1912

ARIZONA
WATER COMMISSION
BULLETIN 9

ANNUAL REPORT ON GROUND WATER IN ARIZONA

with emphasis on
GILA BEND BASIN
McMULLEN VALLEY
and the southeast part of the
HARQUAHALA PLAINS

SPRING 1973 TO SPRING 1974

PREPARED UNDER THE DIRECTION OF
H. M. BABCOCK, DISTRICT CHIEF OF THE
U. S. GEOLOGICAL SURVEY IN ARIZONA

PREPARED BY THE GEOLOGICAL SURVEY
UNITED STATES DEPARTMENT OF THE INTERIOR

PHOENIX, ARIZONA
FEBRUARY 1975

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
Water Resources Division
Federal Building
301 West Congress
Tucson, Arizona 85701

March 28, 1975

TO THE USERS OF GEOLOGICAL SURVEY HYDROLOGIC DATA:

Enclosed is a copy of the report entitled "Annual Report on Ground Water in Arizona--with Emphasis on Gila Bend Basin, McMullen Valley, and the Southeast Part of the Harquahala Plains---Spring 1973 to Spring 1974," prepared under the direction of H. M. Babcock, district chief of the U.S. Geological Survey in Arizona. The report was prepared by the Geological Survey in cooperation with the Arizona Water Commission and is a summary and analysis of the hydrologic data collected under the statewide ground-water program during the period spring 1973 to spring 1974. The report describes the ground-water conditions throughout Arizona and includes maps showing potential well production by areas, depth to water in selected wells in spring 1974, and change in water levels in selected wells from 1969 to 1974. The report also contains maps showing detailed hydrologic conditions in three highly developed areas in the State--Gila Bend basin, McMullen Valley, and the southeast part of the Harquahala Plains.

Sincerely yours,

H. M. Babcock

H. M. Babcock
District Chief

Enclosure

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O & G CONS. COMM.

CONTENTS

ILLUSTRATIONS

ANNUAL REPORT ON GROUND WATER IN ARIZONA— WITH EMPHASIS ON GILA BEND BASIN, McMULLEN VALLEY, AND THE SOUTHEAST PART OF THE HARQUAHALA PLAINS— SPRING 1973 TO SPRING 1974

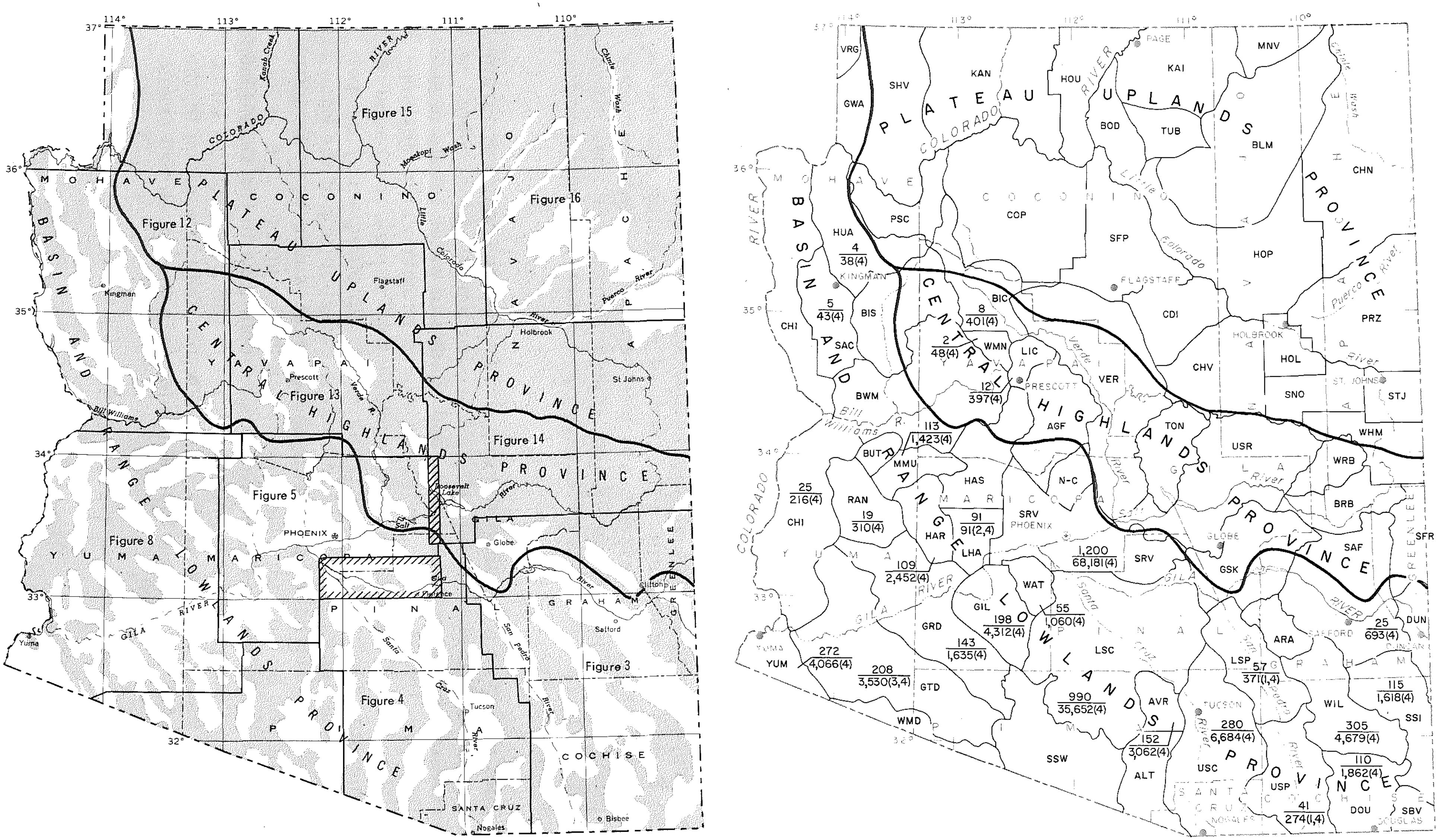
Prepared under the direction of H. M. Babcock,
District Chief of the U. S. Geological Survey in Arizona

INTRODUCTION

In Arizona the availability of adequate and potable water supplies has a great influence on the location of cities and agricultural areas and on the location and type of industries. Agriculture is dependent almost entirely on irrigation because rainfall is inadequate for raising crops. For many years, nearly two-thirds of Arizona's water supply has been withdrawn from the ground-water reservoirs; the principal use of the ground water is for irrigation, although municipal and industrial uses are increasing steadily.

The nature and extent of the ground-water reservoirs must be known for proper management of this resource; since 1939, the U.S. Geological Survey has conducted a program of ground-water studies in cooperation with the State of Arizona, which is represented by the Arizona Water Commission. The program includes the collection and analysis of the geologic and hydrologic data necessary to evaluate the ground-water resources of the State.

This report is a result of the cooperative ground-water program and contains maps that show potential well production by areas, depth to water in selected wells in spring 1974, and change in water levels in selected wells from 1969 to 1974. In areas where ground-water development has taken place the potential well-production values are based on the actual measured production of existing wells. In other areas the potential well-production values are based on the extrapolation of the known production of a few wells that penetrate the several water-bearing units and on the inferred hydrologic characteristics of the units. The report also contains maps showing detailed hydrologic conditions in the Gila Bend basin, McMullen Valley, and the southeast part of the Harquahala Plains. Figure 1 shows the areas for which ground-water data are given in the report, area boundaries, and estimated pumpage in the developed areas.



A. AREAS FOR WHICH GROUND-WATER DATA ARE GIVEN IN THIS REPORT (GROUND-WATER DATA FOR AREA OUTLINED APPEAR ON INDICATED FIGURE; HACHURES INDICATE MAP OVERLAP AREA)

B. ESTIMATED GROUND-WATER PUMPAGE IN DEVELOPED AREAS

FIGURE 1. --AREAS FOR WHICH GROUND-WATER DATA ARE GIVEN AND ESTIMATED PUMPAGE IN DEVELOPED AREAS.

EXPLANATION
Figure 1

□ ALLUVIAL DEPOSITS—Most wells in the Basin and Range lowlands province obtain their water from the alluvial deposits, and a few wells in the Plateau uplands province obtain moderate amounts of water from narrow alluvial deposits

▨ CONSOLIDATED ROCKS—Most wells in the Central highlands province obtain their water from fractures and joints in the consolidated rocks, and most wells in the Plateau uplands province obtain their water from fine-grained sandstone in this unit

AGF = Agua Fria basin
ALT = Altar Valley
ARA = Aravaipa Valley
AVR = Avra Valley
BIC = Big Chino Valley
BIS = Big Sandy Valley
BWM = Bill Williams
BLM = Black Mesa
BRB = Black River basin
BOD = Bodaway Mesa
BUT = Butler Valley
CDI = Canyon Diablo
CHV = Chevelon
CHN = Chinle
COP = Coconino Plateau
CHI = Colorado River, Hoover Dam to Imperial Dam
CON = Concho
DOU = Douglas basin
DUN = Duncan basin
GIL = Gila Bend basin
GRD = Gila River drainage from Painted Rock Dam to Texas Hill
GSK = Gila River from head of San Carlos Reservoir to Kelvin
GTD = Gila River from Texas Hill to Dome
GWA = Grand Wash
HAR = Harquahala Plains
HAS = Hassayampa basin
HOL = Holbrook
HOP = Hopi
HOU = Houserock
HUA = Hualapai Valley
KAI = Kaibito
KAN = Kanab
LIC = Little Chino Valley
LHA = Lower Hassayampa
LSP = Lower San Pedro basin
LSC = Lower Santa Cruz basin
MMU = McMullen Valley
MNV = Monument Valley
N-C = New River-Cave Creek
PSC = Peach Spring Canyon
PRZ = Puerco-Zuni
RAN = Ranegras Plain
SAC = Sacramento Valley
SAF = Safford basin
SRV = Salt River Valley
SBV = San Bernardino Valley
SFP = San Francisco Peaks
SFR = San Francisco River basin
SSI = San Simon basin
SSW = San Simon Wash
SHV = Shivwits
SNO = Snowflake
STJ = St. Johns
TON = Tonto basin
TUB = Tuba City
USR = Upper Salt River basin
USP = Upper San Pedro basin
USC = Upper Santa Cruz basin
VER = Verde Valley
VRG = Virgin River
WAT = Waterman Wash
WMD = Western Mexican drainage
WHM = White Mountains
WRB = White River basin
WIL = Willcox basin
WMN = Williamson Valley
YUM = Yuma

—— AREA BOUNDARY

$\frac{152}{3,062(4)}$ ESTIMATED GROUND-WATER PUMPAGE, IN THOUSANDS OF ACRE-FEET—Upper part of fraction is pumpage in 1973; lower part of fraction is accumulated pumpage through 1973

(1) Indicates that pumpage for upper and lower San Pedro basins was not computed prior to 1966. Thus, accumulated total is for 1966-73 only. Estimated pumpage before 1966 is included with that in other areas

(2) Indicates that pumpage for lower Hassayampa was included in Salt River Valley prior to 1973

(3) Indicates that withdrawal is for drainage purposes only

(4) Indicates that the number of significant figures in total pumpage is the result of small increments in the early years when ground-water pumpage was small and is not intended to imply that the data are accurate to the extent indicated

In areas where no data are shown, the pumpage is mostly from domestic and stock wells and is negligible

The well-numbering system used in Arizona is explained and illustrated in figure 2.

