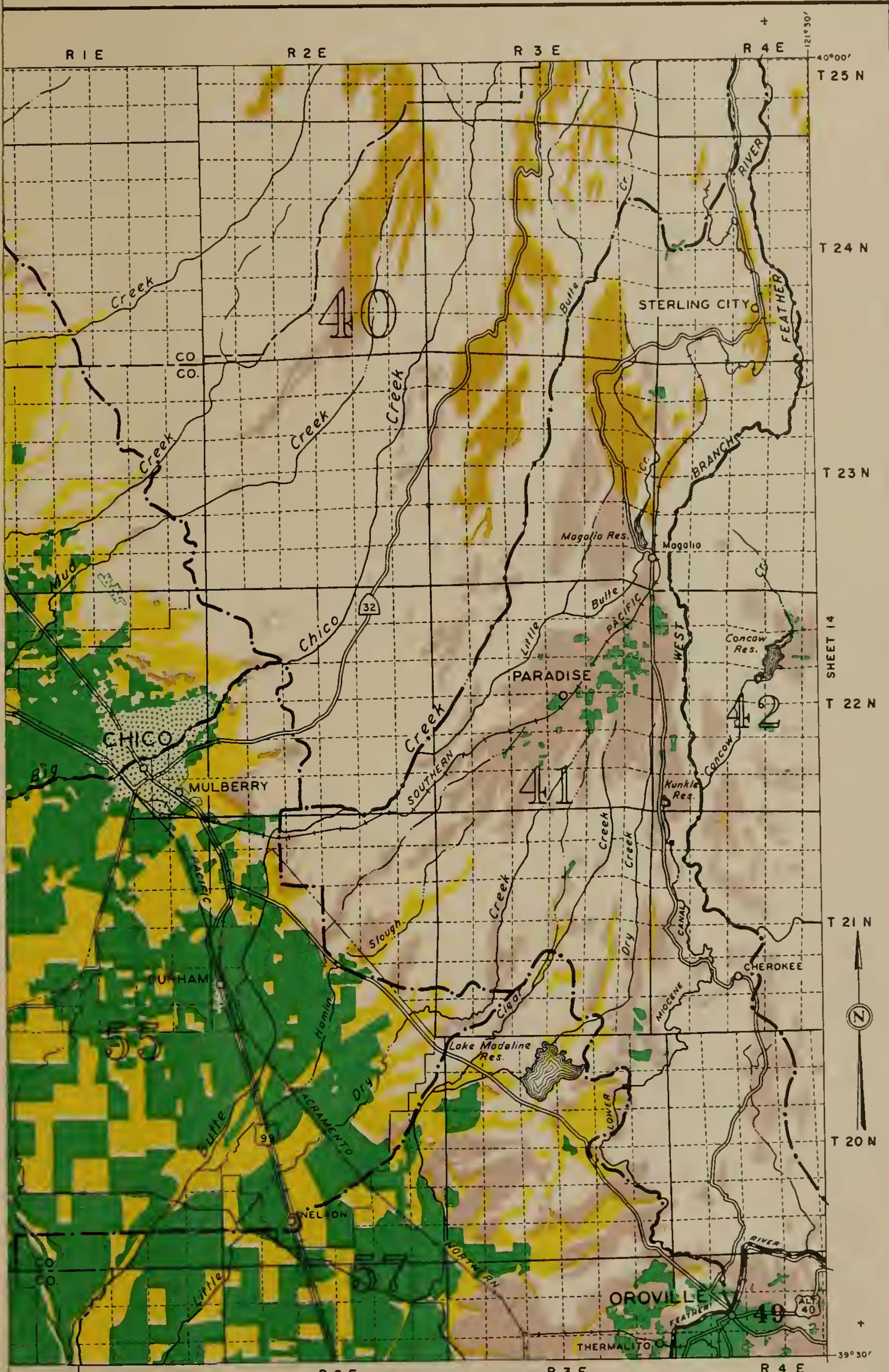

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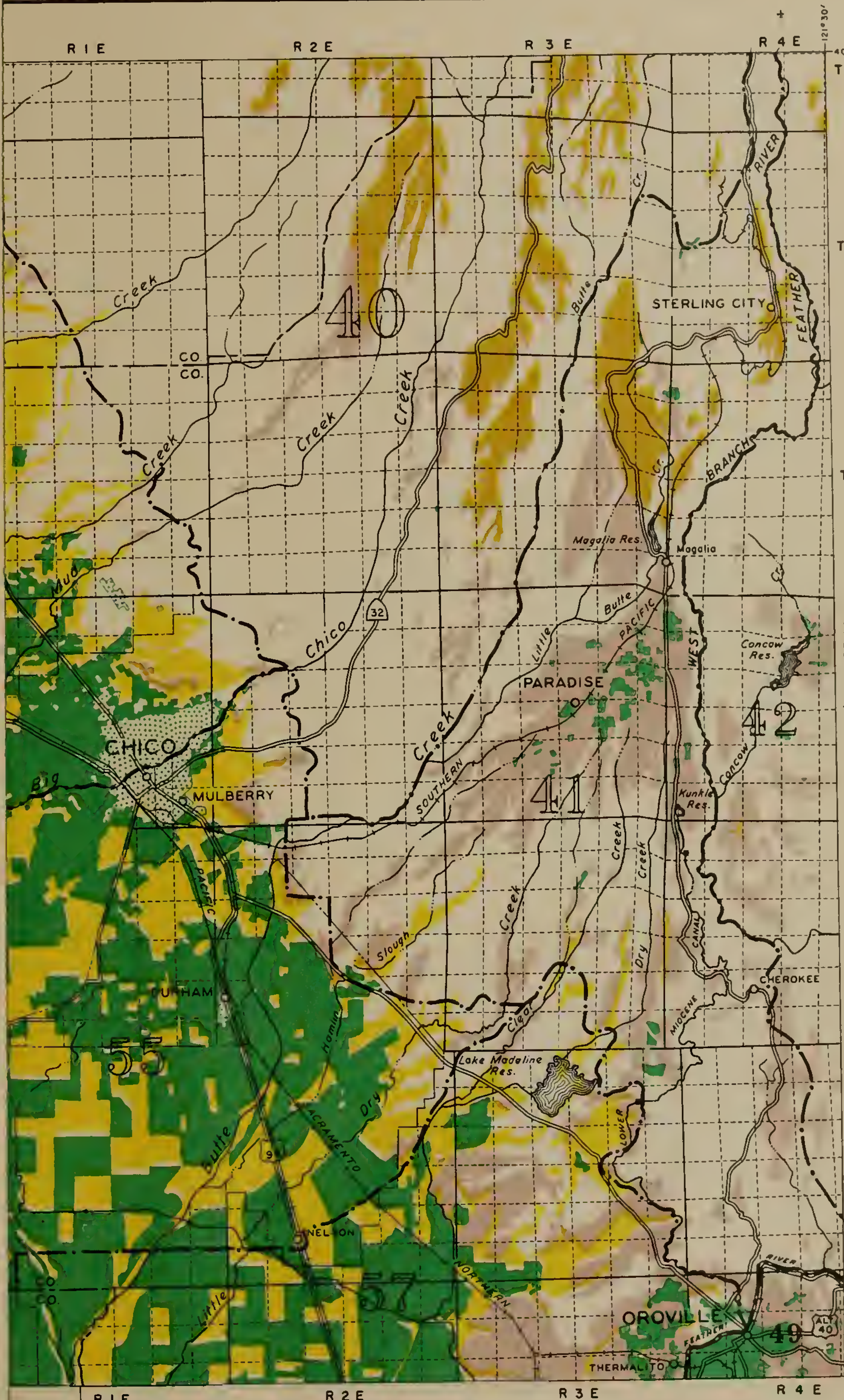

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CLASSIFICATION OF LANDS FOR WATER SERVICE

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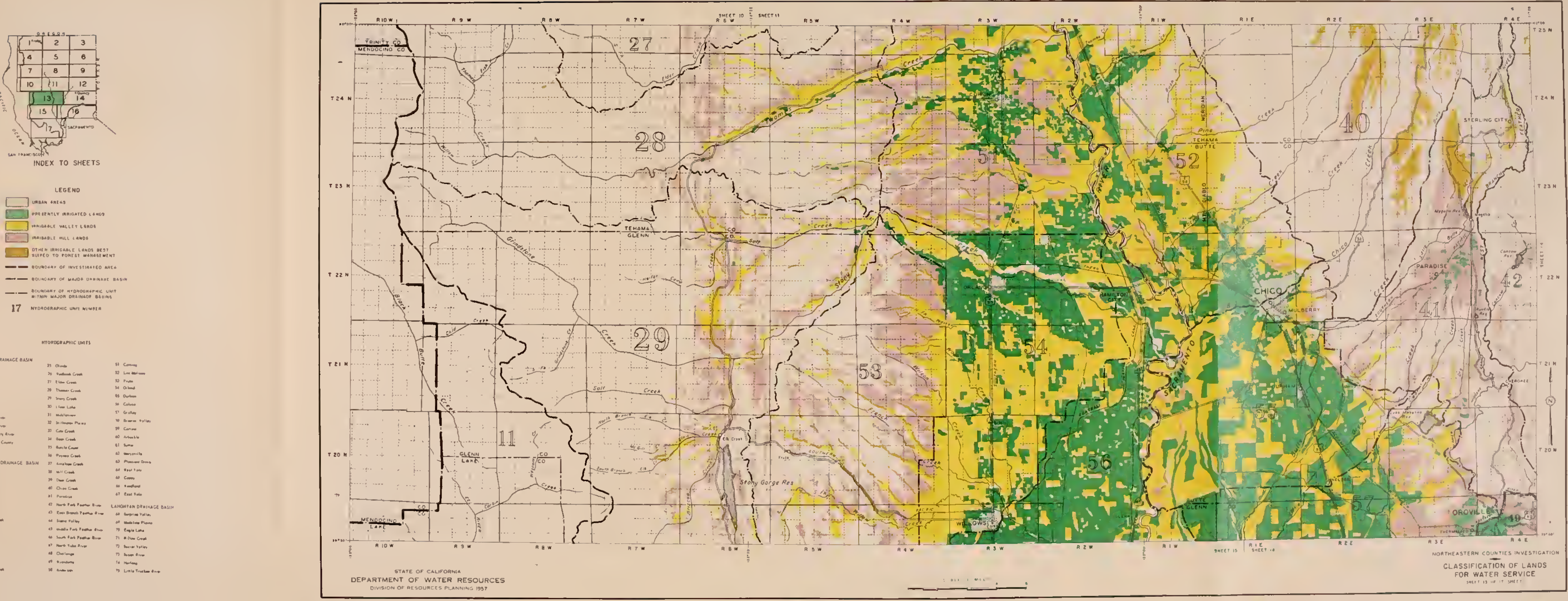

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8 Lower Trinity River
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57 Gridley
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60 Arbuckle
61 Sutter
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63 Pleasant Grove
64 West Yolo
65 Capay
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67 East Yolo