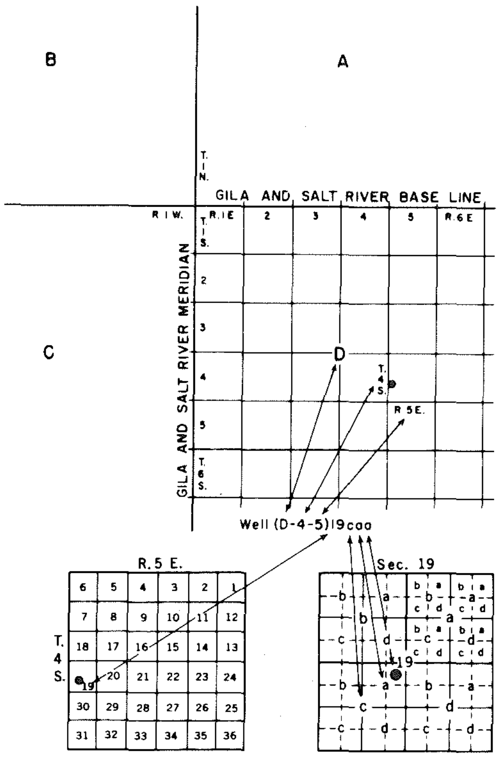
For use of those readers who may prefer to use metric units rather than English units, the conversion factors for the terms used in this report are listed below:

Multiply English unit	By	To obtain metric unit
feet (ft)	0.3048	metres (m)
miles (mi)	1.609	kilometres (km)
gallons per minute (gal/min)	3.785	litres per minute (l/min)
acre-feet (acre-ft)	1.233×10^{-3}	cubic hectometres (hm^3)
acres	.4047	hectares (ha)

In spring 1974 the U.S. Geological Survey in cooperation with the Arizona Water Commission revised the system of collecting ground-water data in Arizona. Under the revised system, several selected areas will be studied in detail each year. Information will be obtained for wells drilled since the previous inventory, water levels will be measured, pumpage will be estimated, and chemical quality-of-water data will be obtained. Well, water-level, and quality-of-water data will be entered into computer storage, and printouts will be available for consultation by the public. Data for each area will be compiled on maps, which will be accompanied by a short text. The current plan is to cover the entire State in a 6-year period and to give more frequent attention to the areas in which there is rapid ground-water development.

In 1973-74 ground-water studies were being conducted in cooperation with the following agencies:

City of Flagstaff
City of Tucson
International Boundary and Water Commission
Navajo Tribal Council
Navajo Tribal Utility Authority
Salt River Valley Water Users' Association
University of Arizona
U.S. Bureau of Indian Affairs
U.S. Bureau of Reclamation
U.S. National Park Service



The well numbers used by the Geological Survey in Arizona are in accordance with the Bureau of Land Management's system of land subdivision. The land survey in Arizona is based on the Gila and Salt River meridian and base line, which divide the State into four quadrants. These quadrants are designated counterclockwise by the capital letters A, B, C, and D. All land north and east of the point of origin is in A quadrant, that north and west in B quadrant, that south and west in C quadrant, and that south and east in D quadrant. The first digit of a well number indicates the township, the second the range, and the third the section in which the well is situated. The lowercase letters a, b, c, and d after the section number indicate the well location within the section. The first letter denotes a particular 160-acre tract, the second the 40-acre tract, and the third the 10-acre tract. These letters also are assigned in a counterclockwise direction, beginning in the northeast quarter. If the location is known within the 10-acre tract, three lowercase letters are shown in the well number. In the example shown, well number (D-4-5)19caa designates the well as being in the NE$\frac{1}{4}$NE$\frac{1}{4}$SW$\frac{1}{4}$ sec. 19, T. 4 S., R. 5 E. Where more than one well is within a 10-acre tract, consecutive numbers beginning with 1 are added as suffixes.

FIGURE 2.--WELL-NUMBERING SYSTEM IN ARIZONA.

CURRENT PUBLICATIONS OF THE ARIZONA DISTRICT

The following reports on the water resources and geology of Arizona were published or released to the open file from July 1, 1973, through June 30, 1974.

Geologic map of the Laguna Dam 7.5-minute quadrangle, Arizona and California, by F. H. Olmsted: U.S. Geol. Survey Geol. Quad. Map GQ-1014, 1972. 1 sheet.

Soil-moisture and energy relationships associated with riparian vegetation near San Carlos, Arizona, by I. S. McQueen and R. F. Miller: U.S. Geol. Survey Prof. Paper 655-E, 1972. 51 p., 47 figs., 3 tables.

Subsurface hydraulics in the area of the Gila River Phreatophyte Project, Graham County, Arizona, by R. L. Hanson, with a section on Aquifer tests, by S. G. Brown: U.S. Geol. Survey Prof. Paper 655-F, 1972. 27 p., 16 figs., 13 tables.

Arability map of the Phoenix area, Arizona, by U.S. Bureau of Reclamation and U.S. Department of Agriculture: U.S. Geol. Survey Misc. Inv. Ser. Map I-845-E, 1973. 1 sheet.

Availability of ground water for irrigation, municipal, or industrial use in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah, by E. H. McGavock and R. J. Edmonds: U.S. Geol. Survey open-file report, 1973. 10 p., 5 figs.

Geohydrology and water resources of the Tucson basin, Arizona, by E. S. Davidson: U.S. Geol. Survey Water-Supply Paper 1939-E, 1973. 81 p., 7 pls., 3 figs., 3 tables.

Geohydrology of the Parker-Blythe-Cibola area, Arizona and California, by D. G. Metzger, O. J. Loeltz, and Burdge Irelan: U.S. Geol. Survey Prof. Paper 486-G, 1973. 130 p., 6 pls., 37 figs., 14 tables.

Geohydrology of the Yuma area, Arizona and California, by F. H. Olmsted, O. J. Loeltz, and Burdge Irelan: U.S. Geol. Survey Prof. Paper 486-H, 1973. 227 p., 17 pls., 58 figs., 21 tables.

Geophysical studies in the Yuma area, Arizona and California, by R. E. Mattick, F. H. Olmsted, and A. A. R. Zohdy: U.S. Geol. Survey Prof. Paper 726-D, 1973. 36 p., 5 pls., 21 figs., 3 tables.

Ground water in the Navajo Sandstone in the Black Mesa area, Arizona, by E. H. McGavock and G. W. Levings: New Mexico Geol. Soc. 24th Field Conf., 1973, Guidebook of Monument Valley and vicinity, Arizona and Utah, 1973. p. 150-155, 5 figs.

Ground-water recharge in the Tucson area, Arizona, by W. R. Osterkamp: U.S. Geol. Survey Misc. Inv. Ser. Map I-844-E, 1973. 1 sheet.

Hydrologic application of ERTS-1 Data System in central Arizona [abs.], by H. H. Schumann, *in* Third ERTS symposium—Abstracts: Greenbelt, Maryland, Natl. Aeronautics and Space Adm., Goddard Space Flight Center, 1973. p. 70.

Index and description of flood-prone area maps in the Tucson-Phoenix area, Arizona, by E. S. Davidson: U.S. Geol. Survey Misc. Inv. Ser. Map I-843-A, 1973. 1 sheet.

Map of irrigated land in the Phoenix area, Arizona—1973, by U.S. Geological Survey, U.S. Department of Agriculture, and Arizona Water Commission: U.S. Geol. Survey Misc. Inv. Ser. Map I-845-B, 1973. 1 sheet.

Map of irrigated land in the Tucson area, Arizona, by U.S. Department of Agriculture and Arizona Water Commission: U.S. Geol. Survey Misc. Inv. Ser. Map I-844-B, 1973. 1 sheet.

Map of land status in the Phoenix area, Arizona—1973, by U.S. Bureau of Land Management, U.S. Department of Agriculture, and Arizona Water Commission: U.S. Geol. Survey Misc. Inv. Ser. Map I-845-A, 1973. 1 sheet.

Map of land status in the Tucson area, Arizona—1973, by U.S. Department of Agriculture and Arizona Water Commission: U.S. Geol. Survey Misc. Inv. Ser. Map I-844-A, 1973. 1 sheet.

Map of slopes and their environmental significance in the Marana quadrangle, Arizona, by U.S. Geological Survey: U.S. Geol. Survey Misc. Inv. Ser. Map I-846-A, 1973. 1 sheet.

Map showing depth to water in wells in the Phoenix area, Arizona, 1972, by W. R. Osterkamp: U.S. Geol. Survey Misc. Inv. Ser. Map I-845-D, 1973. 1 sheet.

Map showing depth to water in wells in the Tucson area, Arizona, 1972, by W. R. Osterkamp: U.S. Geol. Survey Misc. Inv. Ser. Map I-844-D, 1973. 1 sheet.

Map showing distribution and estimated thickness of alluvial deposits in the Phoenix area, Arizona, by M. E. Cooley: U.S. Geol. Survey Misc. Inv. Ser. Map I-845-C, 1973. 1 sheet.

Map showing distribution and estimated thickness of alluvial deposits in the Tucson area, Arizona, by M. E. Cooley: U.S. Geol. Survey Misc. Inv. Ser. Map I-844-C, 1973. 1 sheet.

Map showing distribution of recoverable ground water in the Tucson area, Arizona, by W. R. Osterkamp: U.S. Geol. Survey Misc. Inv. Ser. Map I-844-F, 1973. 1 sheet.

Map showing potential for copper deposits in the eastern three-quarters of the Nogales 2° quadrangle, Tucson area, Arizona, by U.S. Geological Survey: U.S. Geol. Survey Misc. Inv. Ser. Map I-844-G, 1973. 1 sheet.

Preliminary maps showing the ground-water resources in the lower Colorado River region, Arizona, Nevada, New Mexico, and Utah, by S. G. Brown: U.S. Geol. Survey open-file report, 1973. 3 sheets.

Storage and retrieval of water data for Arizona, by D. E. Click, in Proceedings of 1973 Western State Conference on water information dissemination, held June 8, 1973, Phoenix, Arizona: Tucson, Univ. Arizona, Water Resources Research Center, 1973. p. 41-45.

Water-resources appraisal of the Big Sandy area, Mohave County, Arizona, by E. S. Davidson: Arizona Water Comm. Bull. 6, December 1973. 40 p., 2 pls., 4 figs., 2 tables.

Water resources data for Arizona, 1971—Part 2. Water quality records, by U.S. Geological Survey: U.S. Geol. Survey duplicated report, 1973. 154 p., 2 figs., 4 tables.

Water resources data for Arizona, 1972—Part 1. Surface water records, by U.S. Geological Survey: U.S. Geol. Survey duplicated report, 1973. 251 p., 4 figs.

Water resources investigations in Arizona, 1973, by U.S. Geological Survey: U.S. Geol. Survey folder, 1973.

Annual report on ground water in Arizona, spring 1972 to spring 1973, prepared under the direction of H. M. Babcock: Arizona Water Comm. Bull. 7, April 1974. 46 p., 3 pls., 30 figs., 1 table.

Hydrologic applications of ERTS-1 Data Collection System in central Arizona, by H. H. Schumann, in Third Earth Resources Technology Satellite-1 symposium—volume 1: Technical presentations, section A, S. C. Freden, E. P. Mercanti, and M. A. Becker, eds.: Natl. Aeronautics and Space Adm. SP-351, 1974. p. 1213-1223, 6 figs.

Influence of late Cenozoic stratigraphy on distribution of impoundment-related seismicity at Lake Mead, Nevada-Arizona [abs.], by R. E. Anderson and R. L. Laney: Geol. Soc. America Abstracts with programs, v. 6, no. 3, February 1974. p. 138-139.

Quantitative and historical evidence of vegetation changes along the upper Gila River, Arizona, by R. M. Turner: U.S. Geol. Survey Prof. Paper 655-H, 1974. 20 p., 1 pl., 10 figs., 2 tables.

SUMMARY OF GROUND-WATER CONDITIONS

The ground-water reservoirs furnish about two-thirds of the water used in Arizona. The largest use of water is for irrigation; however, more water is being withdrawn each year for municipal and industrial uses. For the 21st consecutive year, the withdrawal of ground water exceeded 4 million acre-feet. In 1973 the withdrawal of ground water was nearly 4.8 million acre-feet; through 1973, nearly 149 million acre-feet of ground water had been withdrawn from the ground-water reservoirs in Arizona. Figure 1B shows the amount of water pumped in 1973 and the accumulated pumpage since the beginning of record in each of the major developed areas; the figure does not show the pumpage in the less-developed areas in the State—an estimated 100,000 acre-feet per year, of which about 82,000 acre-feet is pumped in the Plateau uplands province.

Ground water occurs under different conditions in each of the three water provinces in Arizona (fig. 1)—the Basin and Range lowlands province, the Central highlands province, and the Plateau uplands province. The use of ground water and the effects of this use on the ground-water reservoirs in each of the three provinces are discussed separately in the following sections.

Basin and Range Lowlands Province

The Basin and Range lowlands province (fig. 1)—the most highly developed of the three water provinces—covers only about 45 percent of the State but contains more than 90 percent of the cultivated land and more than 80 percent of the population. In 1973 about 97 percent of the ground water pumped in the State was pumped in the Basin and Range lowlands province, and water levels are declining.

The Salt River Valley and the lower Santa Cruz basin are the largest agricultural areas in the State. Through 1973, slightly more than 68 million acre-feet of ground water had been withdrawn in the Salt River Valley, and nearly 36 million acre-feet had been withdrawn in the lower Santa Cruz basin. In the last few years the amount of ground water pumped in these areas has been somewhat less than that pumped in the middle 1950's and early 1960's, and the rates of water-level decline have decreased accordingly. Other areas in the Basin and Range lowlands province where ground-water withdrawals have caused large water-level declines are the Willcox basin, San Simon basin, upper Santa Cruz basin, Avra Valley, Gila Bend basin, Harquahala Plains, and McMullen Valley.

Figures 3, 4, 5, 8, and 12 show the depth to water in spring 1974 and the change in water levels from 1969 to 1974 in selected wells in the Basin and Range lowlands province. Figures 6, 7, 9, 10, and 11 show detailed ground-water data for the Gila Bend basin, McMullen Valley, and the southeast part of the Harquahala Plains.

Ground-water recharge from the Salt and Gila Rivers, Maricopa County.--In 1972-73 the winter precipitation was 60 and 100 percent above average in the Salt and Verde River watersheds, respectively, and resulted in record snowpacks. The snowfall produced the largest amount of streamflow recorded in the Salt River in the last 32 years and the largest amount recorded in the Verde River in the last 53 years. The combined discharge of the Salt and Verde Rivers was more than 3 million acre-feet. The unusually large amount of runoff necessitated the release of water from the Salt and Verde reservoir system into the normally dry Salt River below Granite Reef Dam (fig. 5). The releases, which were intermittent from January through May 1973, amounted to about 1.2 million acre-feet; however, the total inflow into Painted Rock Reservoir on the Gila River 108 miles downstream from Granite Reef Dam (fig. 5) was only 700,000 acre-feet. Nearly all the 500,000-acre-foot loss in surface flow was recharged to the ground-water reservoirs along the river channels.

In general, rises in water levels occurred throughout the areas near the rivers from spring 1973 to spring 1974. A maximum water-level rise of 52 feet occurred in well (A-1-4)2 near the Salt River. Part of the rise in water levels, especially in the Salt River Project area, may be attributed to a decrease in ground-water pumpage; in the Salt River Valley ground-water pumpage was about 500,000 acre-feet less in 1973 than in 1972.

The general shape of the recharge mound underlying the Salt and Gila Rivers about the time that surface flow ceased was estimated using water-level measurements made before flow began and after flow ceased. The average rise in water level directly under the rivers was about 30 feet, and the mound was about 6 miles wide and about 108 miles long. The volume of water required to create a mound of this size indicates that recharge to the ground-water reservoir was about 500,000 acre-feet. By spring 1974, the recharge mound had spread laterally and had dissipated, which, combined with the decrease in ground-water pumpage, caused general rises in water levels in parts of the Salt River Valley and the Gila Bend basin. The water-level changes in these areas for 1969-74 reflect, in part, the water-level rises for 1973-74 (fig. 5).

Ground-water conditions in the Gila Bend basin.--Water-table contours for 1973 indicate an elongated cone of depression along the Gila River in the central part of the basin (fig. 6). Ground water moves into the cone from the north end of the basin and from the south and west. The depth to water ranges from less than 50 feet below land surface at the west edge of the basin in the Citrus Valley area to about 400 feet on the southeast edge in the Gila Bend-Theba area (fig. 6).

In the Gila Bend basin the water-level changes for 1966-73 ranged from a rise of about 60 feet in the west part of Rainbow Valley to a decline of about 30 feet in the Citrus Valley area (fig. 7). The water-level rises were the result of the large amounts of winter flow in the Gila River in 1972-73 (see the section entitled "Ground-Water Recharge from the Salt and Gila Rivers, Maricopa County"). More than 1,270,000 acre-feet of ground water was pumped in the Gila Bend basin from 1966 through 1972.

Ground-water conditions in McMullen Valley.--Water-table contours for December 1973 indicate two cones of depression in McMullen Valley as a result of the withdrawal of ground water in excess of the natural rate of recharge (fig. 9). The depth to water ranges from less than 100 feet below land surface southeast of Salome to more than 600 feet in a small area southeast of Aguila. The area around Aguila is highly developed for agriculture, and the depth to water generally is more than 350 feet below land surface. In the agricultural area between Salome and Wenden the depth to water generally is from 200 to 350 feet below land surface.

Ground-water conditions in the southeast part of the Harquahala Plains.--Water-table contours for January 1974 indicate a well-developed cone of depression in the central part of the southeast Harquahala Plains (fig. 10). The cone is the result of the withdrawal of ground water in excess of the natural rate of recharge, and ground water moves into it from all directions. The depth to water ranges from less than 150 feet below land surface in the extreme southeast part of the area to more than 550 feet at the southwest edge. In a large part of the major agricultural area the depth to water is from 400 to 450 feet below land surface.

From December 1966 to January 1974, water levels declined as much as 100 feet in the southeast part of the Harquahala Plains (fig. 11). Ground-water pumpage during this period was nearly 910,000 acre-feet.

Central Highlands Province

The Central highlands province receives more precipitation than the other provinces; much of the water in the perennial streams flows into the Verde and Salt Rivers, where it is stored in reservoirs and transported for use in the Basin and Range lowlands province. The small amount of land under cultivation in the Central highlands province is concentrated mainly in the Chino and Verde Valleys, where some surface water is available for irrigation. The amount of ground-water withdrawal in the province is small, and water-level declines generally average less than 1 foot per year.

Figures 13 and 14 show the depth to water in spring 1974 and the change in water levels from 1969 to 1974 in selected wells in the Central highlands province. The pumpage for the areas for which data are available is shown in figure 1B.

Plateau Uplands Province

Only about 35,000 acres of land is under cultivation in the Plateau uplands province. About half the cultivated land is irrigated with ground water, and half is irrigated mainly with surface water from small reservoirs; dryland farming is practiced in a few places. In a few population centers, such as Flagstaff, Holbrook, and the White Mountains recreational areas, ground water is the main source of supply. The Navajo and Hopi Indian Reservations make up a large part of the province.

Figures 13, 14, 15, and 16 show the depth to water in spring 1974 and the change in water levels from 1969 to 1974 in selected wells in the Plateau uplands province. In 1973 the estimated ground-water pumpage in the province was about 82, 000 acre-feet.

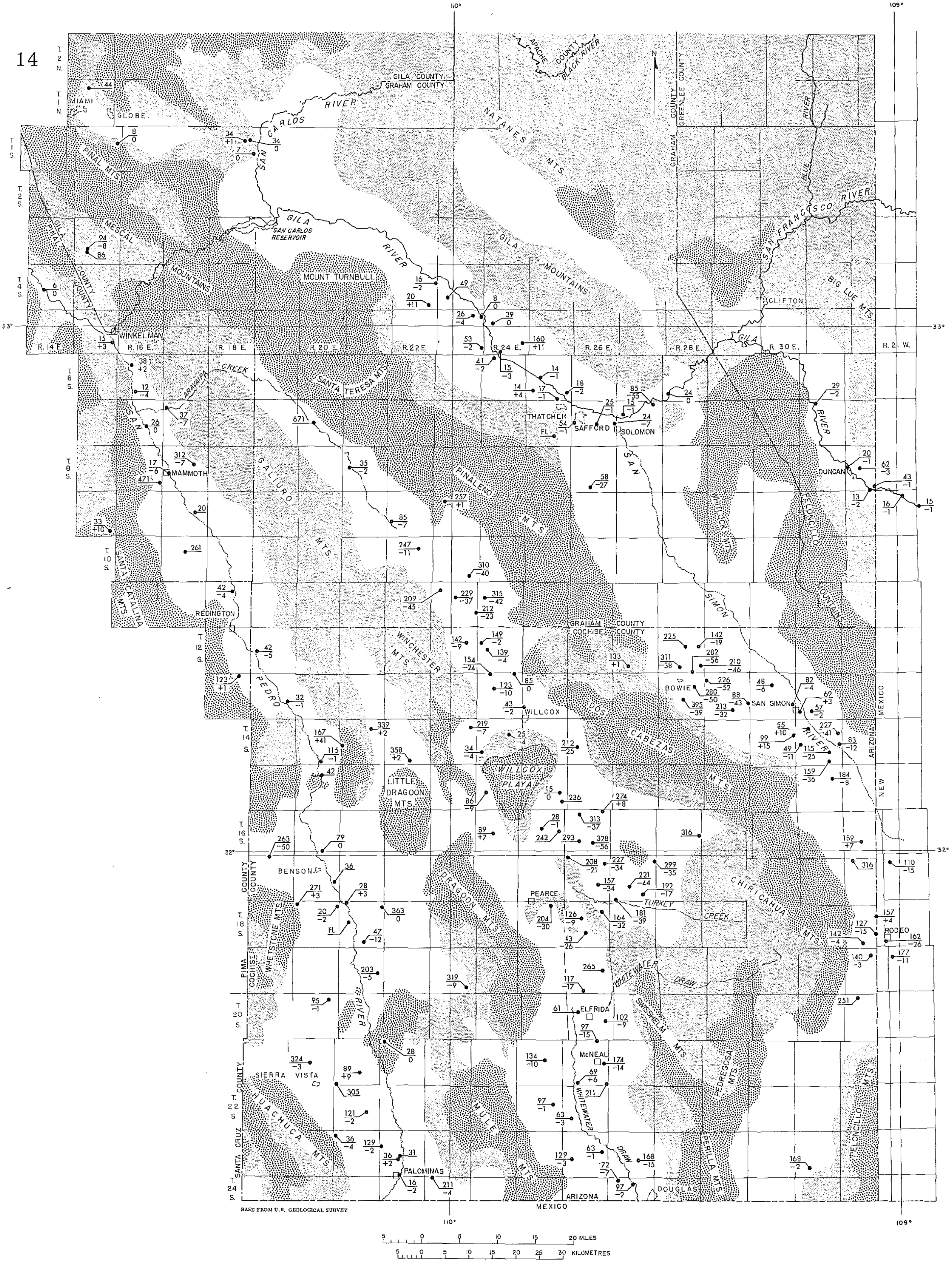


FIGURE 3.--POTENTIAL WELL PRODUCTION, DEPTH TO WATER, 1974, AND CHANGE IN WATER LEVEL, 1969-74, IN SELECTED WELLS IN THE SOUTHEAST PART OF THE BASIN AND RANGE LOWLANDS PROVINCE.