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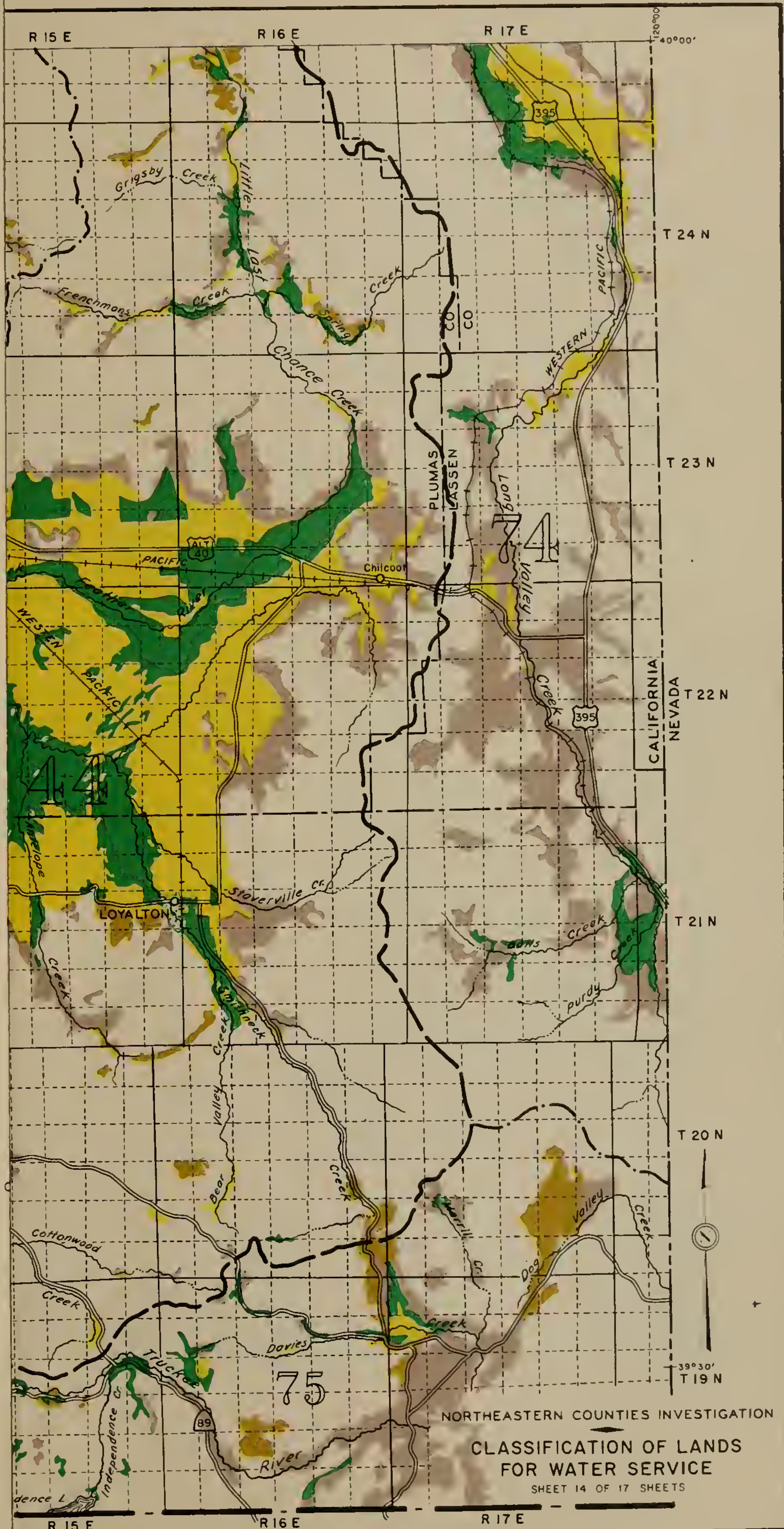

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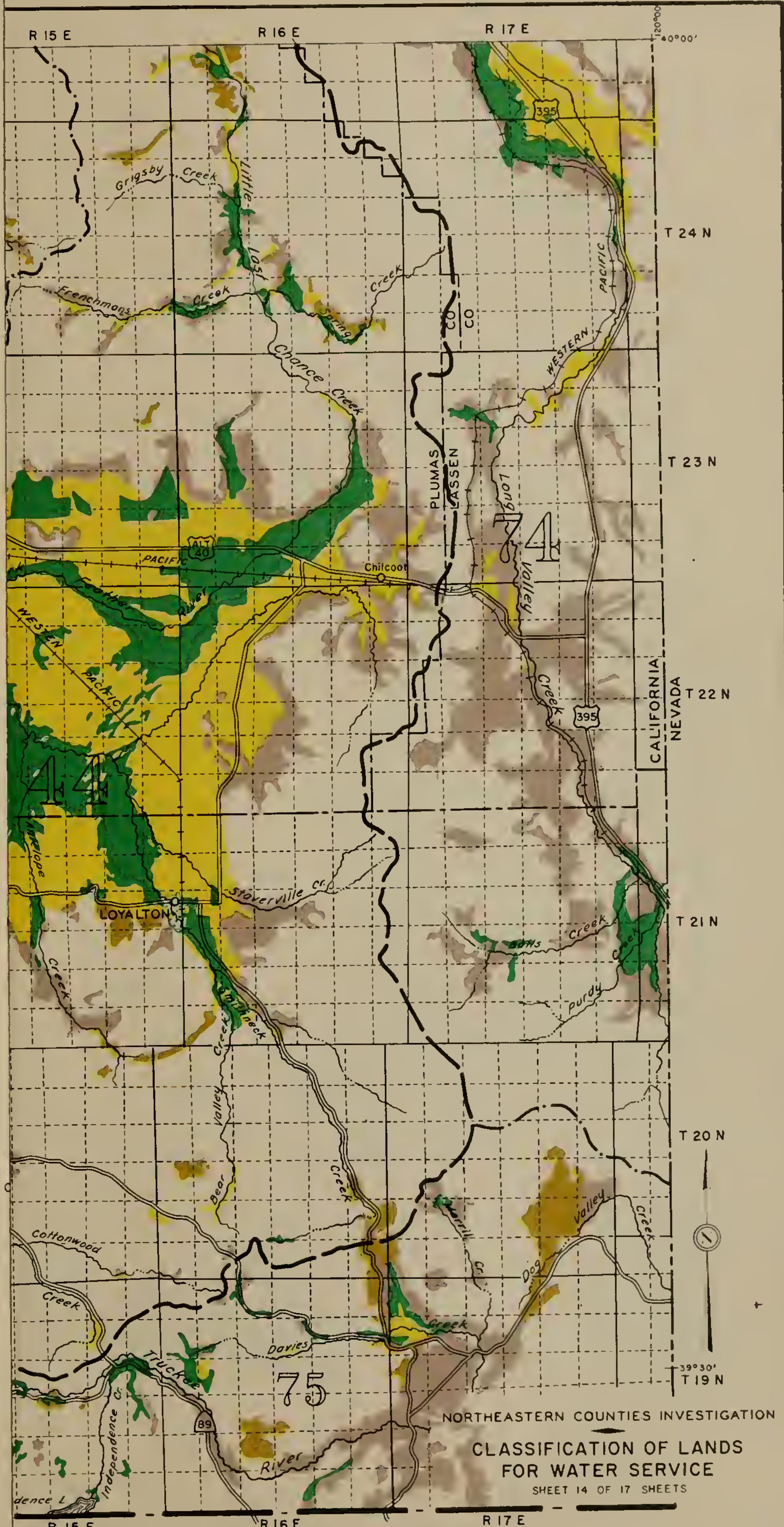

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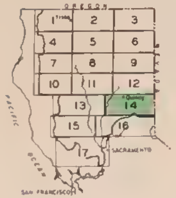
PLATE 4



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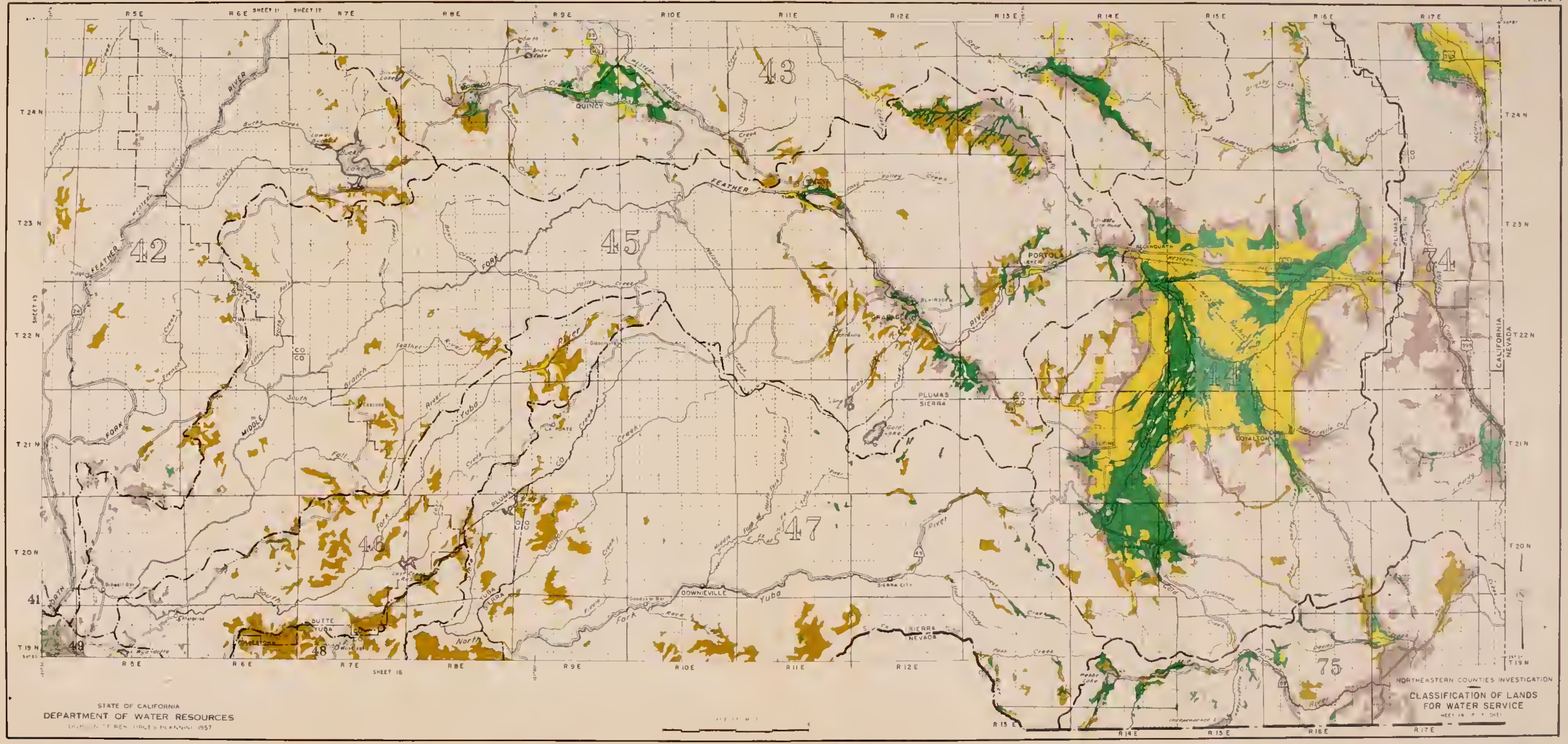

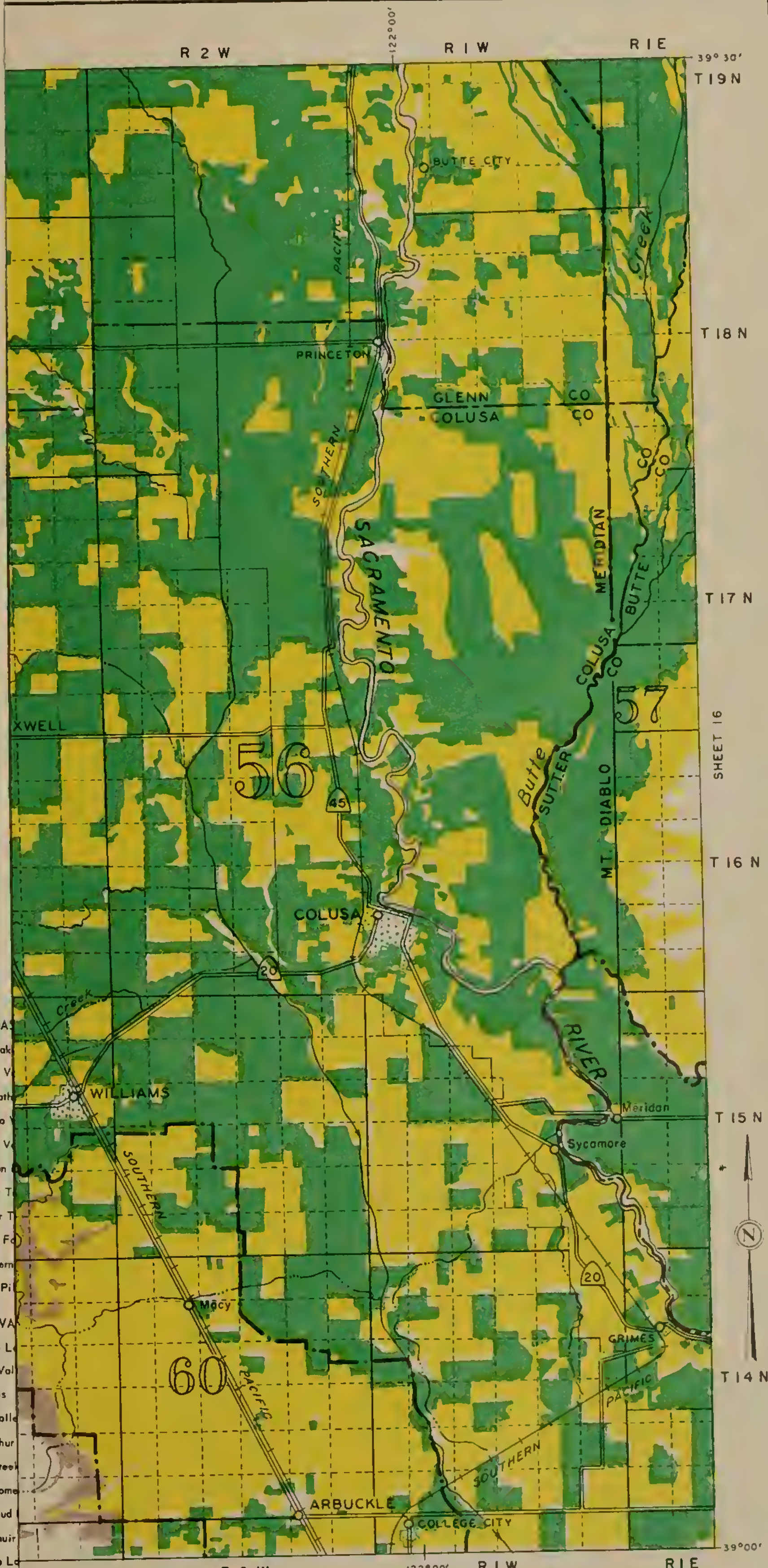

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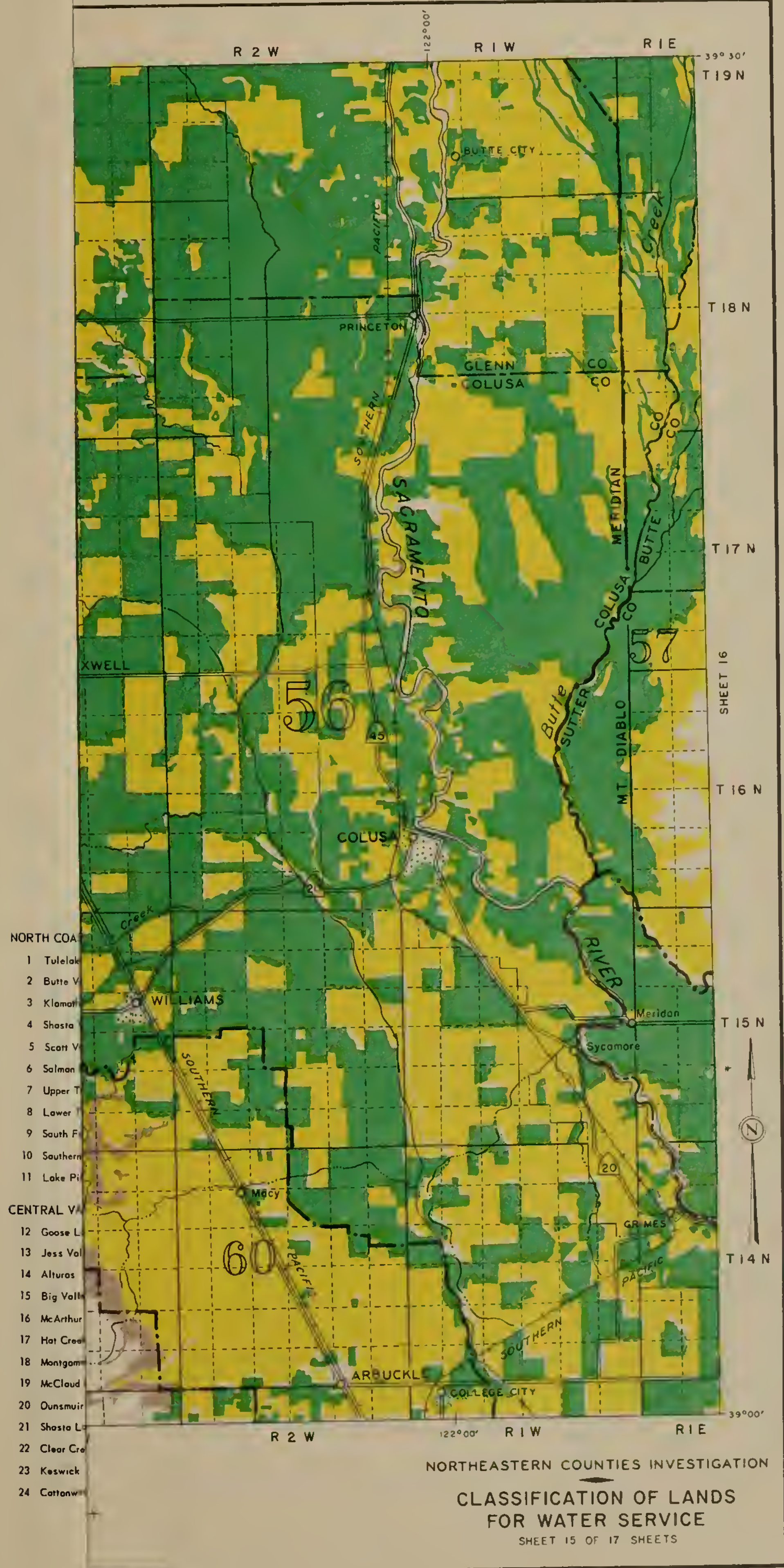

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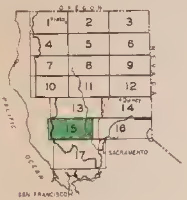

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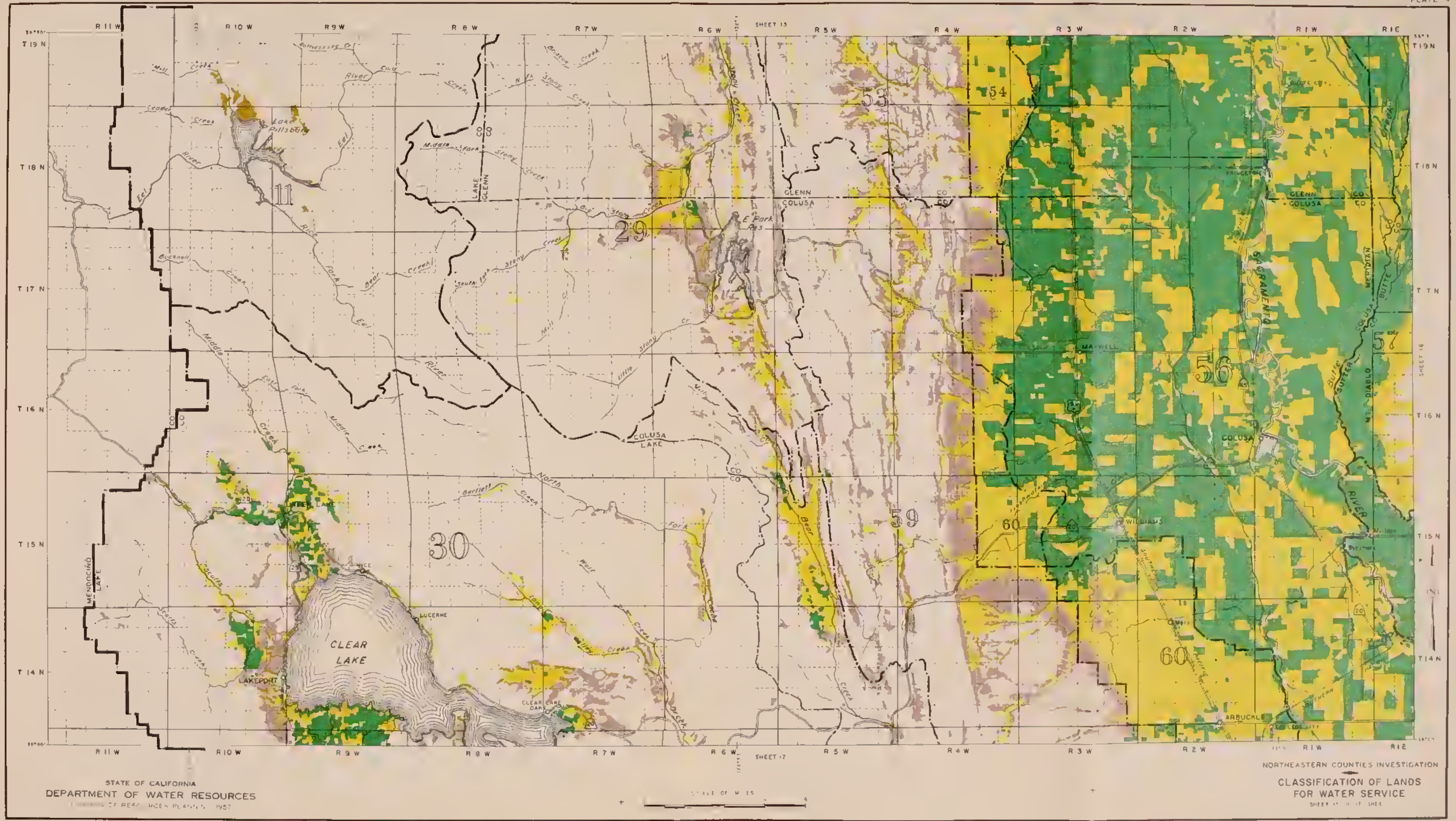

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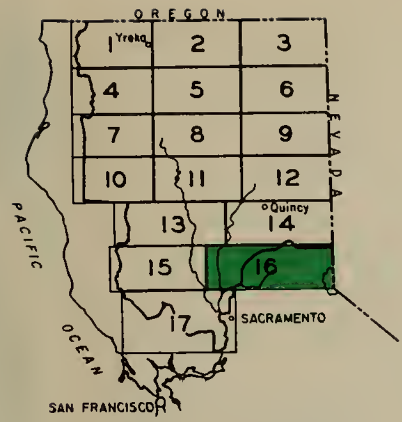

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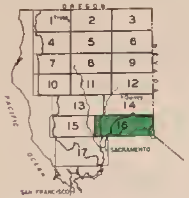