EXPLANATION
Figure 3

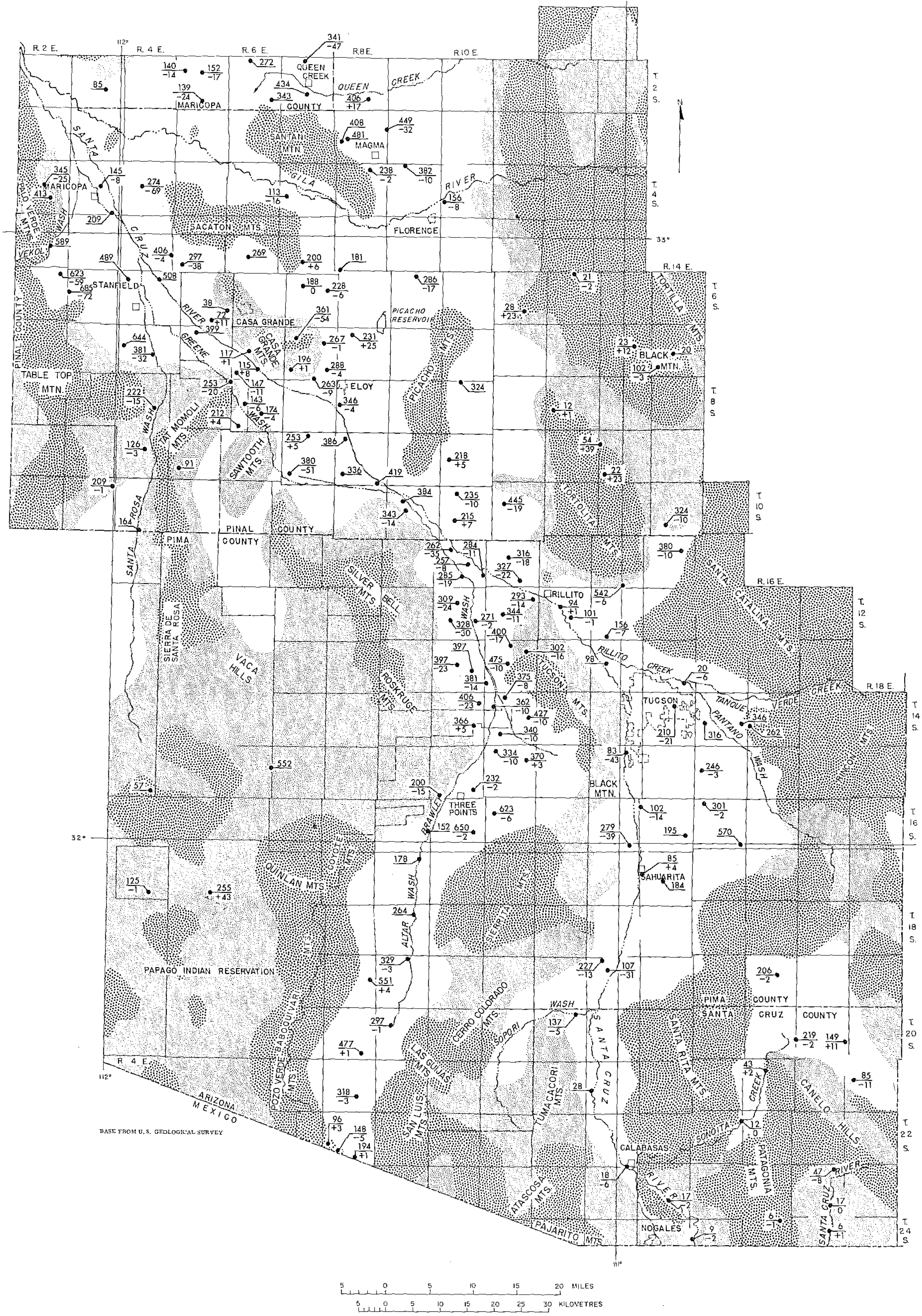
POTENTIAL WELL PRODUCTION, IN GALLONS PER MINUTE (NOTE: THE VALUES OF POTENTIAL WELL PRODUCTION ARE BASED ON THE ASSUMPTION THAT THE WELL IS LOCATED FAVORABLY, IS SUFFICIENTLY DEEP TO TAP THE AQUIFER, AND IS PROPERLY CONSTRUCTED)

□ 50 to more than 2,500—Most wells in area capable of producing 1,000 gallons per minute or more

░ 10 to 500—Most wells capable of producing 100 gallons per minute

▓ 0 to 10

●$\frac{102}{-9}$ INDEX WELL—Upper part of fraction, 102, is depth to water, in feet, 1974; lower part of fraction, -9, is change in water level, in feet, 1969-74. FL=flowing



BASE FROM U.S. GEOLOGICAL SURVEY

FIGURE 4.--POTENTIAL WELL PRODUCTION, DEPTH TO WATER, 1974, AND CHANGE IN WATER LEVEL, 1969-74, IN SELECTED WELLS IN THE SOUTH-CENTRAL PART OF THE BASIN AND RANGE LOWLANDS PROVINCE

EXPLANATION
Figure 4

POTENTIAL WELL PRODUCTION, IN GALLONS PER MINUTE (NOTE: THE VALUES OF POTENTIAL WELL PRODUCTION ARE BASED ON THE ASSUMPTION THAT THE WELL IS LOCATED FAVORABLY, IS SUFFICIENTLY DEEP TO TAP THE AQUIFER, AND IS PROPERLY CONSTRUCTED)

□	50 to more than 2,500—Most wells in area capable of producing 1,000 gallons per minute or more
░	10 to 500—Most wells capable of producing 100 gallons per minute
▒	0 to 10
● $\frac{227}{-13}$	INDEX WELL—Upper part of fraction, 227, is depth to water, in feet, 1974; lower part of fraction, -13, is change in water level, in feet, 1969-74. Some of the water-level measurements were made by the Department of Soils, Water, and Engineering of the University of Arizona

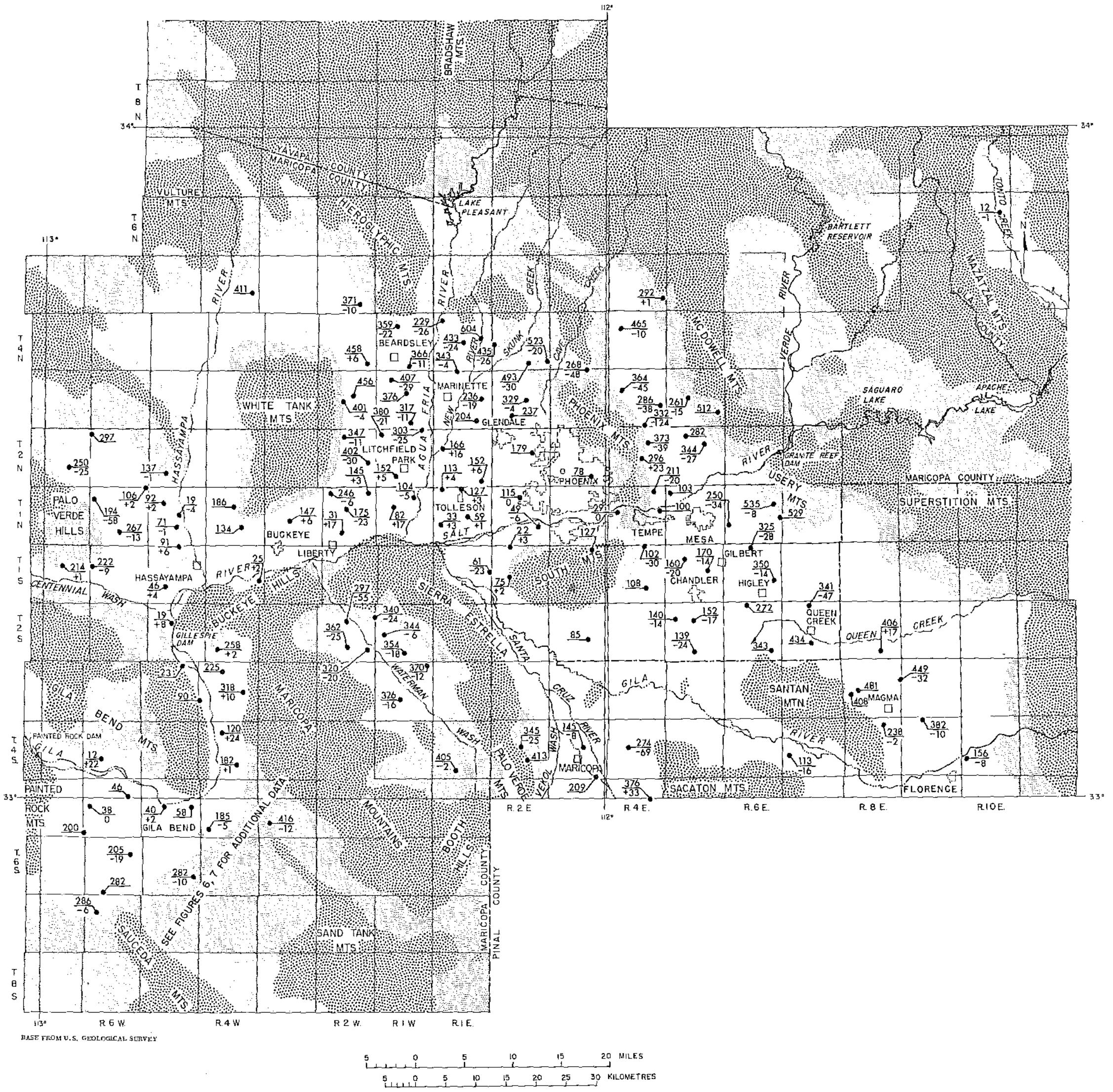


FIGURE 5.--POTENTIAL WELL PRODUCTION, DEPTH TO WATER, 1974, AND CHANGE IN WATER LEVEL, 1969-74, IN SELECTED WELLS IN THE CENTRAL PART OF THE BASIN AND RANGE LOWLANDS PROVINCE.

EXPLANATION
Figure 5

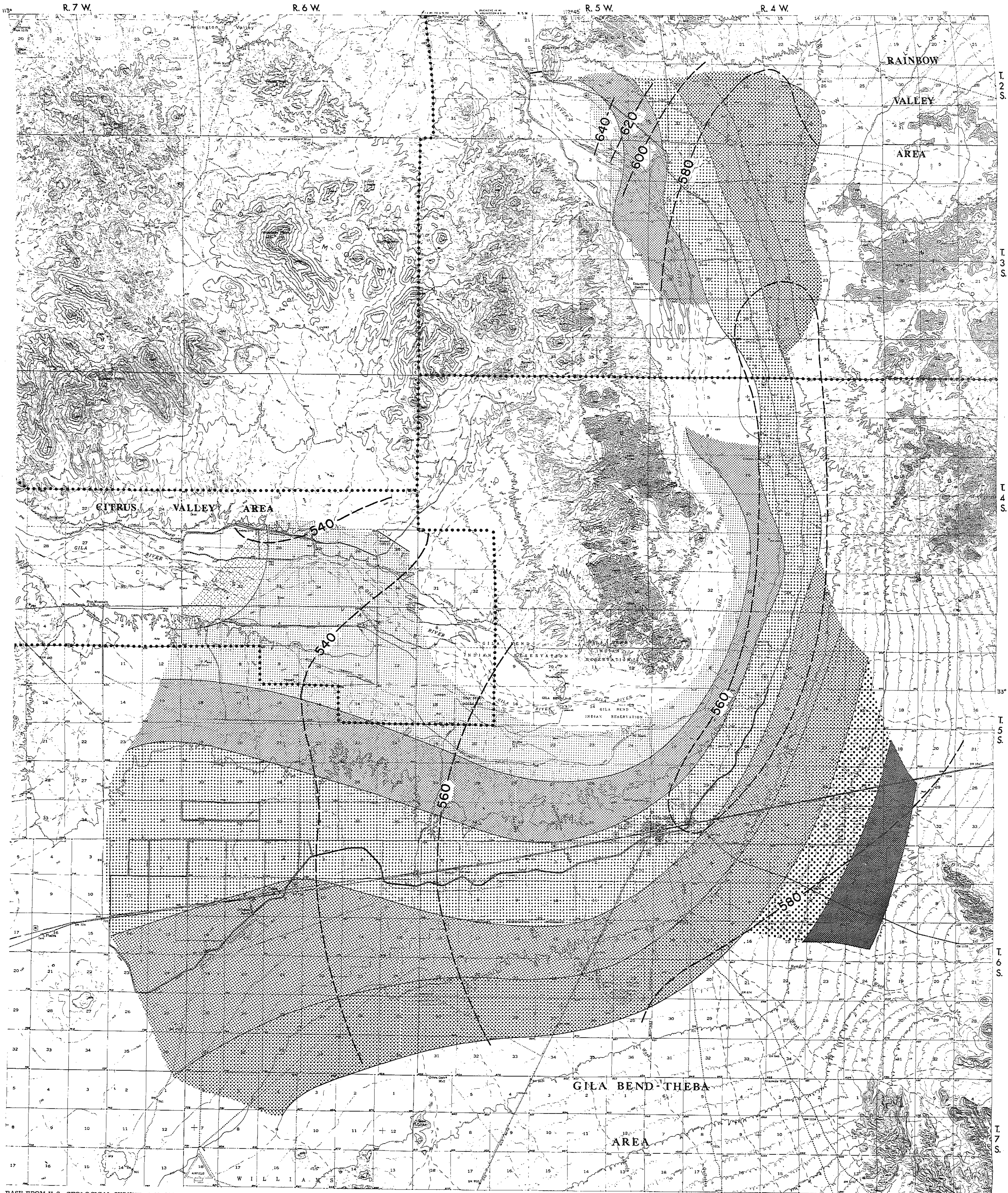
POTENTIAL WELL PRODUCTION, IN GALLONS PER MINUTE (NOTE: THE VALUES OF POTENTIAL WELL PRODUCTION ARE BASED ON THE ASSUMPTION THAT THE WELL IS LOCATED FAVORABLY, IS SUFFICIENTLY DEEP TO TAP THE AQUIFER, AND IS PROPERLY CONSTRUCTED)