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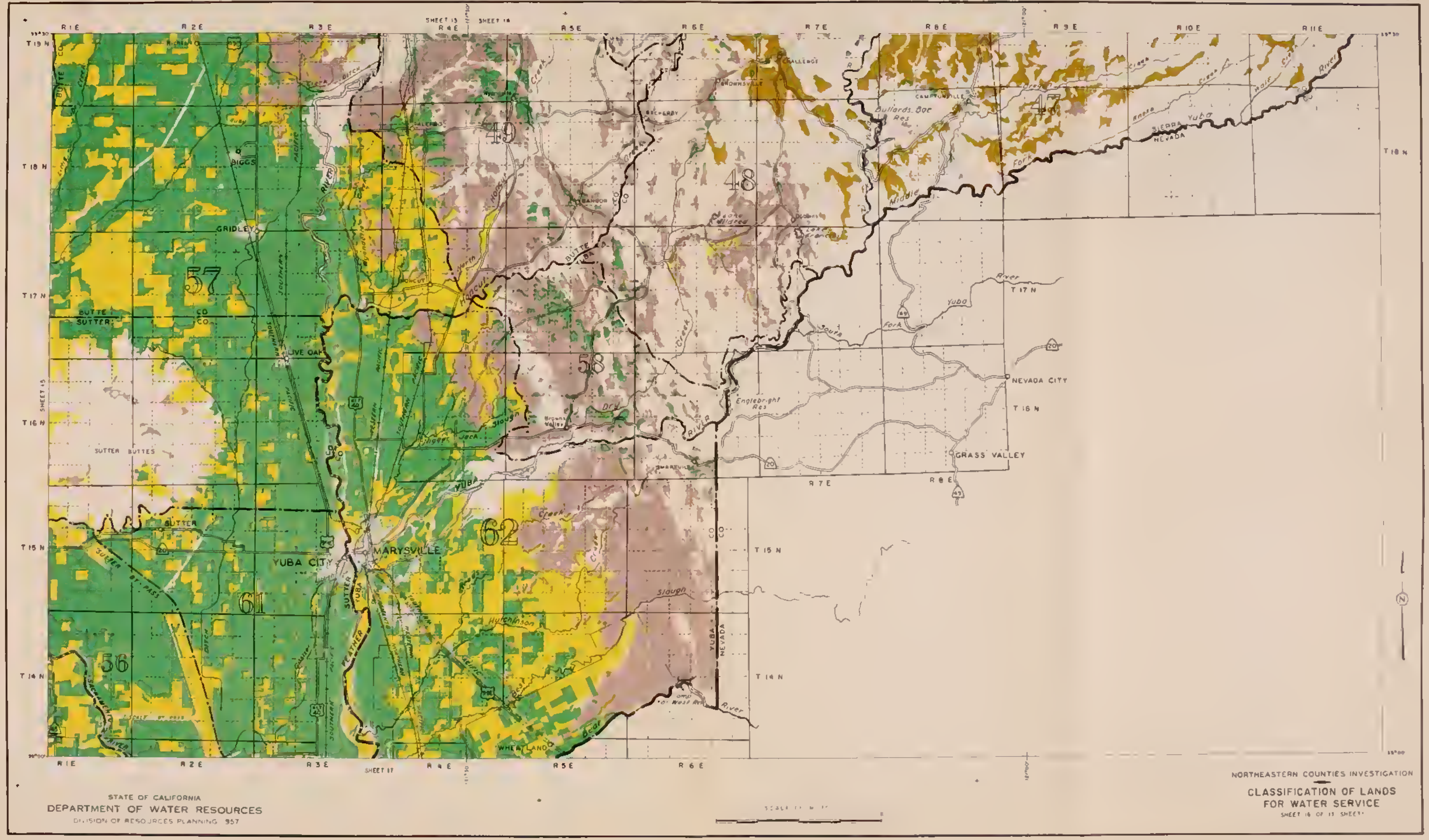

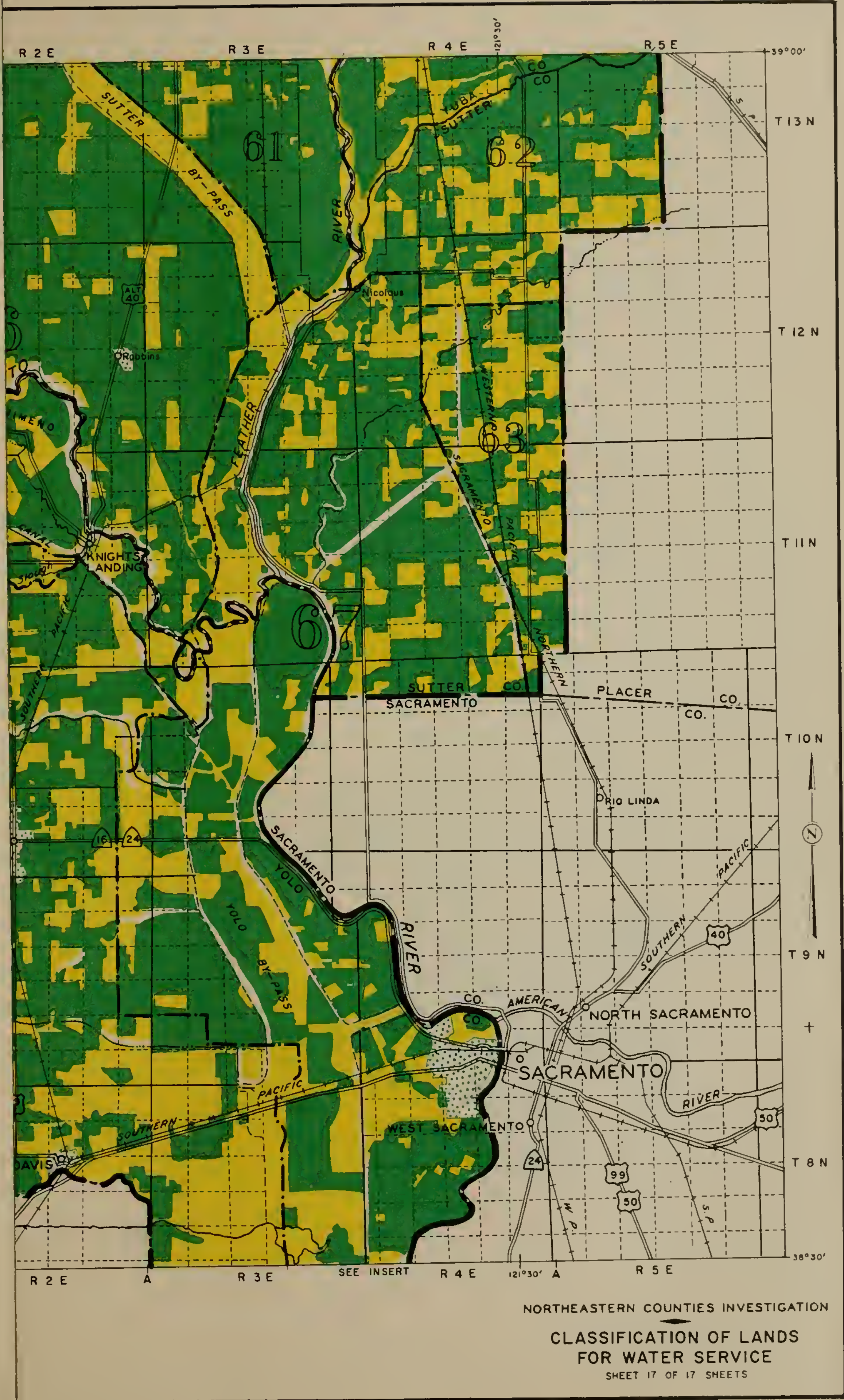

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CLASSIFICATION OF LANDS FOR WATER SERVICE

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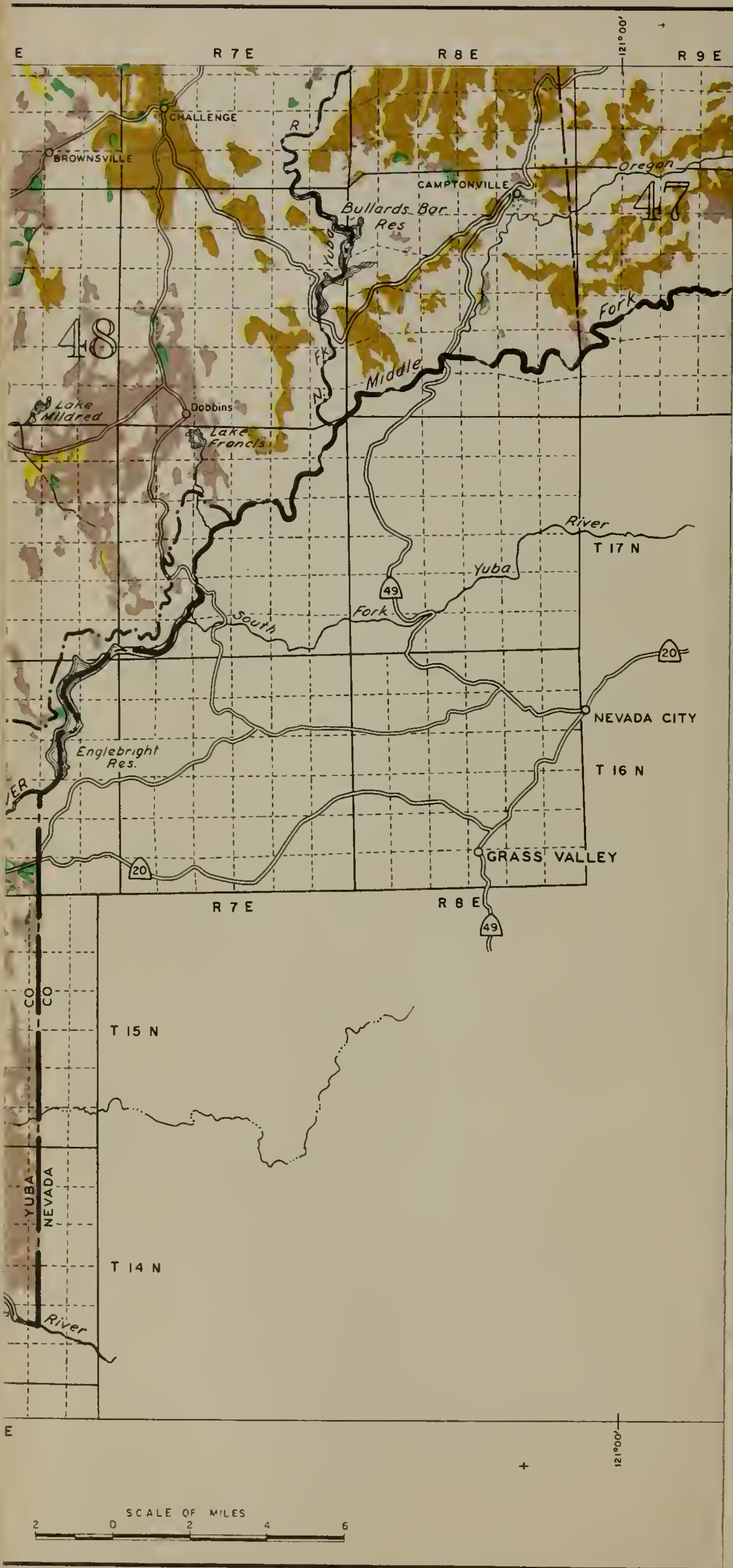

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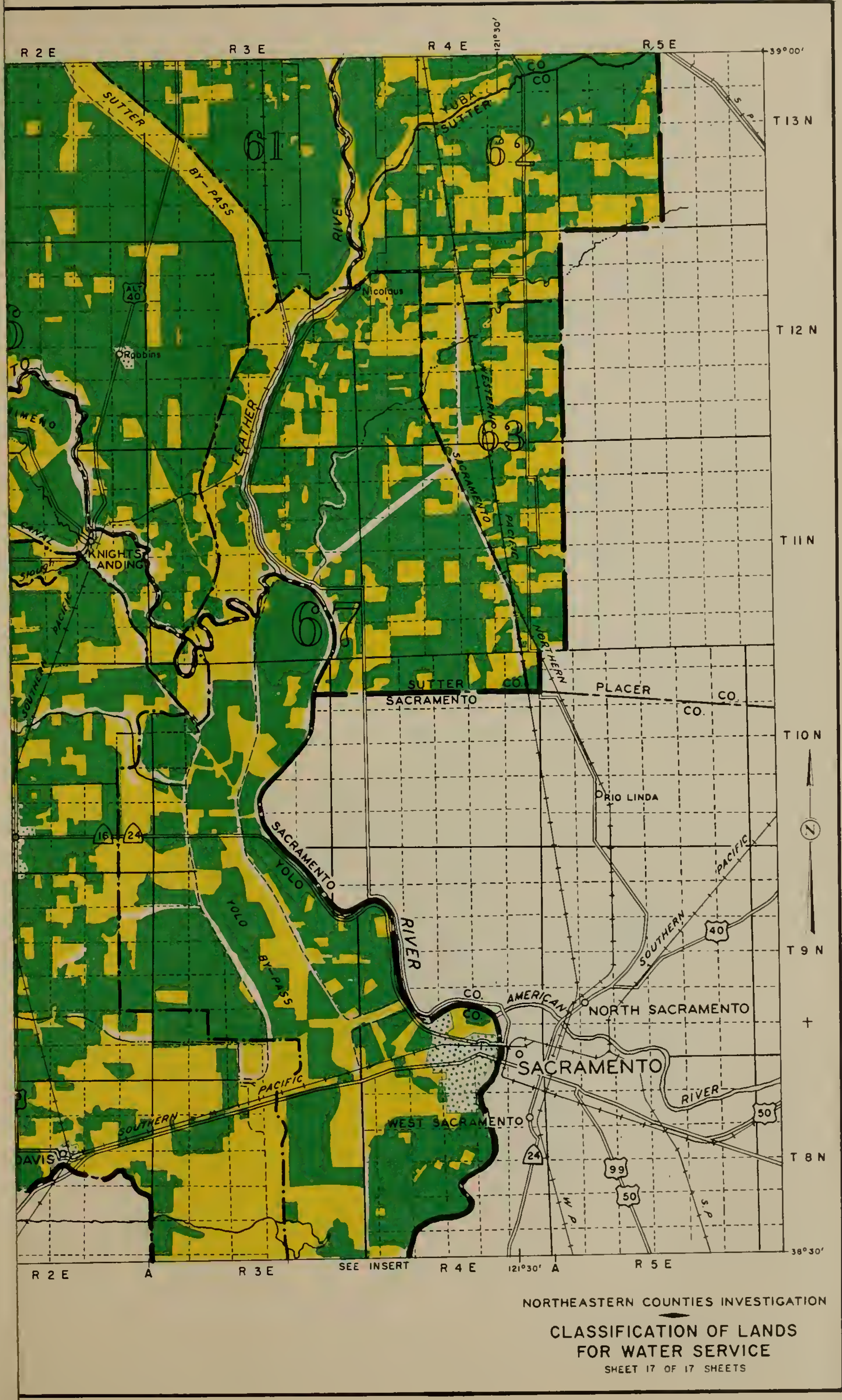

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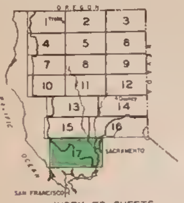

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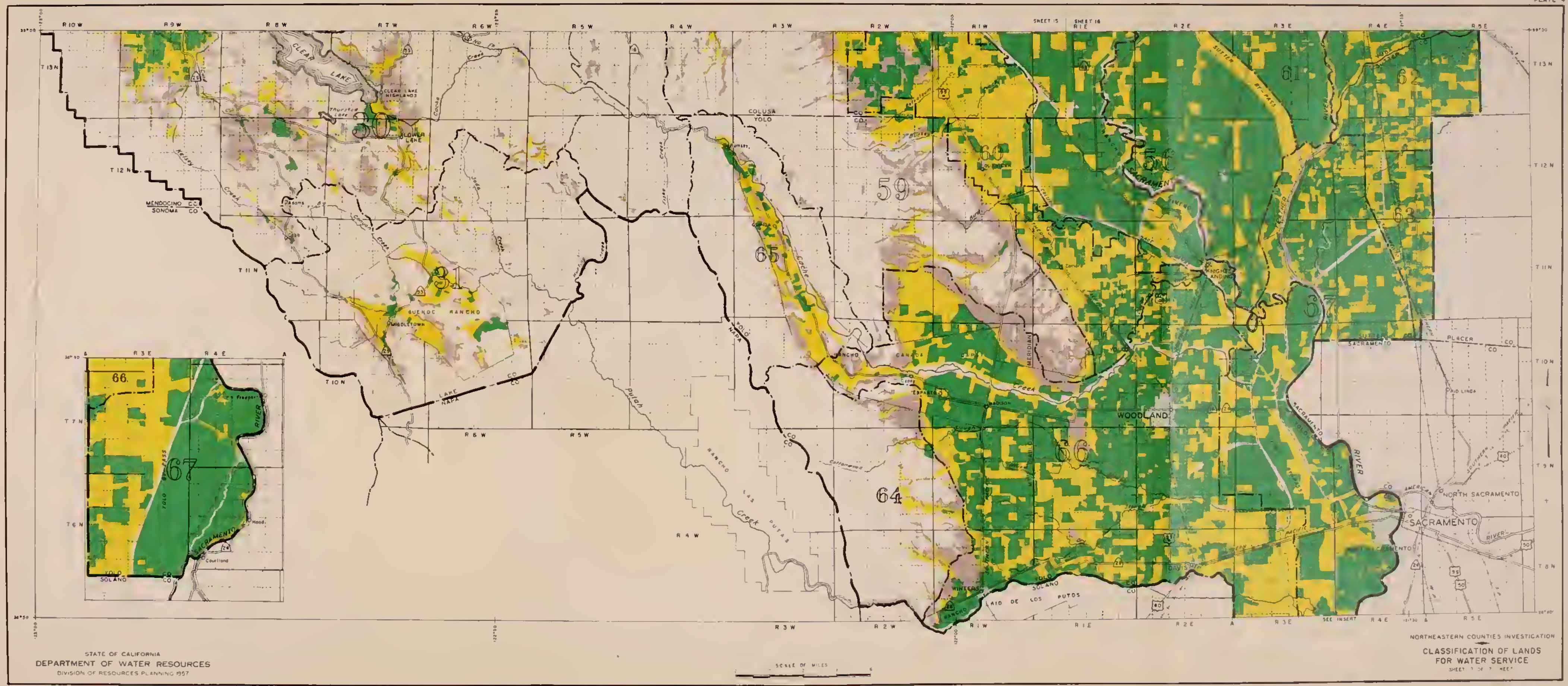

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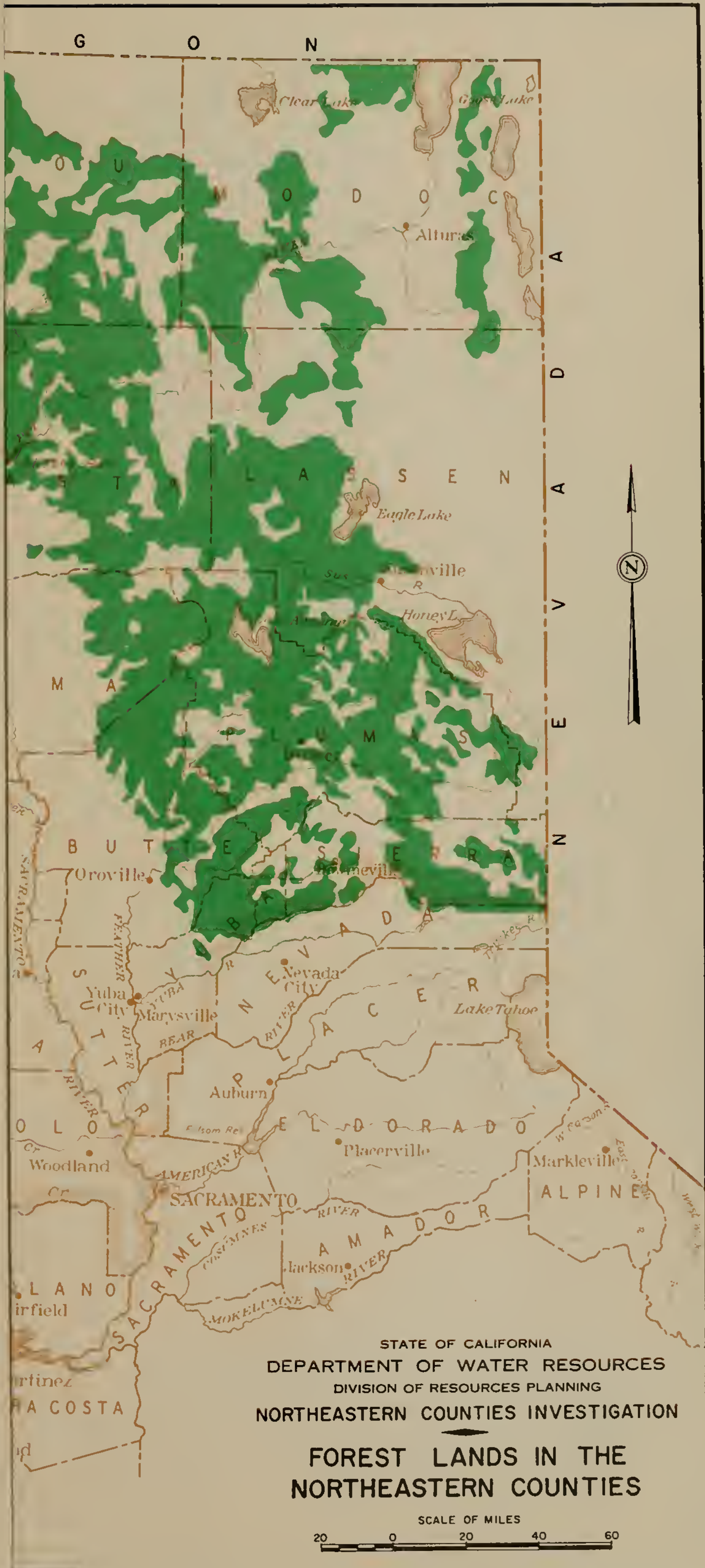

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FOREST LANDS IN THE NORTHEASTERN COUNTIES

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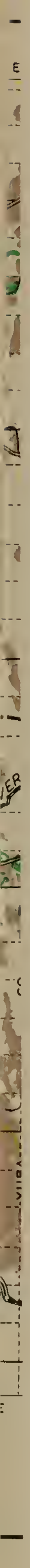