☐ 50 to more than 2,500—Most wells in area capable of producing 1,000 gallons per minute or more

░ 10 to 500—Most wells capable of producing 100 gallons per minute

▒ 0 to 10

● $\frac{320}{-20}$ INDEX WELL—Upper part of fraction, 320, is depth to water, in feet, 1974; lower part of fraction, -20, is change in water level, in feet, 1969-74



BASE FROM U.S. GEOLOGICAL SURVEY, 1:62, 500, DENDORA VALLEY, 1950; WOOLSEY PEAK, 1951; COTTON CENTER, 1951; SENTINEL, 1949; THEBA, 1950; AND GILA BEND, 1950

HYDROLOGY BY E. A. NEMECEK (ARIZONA WATER COMMISSION) AND R. S. STULIK (U.S. GEOLOGICAL SURVEY), 1974

EXPLANATION

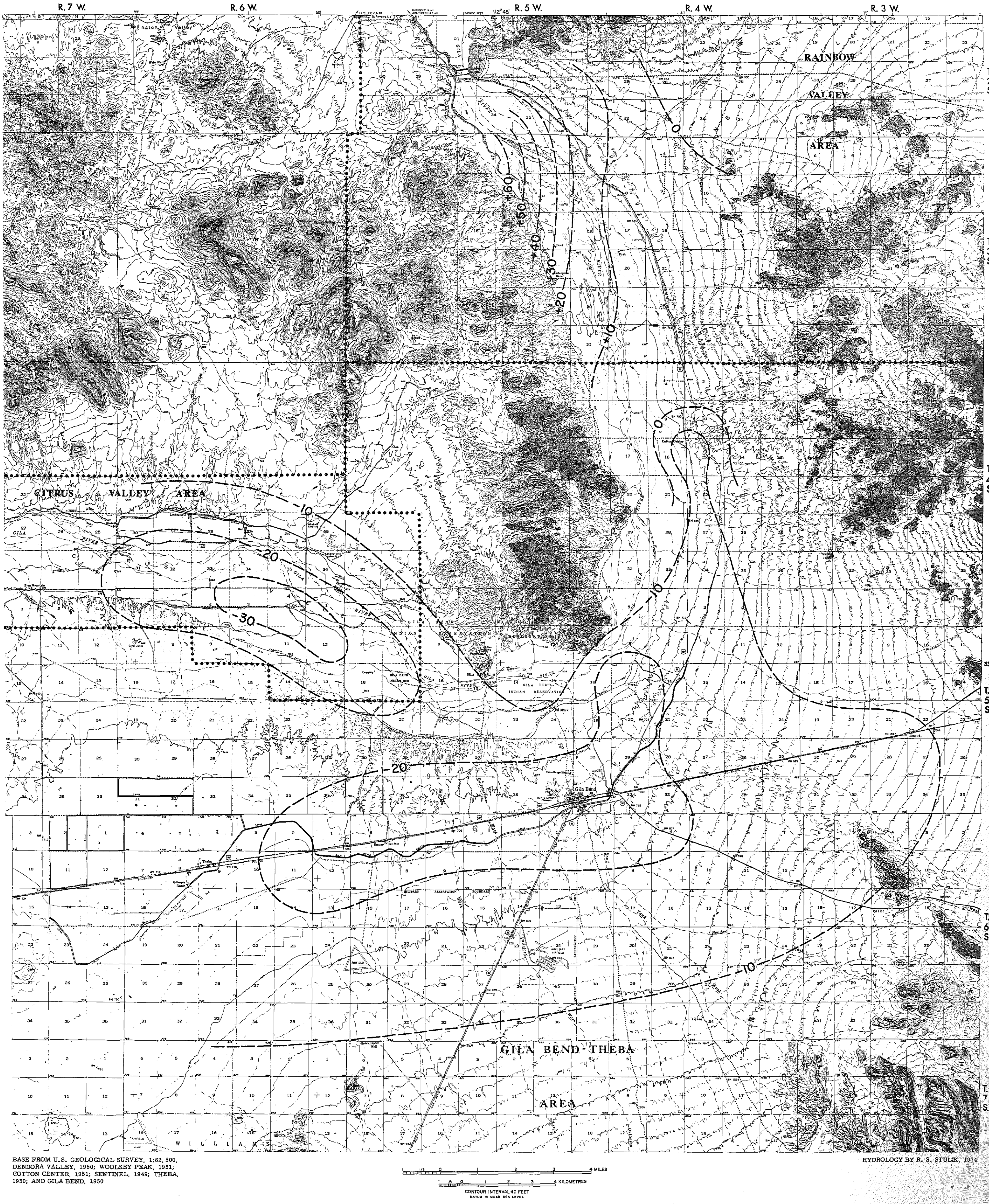
GENERALIZED DEPTH TO WATER, IN FEET BELOW LAND SURFACE

░ Less than 50
░ 50-100
▒ 100-150
▒ 150-200
▒ 200-250
▓ 250-300
▓ 300-350
■ 350-400
□ No data

——580—— WATER-TABLE CONTOUR—Shows approximate altitude of the water table. Contour interval 20 feet. Datum is mean sea level

•••••••••••••• AREA BOUNDARY

FIGURE 6.--ALTITUDE OF THE WATER TABLE AND DEPTH TO WATER, 1973, IN THE GILA BEND BASIN.



BASE FROM U.S. GEOLOGICAL SURVEY, 1:62, 500, DENDORA VALLEY, 1950; WOOLSEY PEAK, 1951; COTTON CENTER, 1951; SENTINEL, 1949; THEBA, 1950; AND GILA BEND, 1950

HYDROLOGY BY R. S. STULIK, 1974

EXPLANATION

— — -10 — — APPROXIMATE LINE OF EQUAL CHANGE IN WATER LEVEL— Interval 10 feet

•••••••••••••••• AREA BOUNDARY

FIGURE 7.--CHANGE IN WATER LEVEL, 1966-73, IN THE GILA BEND BASIN.

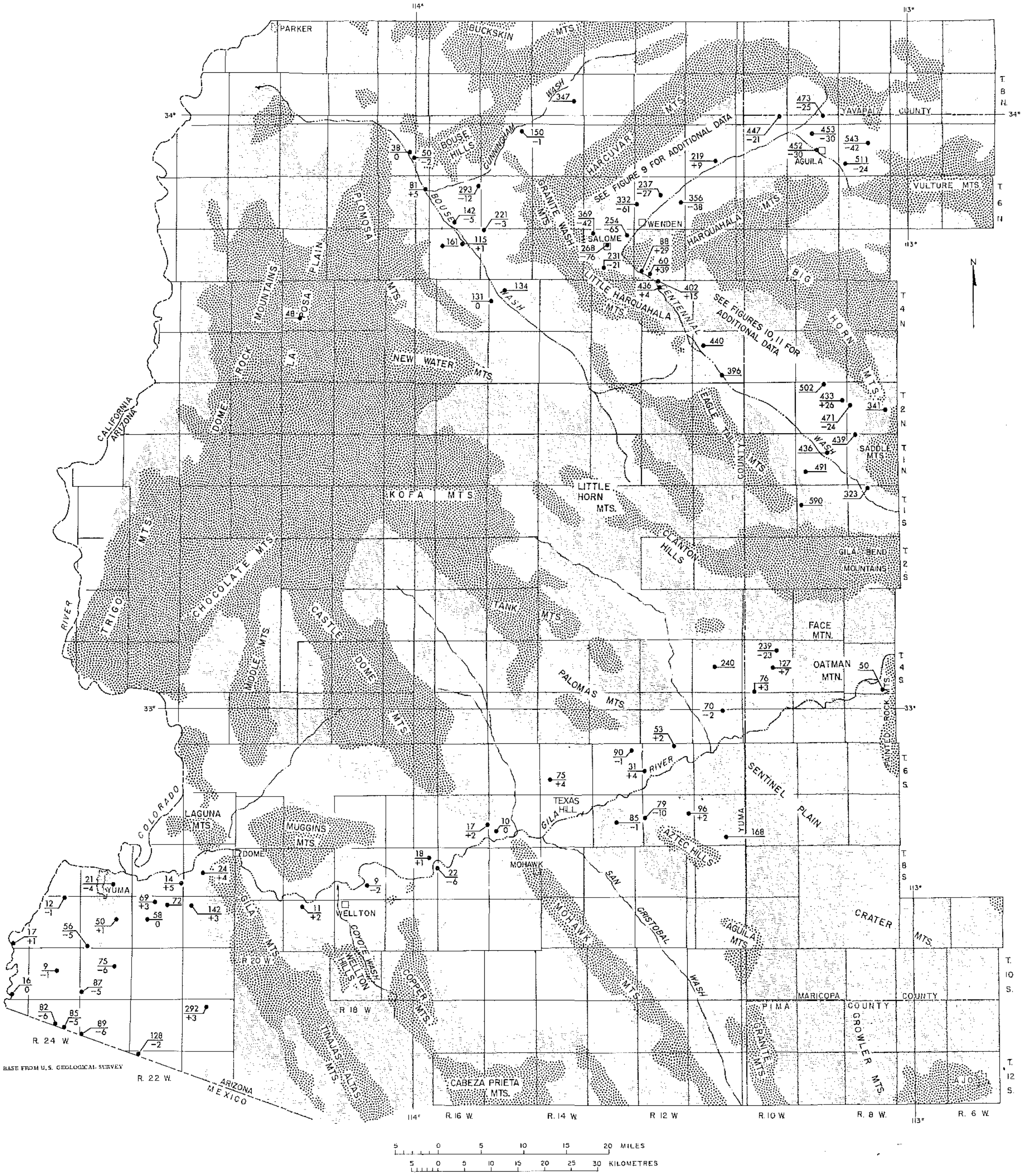
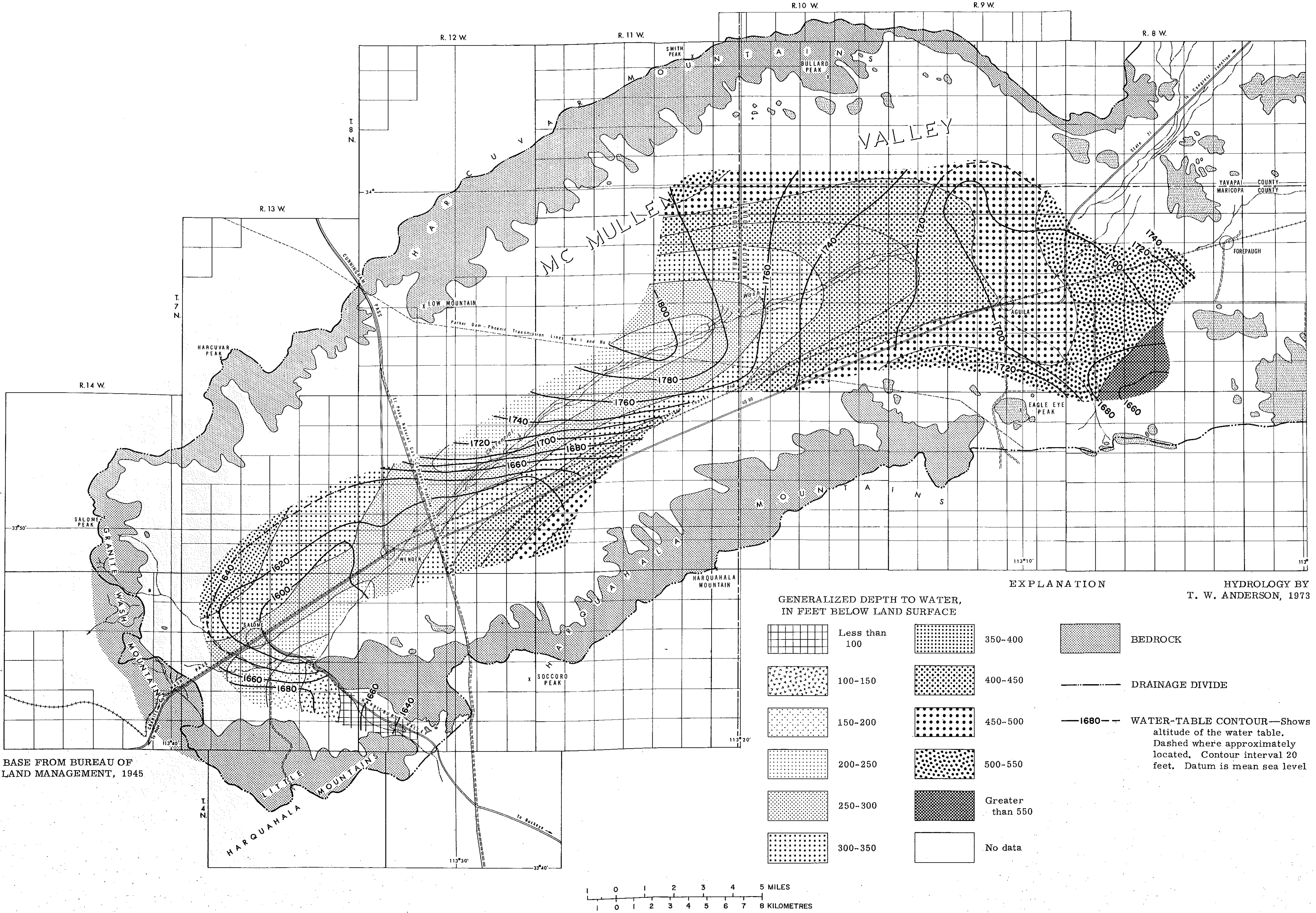