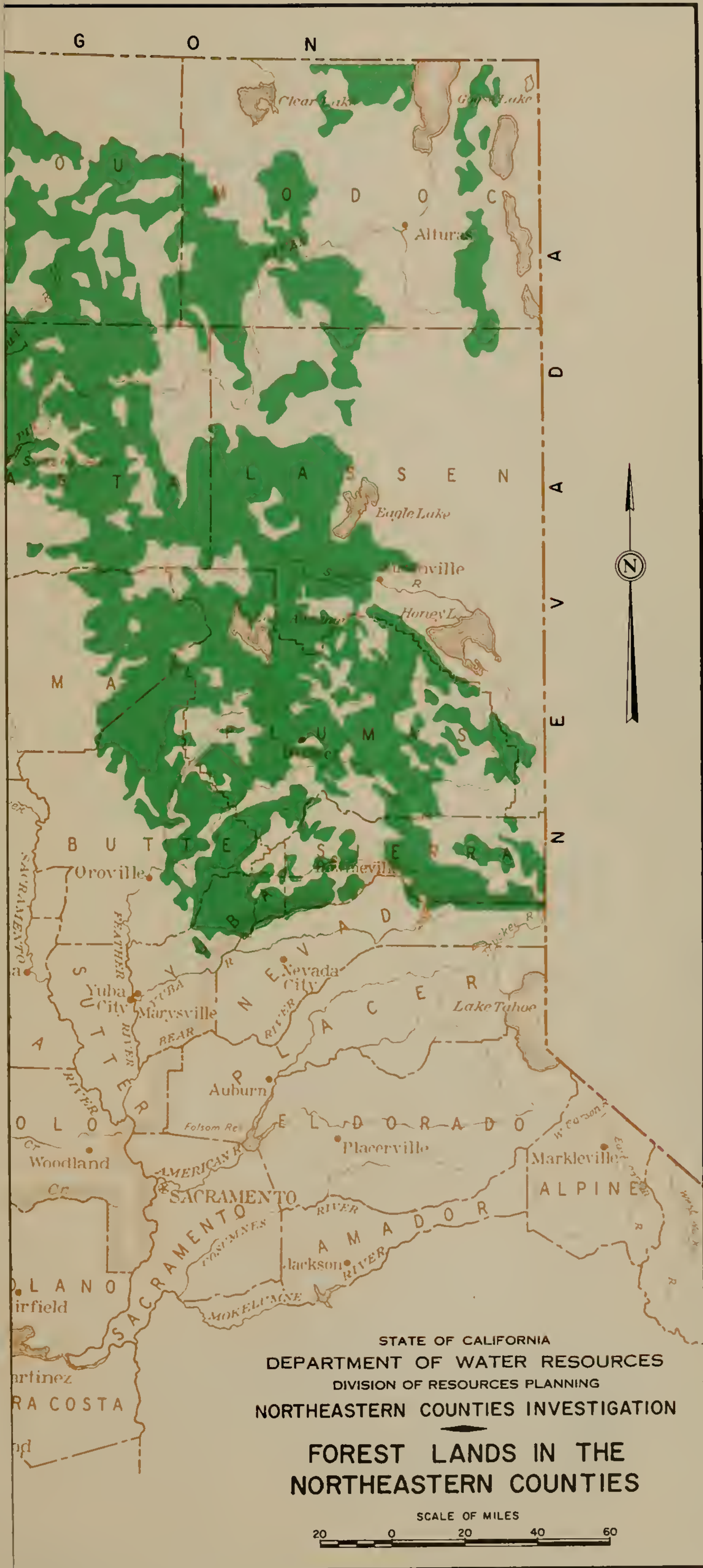

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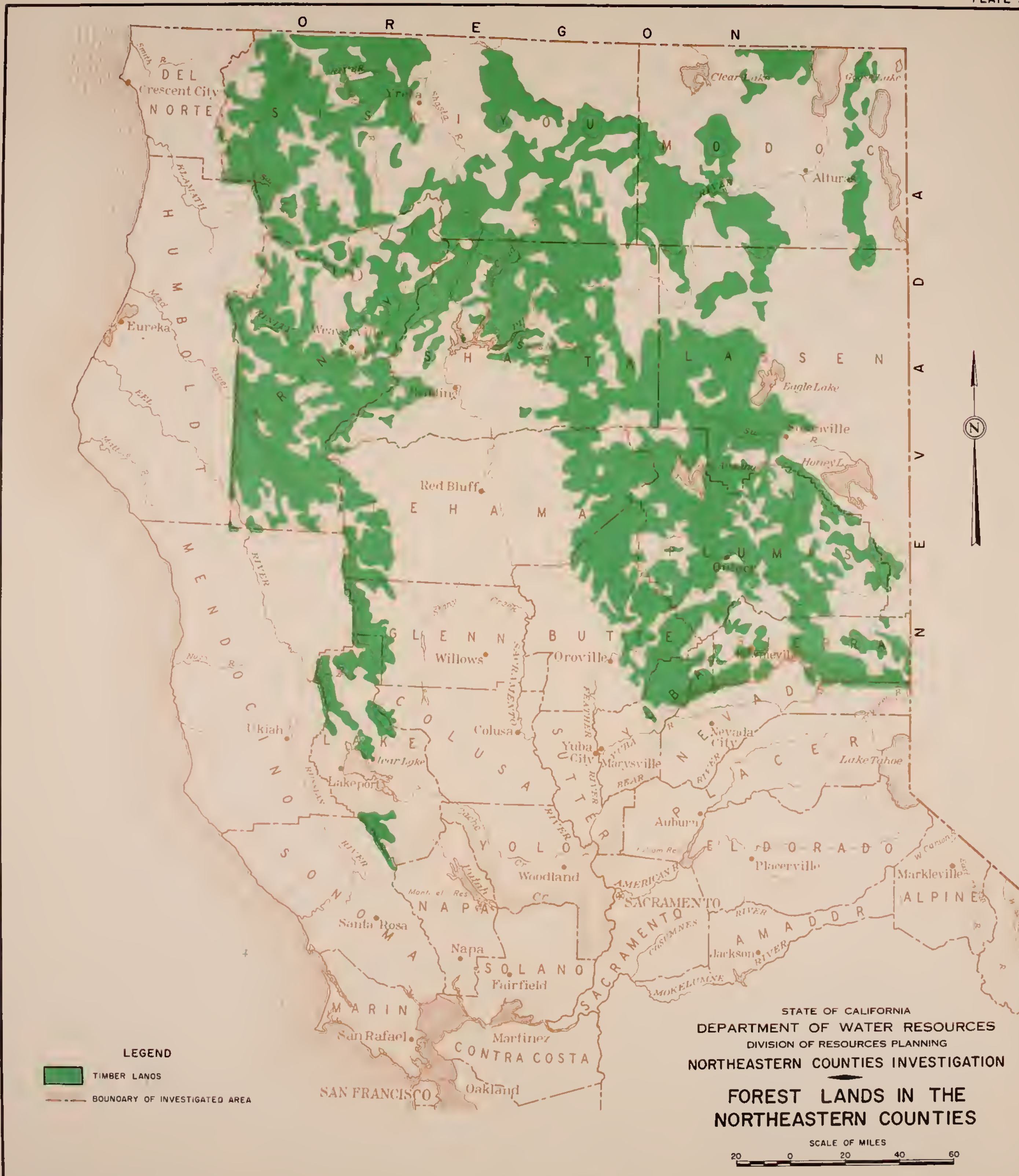
FOREST LANDS IN THE NORTHEASTERN COUNTIES



DEPARTMENT OF WATER RESOURCES 1957

LEGEND

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HIGH INTENSITY RECREATION: AREAS OF PRIME RECREATION POTENTIAL THAT ARE ACCESSIBLE BY MOTOR VEHICLE DURING THE ENTIRE VACATION SEASON. MOST AREAS SUBJECT TO DEVELOPMENT FOR COMMERCIAL RESORTS, PRIVATE SUMMER HOMES, PRIVATE AND PUBLIC CAMPING AND PICNIC GROUNDS WOULD BE IN THIS CLASSIFICATION.

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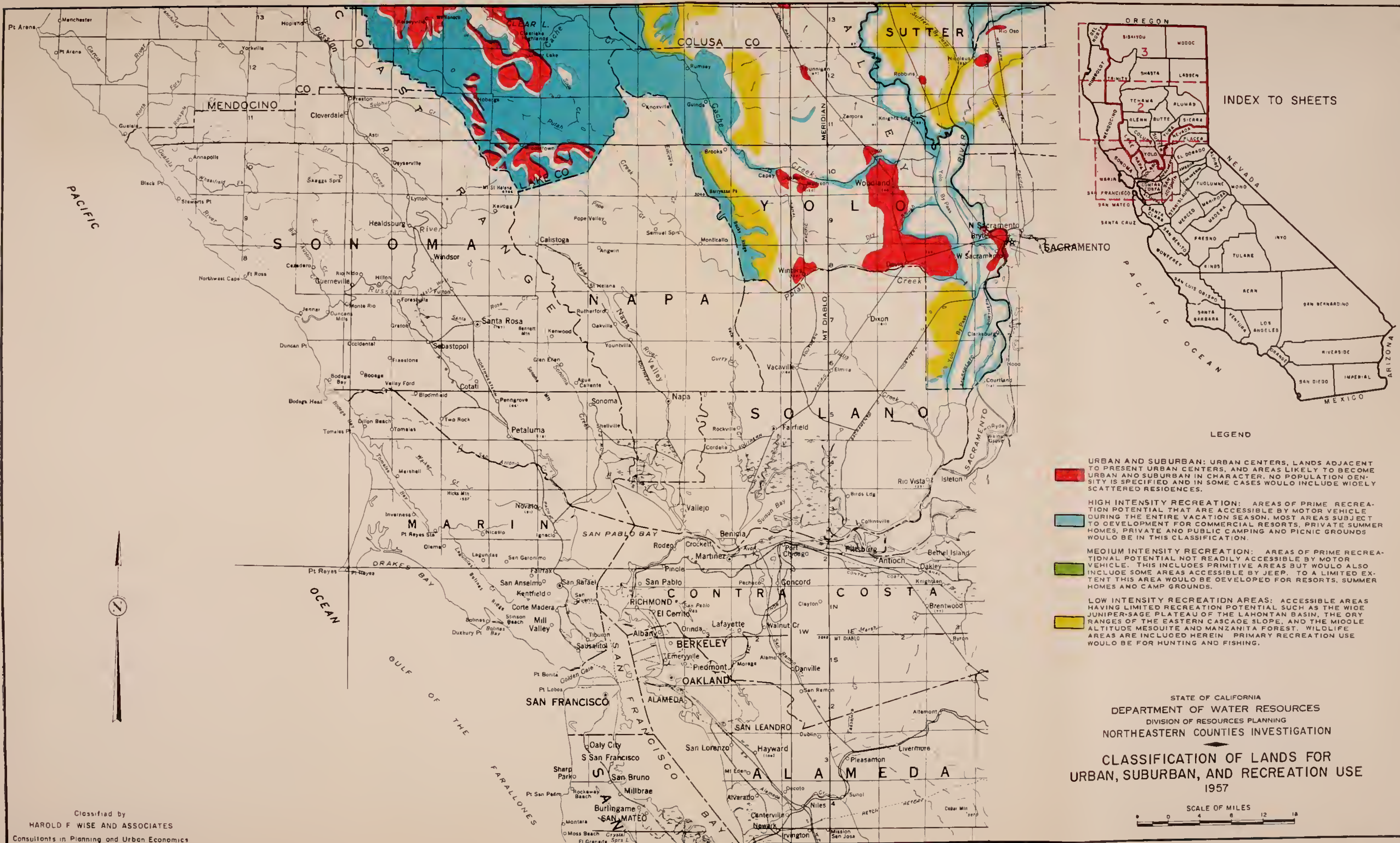
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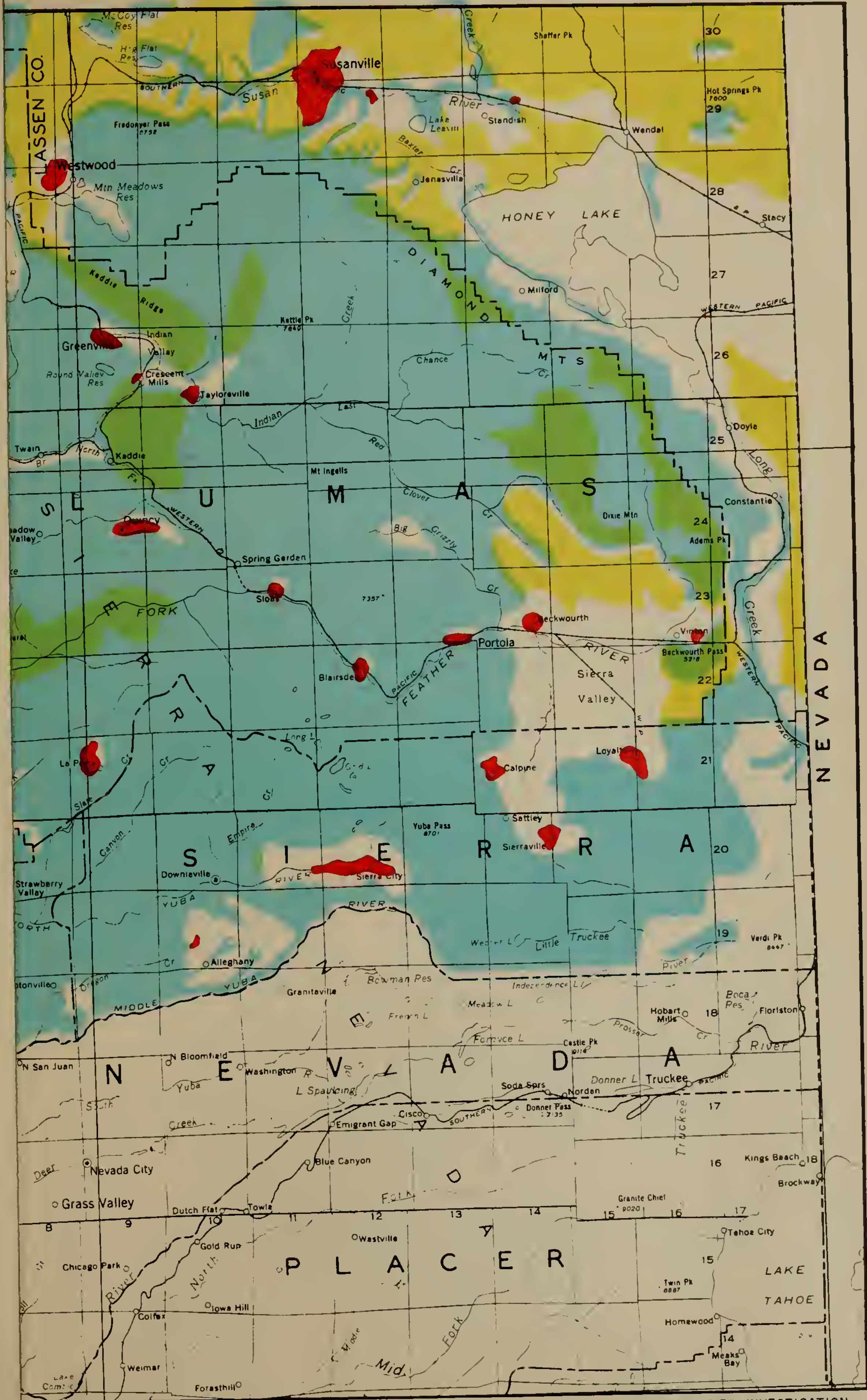
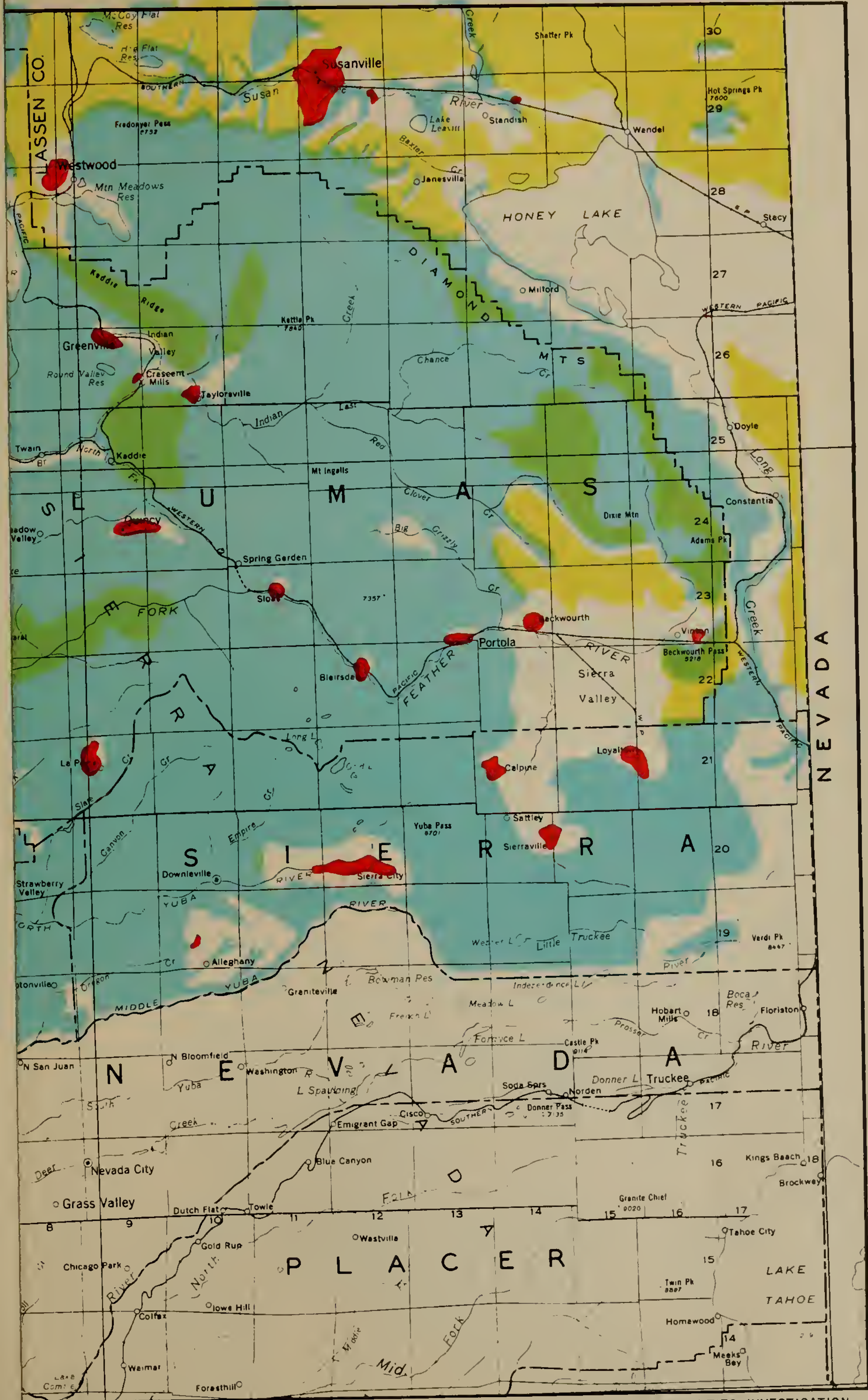
SONOMA
NAPA
YOLO
SOLANO
MARIN
CONTRA COSTA
ALAMEDA
SUTTER
COLUSA CO
MENDOCINO CO
LAKE CO
SAN MATEO
PACIFIC OCEAN
SAN FRANCISCO
OAKLAND
BERKELEY
SACRAMENTO
SAN PABLO BAY
SAN FRANCISCO BAY


LASSEN CO.
Susanville
Westwood
Susan River
Honey Lake
Diamond Mts
Greenville
Indian Valley
Crescent Mills
Taylorsville
Kaddie
Quincy
Spring Garden
Sloat
Blairsden
Portola
Beckwourth
Beckwourth Pass
Sierra Valley
Calpine
Loyalton
Sattley
Sierraville
Sierra City
Downieville
Alleghany
Yuba Pass
Mt Ingalls
Dixie Mtn
Adams Pk
Doyle
Constantia
Milford
Jenesville
Standish
Wendel
Stacy
Hot Springs Pk
Shaffer Pk
Kettle Pk
SIERRA
PLUMAS
NEVADA
Truckee
Donner Pass
Norden
Soda Sprs
Cisco
Emigrant Gap
Blue Canyon
Nevada City
Grass Valley
Dutch Flat
Towle
Gold Run
Colfax
Iowa Hill
Weimar
Foresthill
Chicago Park
N Bloomfield
Washington
N San Juan
Granite Chief
Tahoe City
Twin Pk
Homewood
Meeks Bay
Kings Beach
Brockway
Hobart Mills
Floriston
Boca Res
Verdi Pk
Castle Pk
PLACER
LAKE TAHOE
Strawberry Valley
Meadow Valley
La Porte
Twain
Granitevile
Bowman Res
Mtn Meadows Res
Round Valley Res
Fredonyer Pass
Lake Leavitt
Independence L
Little Truckee River
Feather River
Middle Yuba
North Yuba River



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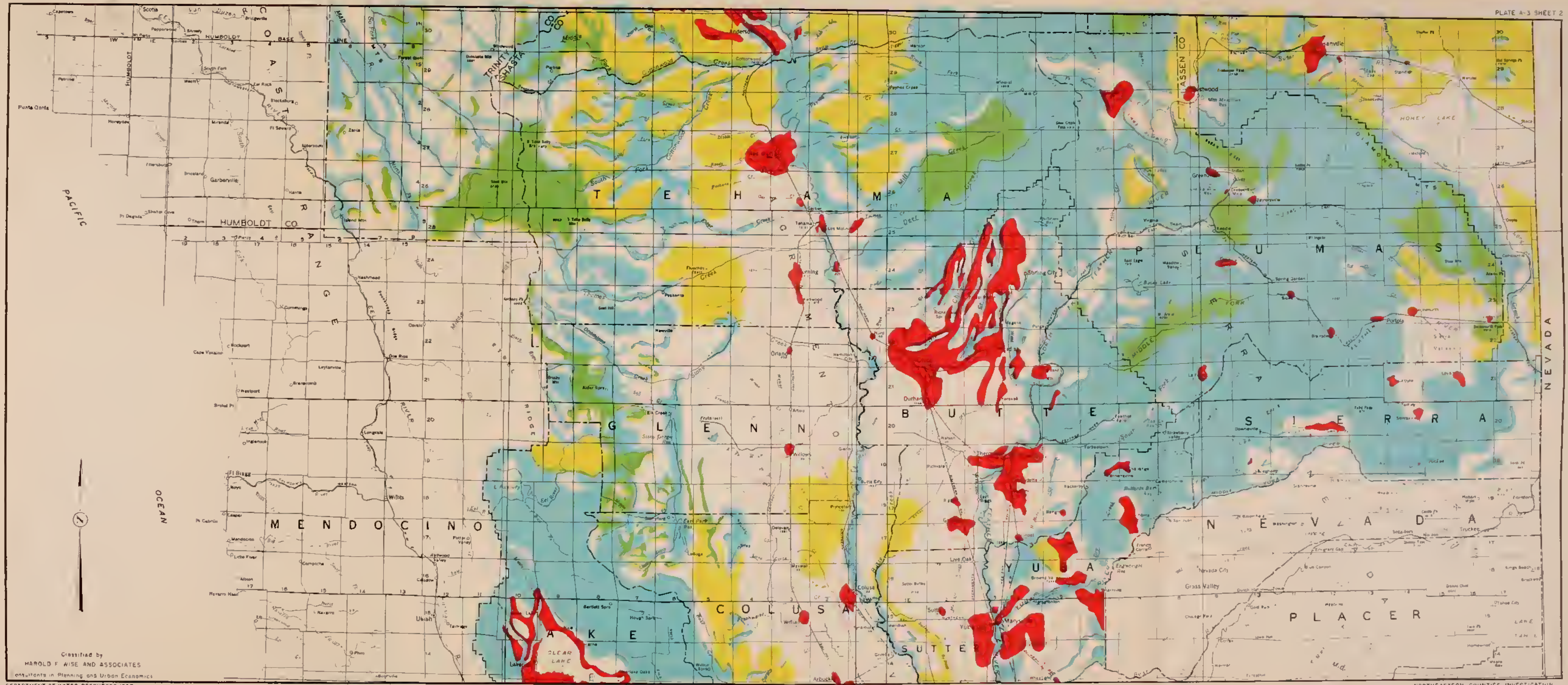