FIGURE 8.--POTENTIAL WELL PRODUCTION, DEPTH TO WATER, 1974, AND CHANGE IN WATER LEVEL, 1969-74, IN SELECTED WELLS IN THE SOUTHWEST PART OF THE BASIN AND RANGE LOWLANDS PROVINCE.

EXPLANATION
Figure 8

POTENTIAL WELL PRODUCTION, IN GALLONS PER MINUTE (NOTE: THE VALUES OF POTENTIAL WELL PRODUCTION ARE BASED ON THE ASSUMPTION THAT THE WELL IS LOCATED FAVORABLY, IS SUFFICIENTLY DEEP TO TAP THE AQUIFER, AND IS PROPERLY CONSTRUCTED)

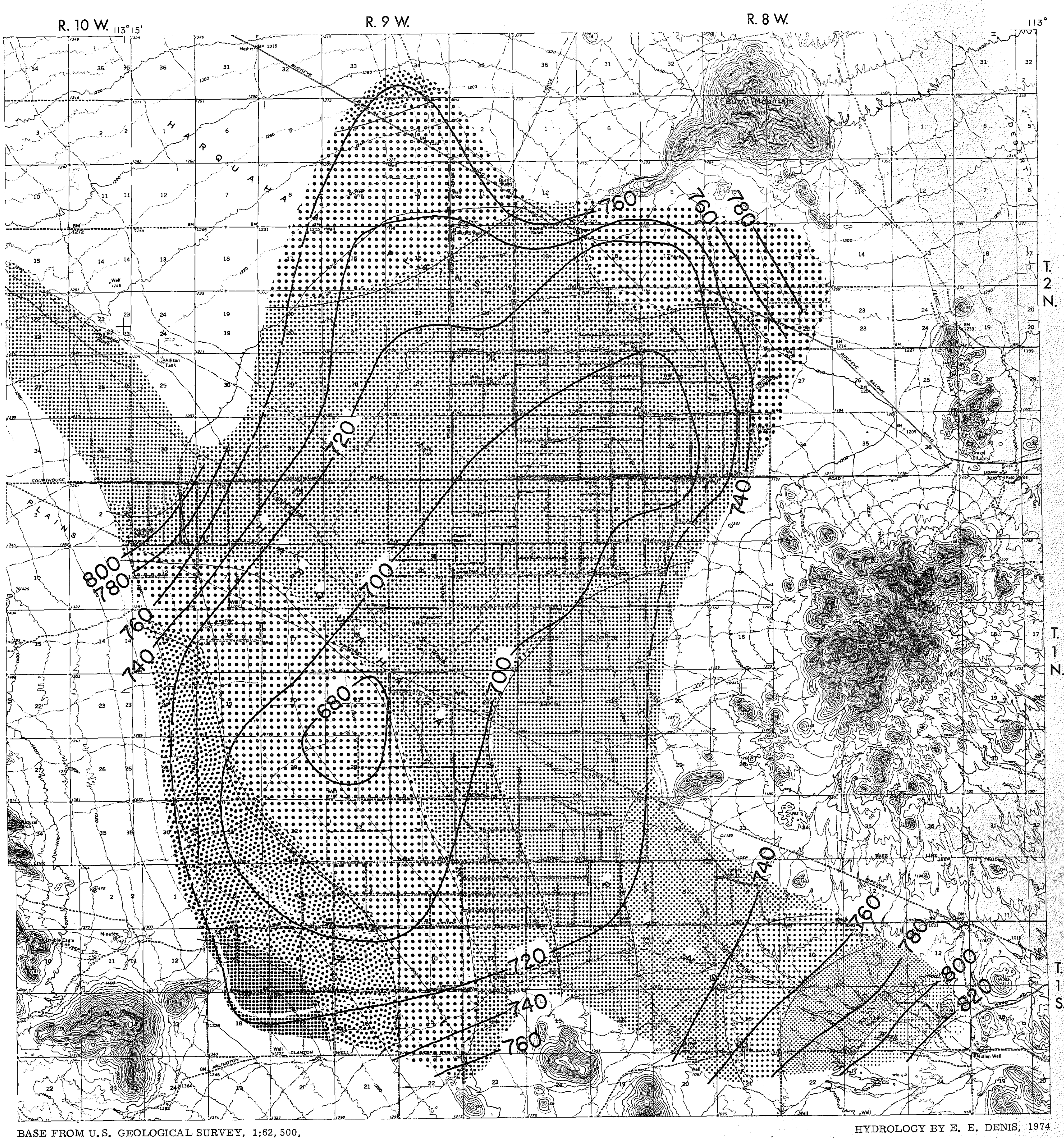
☐	50 to more than 2,500—Most wells in area capable of producing 1,000 gallons per minute or more
░	10 to 500—Most wells capable of producing 100 gallons per minute
▓	0 to 10
● $\frac{471}{-24}$	INDEX WELL—Upper part of fraction, 471, is depth to water, in feet, 1974; lower part of fraction, -24, is change in water level, in feet, 1969-74



BASE FROM BUREAU OF
LAND MANAGEMENT, 1945

HYDROLOGY BY
T. W. ANDERSON, 1973

FIGURE 9.--ALTITUDE OF THE WATER TABLE AND DEPTH TO WATER, DECEMBER 1973, IN M^C^MULLEN VALLEY.



BASE FROM U.S. GEOLOGICAL SURVEY, 1:62,500,
LONE MOUNTAIN, 1961; BIG HORN MOUNTAINS, 1961;
EAGLETAIL MOUNTAINS, 1962; AND CORTEZ PEAK,
1962

HYDROLOGY BY E. E. DENIS, 1974

1 1/2 0 1 2 3 4 MILES

1 .5 0 1 2 3 4 KILOMETRES

CONTOUR INTERVAL 40 FEET
DATUM IS MEAN SEA LEVEL

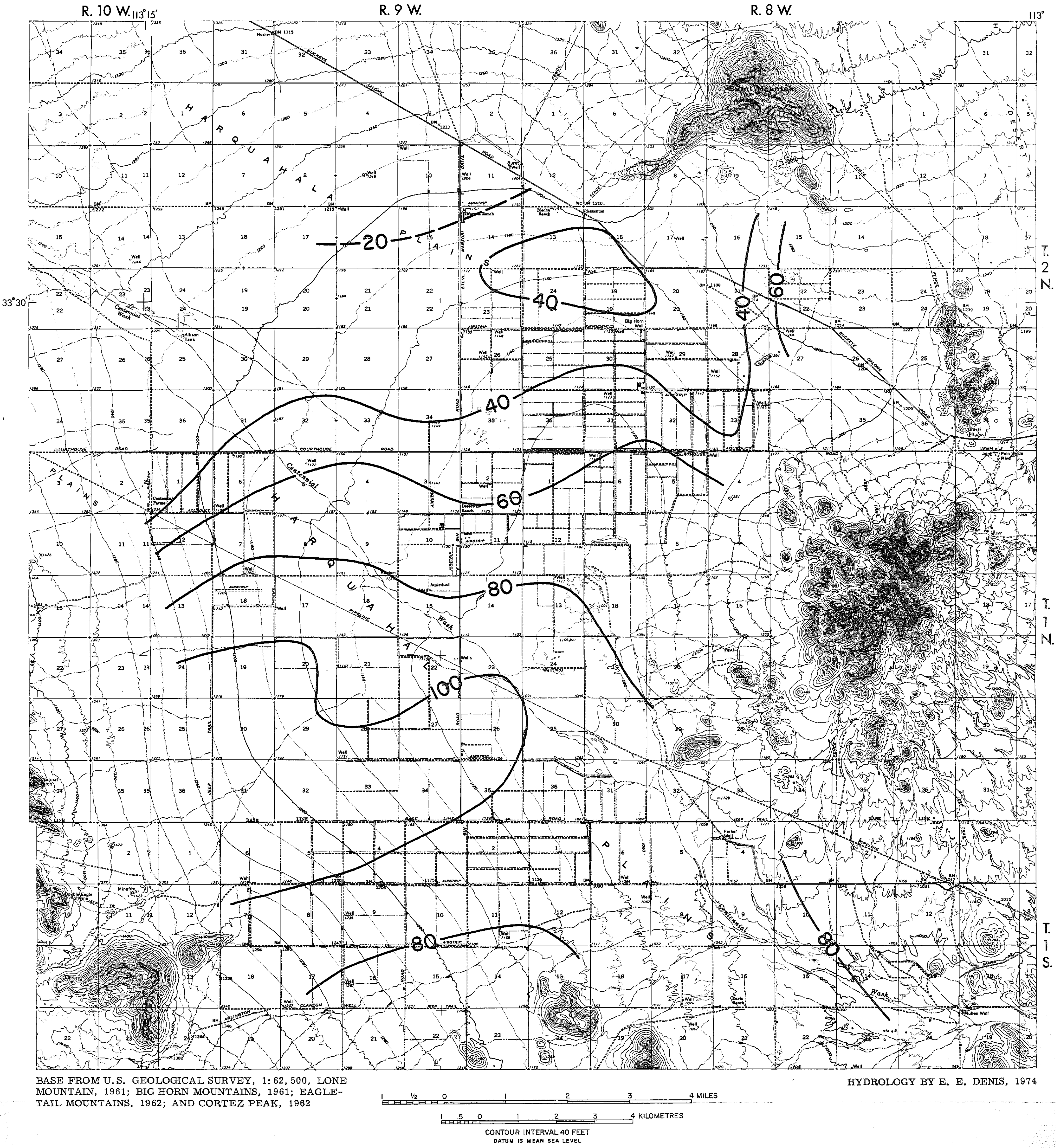
EXPLANATION

GENERALIZED DEPTH TO WATER, IN FEET BELOW LAND SURFACE

░	Less than 150	▒	300 - 350	▓	500 - 550
░	150 - 200	▒	350 - 400	█	Greater than 550
░	200 - 250	▒	400 - 450	☐	No data
░	250 - 300	▓	450 - 500		

——720—— —— WATER-TABLE CONTOUR—Shows altitude of the water table. Dashed where approximately located. Contour interval 20 feet. Datum is mean sea level

FIGURE 10.--ALTITUDE OF THE WATER TABLE AND DEPTH TO WATER, JANUARY 1974, IN THE SOUTHEAST PART OF THE HARQUAHALA PLAINS.