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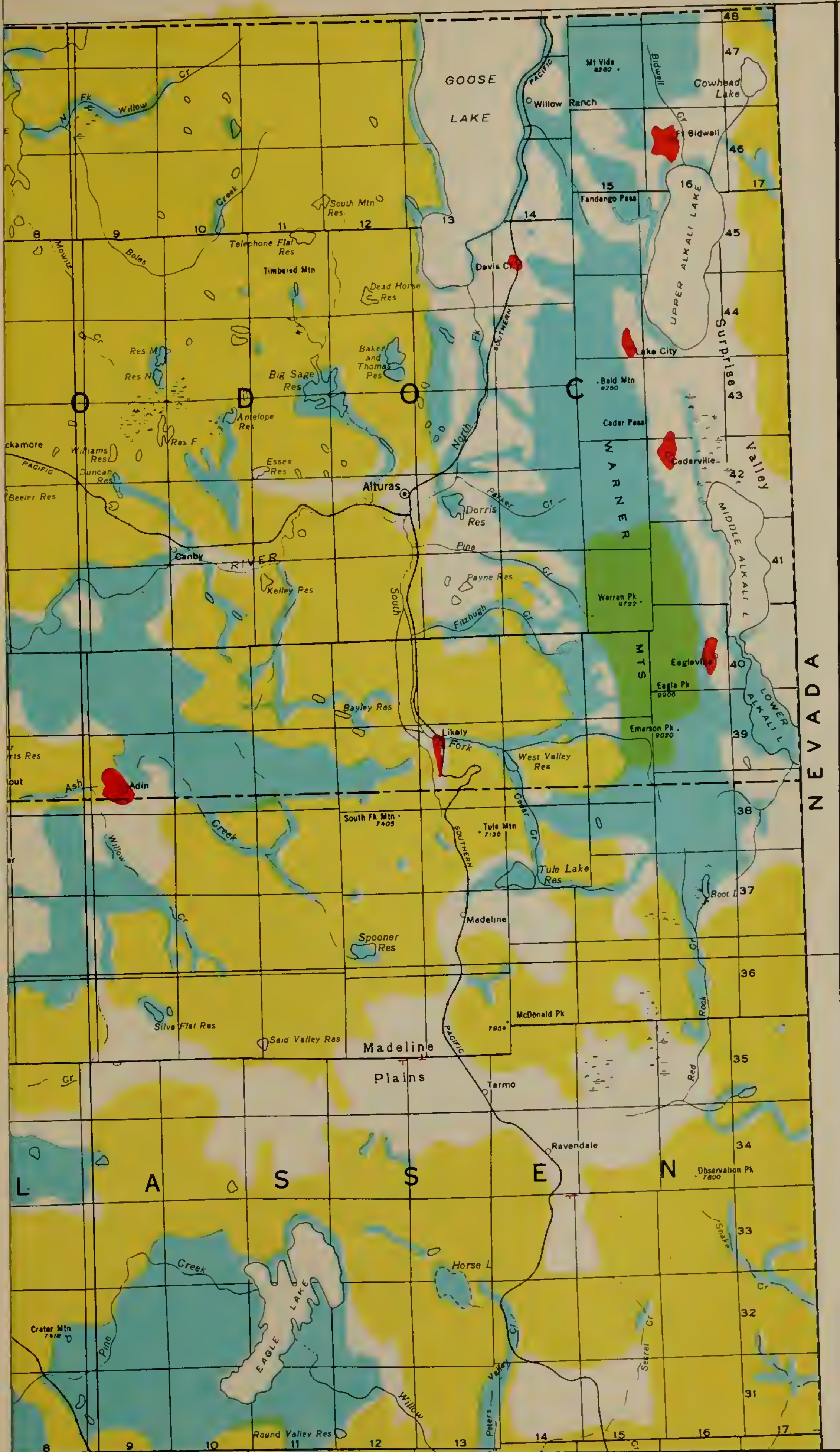

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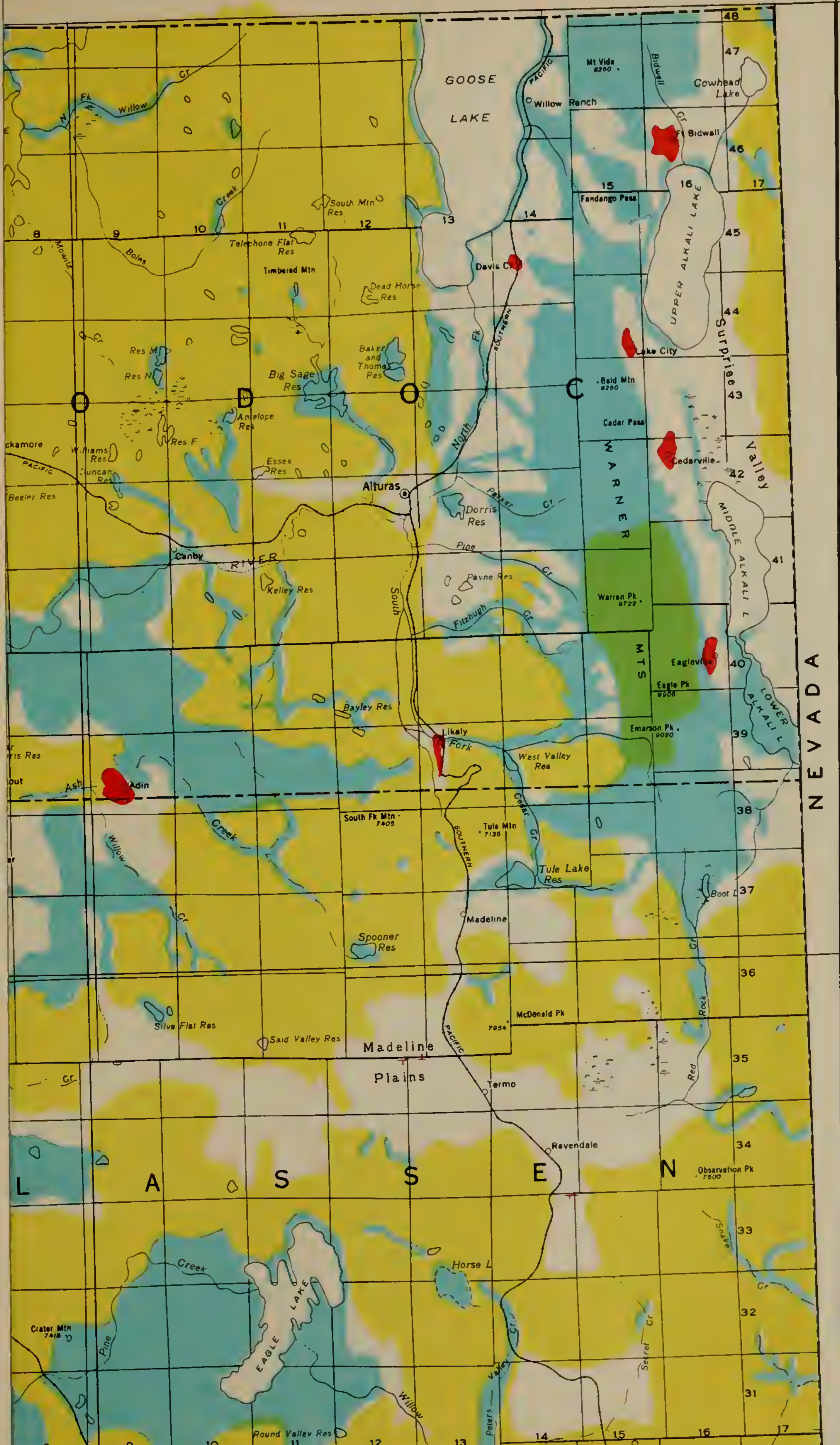

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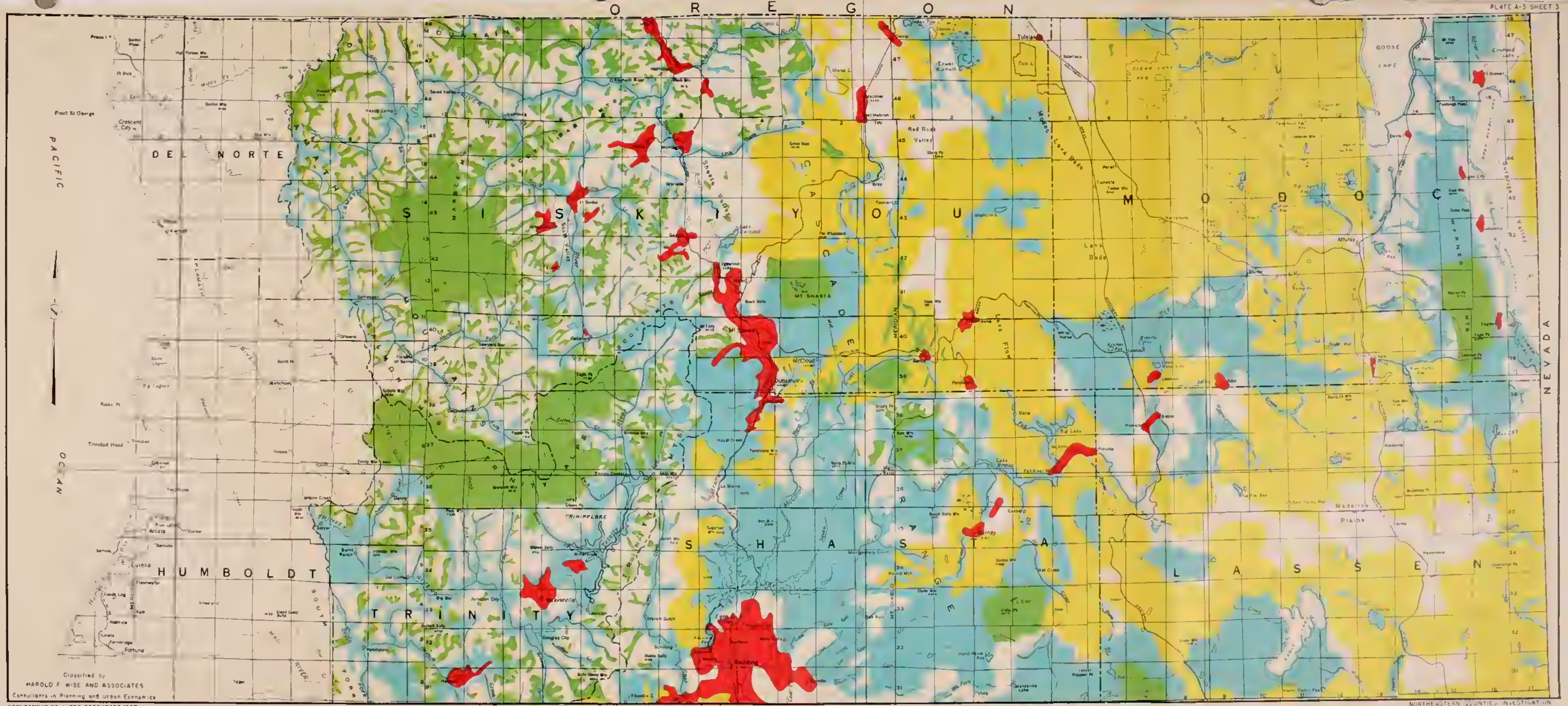

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