BASE FROM U.S. GEOLOGICAL SURVEY, 1:62,500, LONE MOUNTAIN, 1961; BIG HORN MOUNTAINS, 1961; EAGLETAIL MOUNTAINS, 1962; AND CORTEZ PEAK, 1962

HYDROLOGY BY E. E. DENIS, 1974

EXPLANATION

——40— — LINE OF EQUAL DECLINE IN WATER LEVEL—
Dashed where approximately located.
Interval 20 feet

FIGURE 11.--DECLINE IN WATER LEVEL, DECEMBER 1966 TO JANUARY 1974, IN THE SOUTHEAST PART OF THE HARQUAHALA PLAINS.

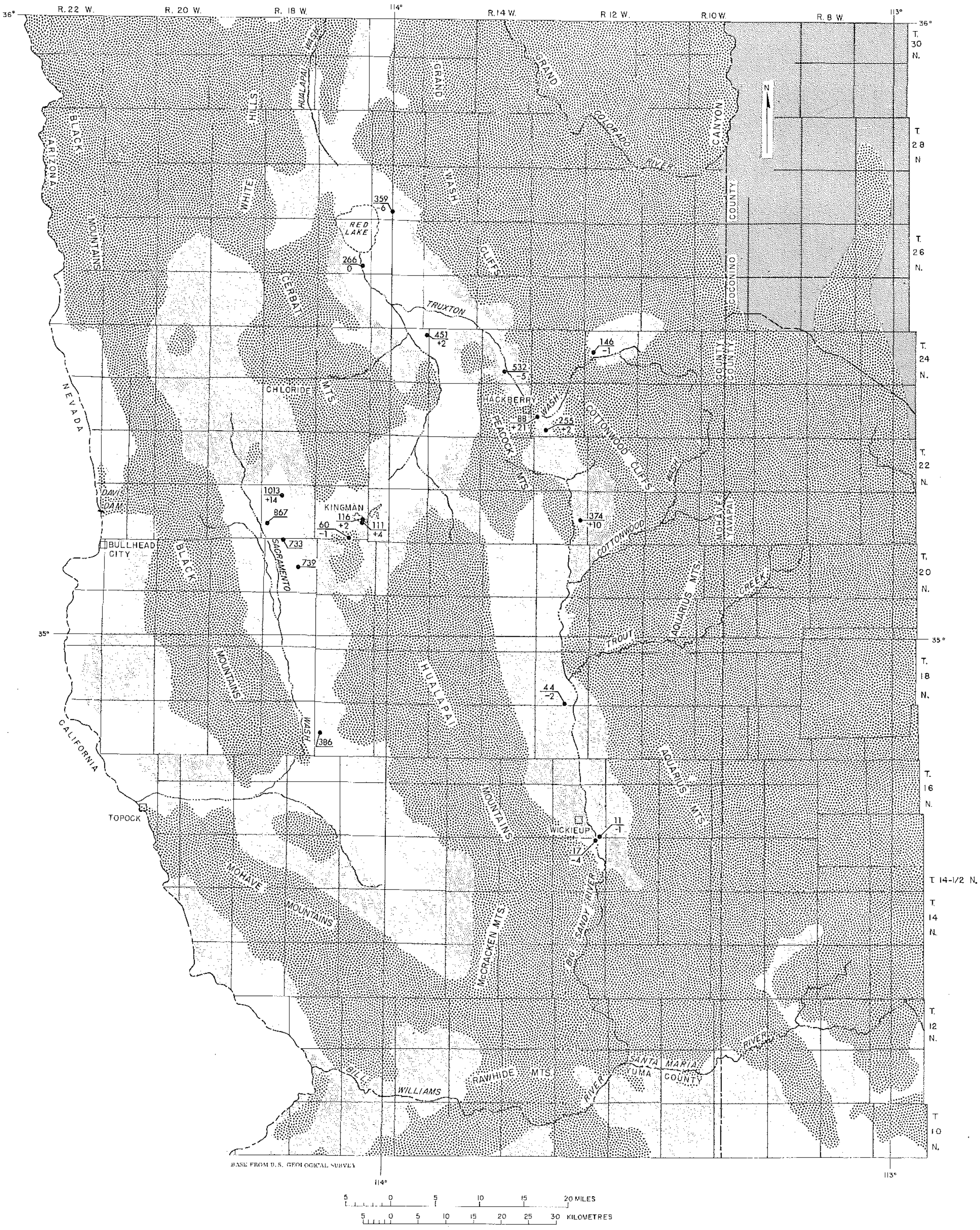


FIGURE 12.--POTENTIAL WELL PRODUCTION, DEPTH TO WATER, 1974, AND CHANGE IN WATER LEVEL, 1969-74, IN SELECTED WELLS IN THE NORTHWEST PART OF THE BASIN AND RANGE LOWLANDS PROVINCE.

EXPLANATION
Figure 12

POTENTIAL WELL PRODUCTION, IN GALLONS PER MINUTE (NOTE: THE VALUES OF POTENTIAL WELL PRODUCTION ARE BASED ON THE ASSUMPTION THAT THE WELL IS LOCATED FAVORABLY, IS SUFFICIENTLY DEEP TO TAP THE AQUIFER, AND IS PROPERLY CONSTRUCTED. IN SOME AREAS, WELL PRODUCTION IN THE 0 TO 10 GALLONS PER MINUTE RANGE COULD BE INCREASED AT DEPTHS OF MORE THAN 2,000 FEET)

□ 50 to more than 2,500—Most wells in area capable of producing 1,000 gallons per minute or more

░ 10 to 500—Most wells capable of producing 100 gallons per minute

▒ 0 to 10

■ Most wells dry or yield poor-quality water

● $\frac{359}{-6}$ INDEX WELL—Upper part of fraction, 359, is depth to water, in feet, 1974; lower part of fraction, -6, is change in water level, in feet, 1969-74

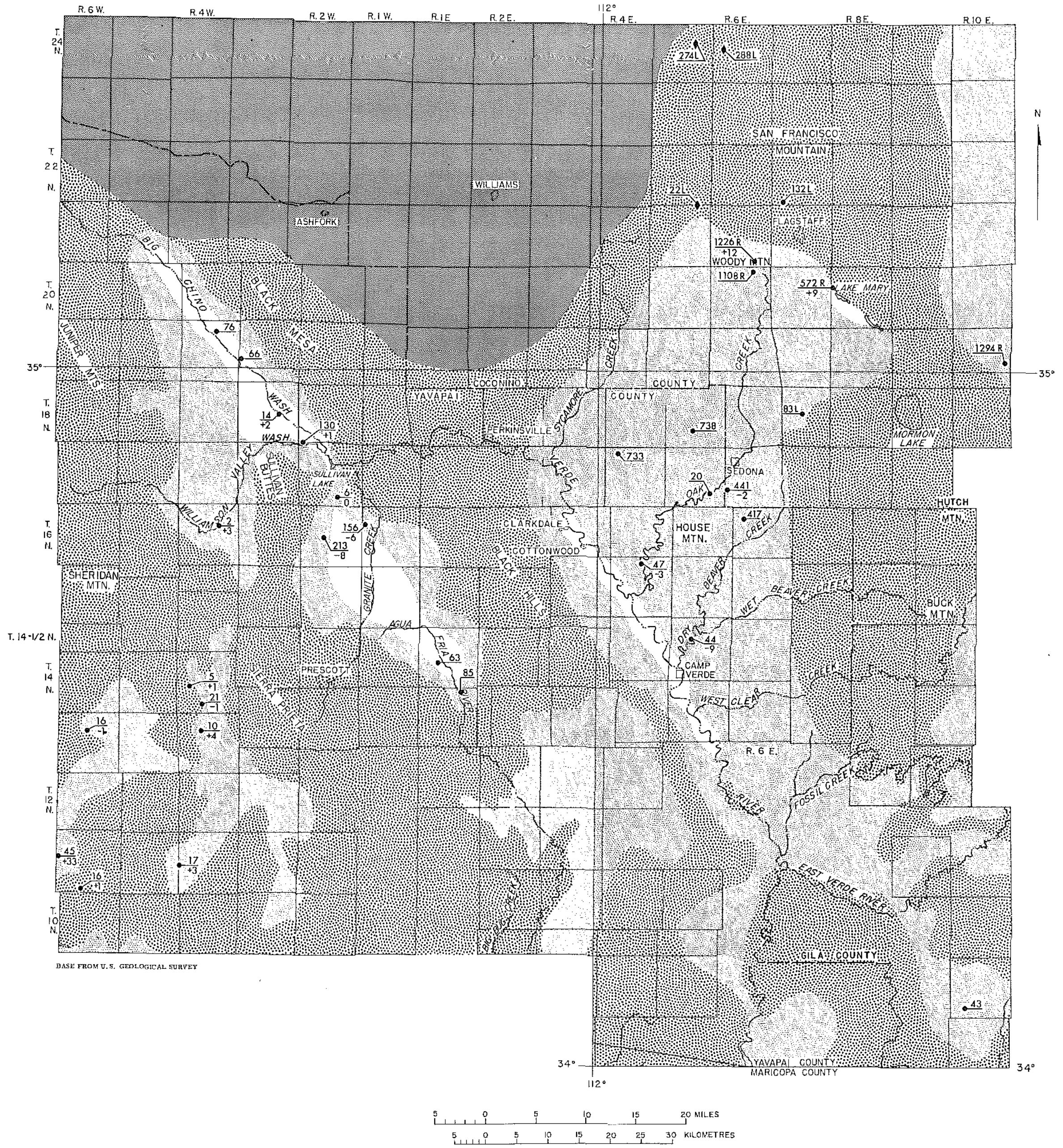


FIGURE 13.--POTENTIAL WELL PRODUCTION, DEPTH TO WATER, 1974, AND CHANGE IN WATER LEVEL, 1969-74, IN SELECTED WELLS IN THE WEST PART OF THE CENTRAL HIGHLANDS PROVINCE AND THE SOUTH-CENTRAL PART OF THE PLATEAU UPLANDS PROVINCE.

EXPLANATION
Figure 13

POTENTIAL WELL PRODUCTION, IN GALLONS PER MINUTE (NOTE: THE VALUES OF POTENTIAL WELL PRODUCTION ARE BASED ON THE ASSUMPTION THAT THE WELL IS LOCATED FAVORABLY, IS SUFFICIENTLY DEEP TO TAP THE AQUIFER, AND IS PROPERLY CONSTRUCTED. IN SOME AREAS, WELL PRODUCTION IN THE 0 TO 10 GALLONS PER MINUTE RANGE COULD BE INCREASED AT DEPTHS OF MORE THAN 2,000 FEET)

□ 50 to more than 2,500—Most wells in area capable of producing 1,000 gallons per minute or more

░ 10 to 500—Most wells capable of producing 100 gallons per minute

▒ 0 to 10

■ Most wells dry or yield poor-quality water

● $\frac{572R}{+9}$ INDEX WELL—Upper part of fraction, 572, is depth to water, in feet, 1974; lower part of fraction, +9, is change in water level, in feet, 1969-74. R = well taps regional aquifer of great areal extent; L = well taps local aquifer of limited areal extent

◆ 274L WELL IN WHICH MISCELLANEOUS WATER-LEVEL MEASUREMENTS WERE MADE—274 is depth to water, in feet, during 1969-73. Used where 1974 data are not available and changes in water levels are negligible

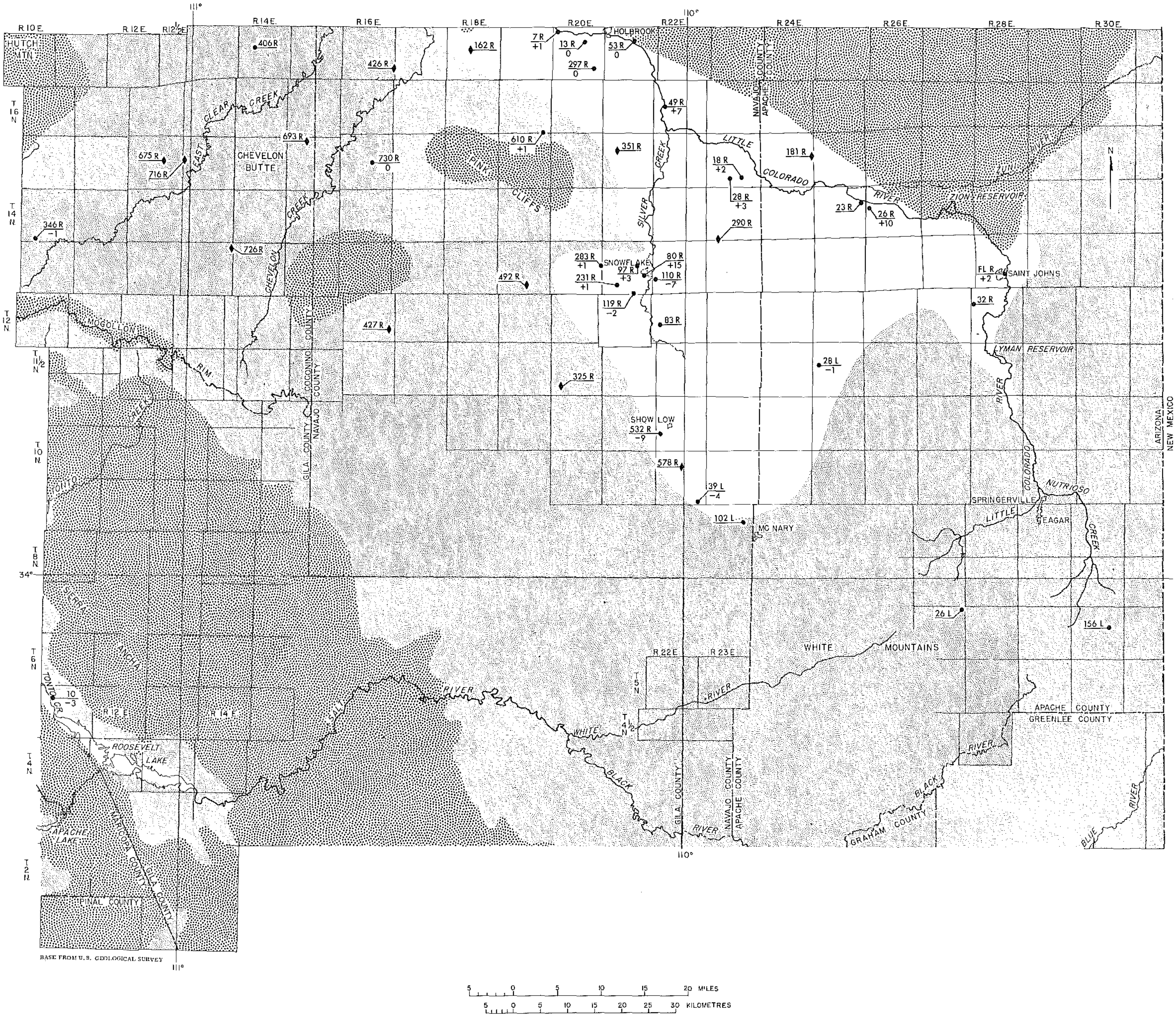


FIGURE 14.--POTENTIAL WELL PRODUCTION, DEPTH TO WATER, 1974, AND CHANGE IN WATER LEVEL, 1969-74, IN SELECTED WELLS IN THE EAST PART OF THE CENTRAL HIGHLANDS PROVINCE AND THE SOUTHEAST PART OF THE PLATEAU UPLANDS PROVINCE.

EXPLANATION
Figure 14

POTENTIAL WELL PRODUCTION, IN GALLONS PER MINUTE (NOTE: THE VALUES OF POTENTIAL WELL PRODUCTION ARE BASED ON THE ASSUMPTION THAT THE WELL IS LOCATED FAVORABLY, IS SUFFICIENTLY DEEP TO TAP THE AQUIFER, AND IS PROPERLY CONSTRUCTED. IN SOME AREAS, WELL PRODUCTION IN THE 0 TO 50 GALLONS PER MINUTE RANGE COULD BE INCREASED AT DEPTHS OF MORE THAN 2,000 FEET)

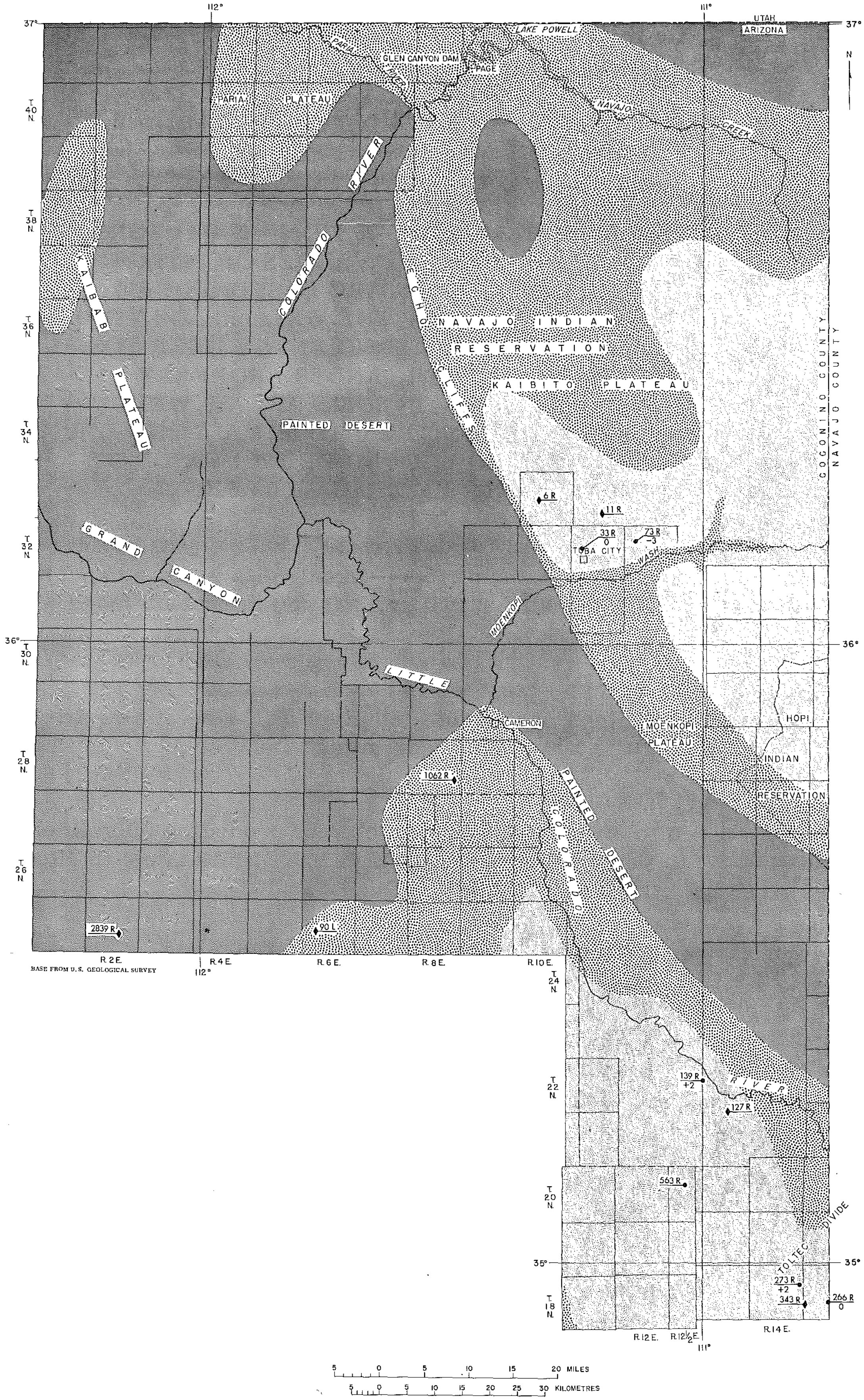
☐ 500 to more than 2,500—Most wells in area capable of producing 1,000 gallons per minute or more

░ 50 to 500—Most wells capable of producing 100 gallons per minute; south of T. 11 N. limits are 10 to 500 gallons per minute

▒ 0 to 50—Most wells capable of producing 10 gallons per minute; south of T. 11 N. limits are 0 to 10 gallons per minute

● $\frac{283\text{R}}{+1}$ INDEX WELL—Upper part of fraction, 283, is depth to water, in feet, 1974; lower part of fraction, +1, is change in water level, in feet, 1969-74. FL=flowing; R = well taps regional aquifer of great areal extent; L = well taps local aquifer of limited areal extent

♦ $\underline{162\text{R}}$ WELL IN WHICH MISCELLANEOUS WATER-LEVEL MEASUREMENTS WERE MADE—162 is depth to water, in feet, during 1969-73. Used where 1974 data are not available and changes in water levels are negligible



BASE FROM U.S. GEOLOGICAL SURVEY

FIGURE 15.--POTENTIAL WELL PRODUCTION, DEPTH TO WATER, 1974, AND CHANGE IN WATER LEVEL, 1969-74, IN SELECTED WELLS IN THE NORTH-CENTRAL PART OF THE PLATEAU UPLANDS PROVINCE.

EXPLANATION
Figure 15

POTENTIAL WELL PRODUCTION, IN GALLONS PER MINUTE (NOTE: THE VALUES OF POTENTIAL WELL PRODUCTION ARE BASED ON THE ASSUMPTION THAT THE WELL IS LOCATED FAVORABLY, IS SUFFICIENTLY DEEP TO TAP THE AQUIFER, AND IS PROPERLY CONSTRUCTED. IN SOME AREAS, WELL PRODUCTION IN THE 0 TO 50 GALLONS PER MINUTE RANGE COULD BE INCREASED AT DEPTHS OF MORE THAN 2,000 FEET)

░ 50 to 500—Most wells capable of producing 100 gallons per minute

▒ 0 to 50—Most wells capable of producing 10 gallons per minute

▓ Most wells dry or yield poor-quality water

● $\frac{73R}{-3}$ INDEX WELL—Upper part of fraction, 73, is depth to water, in feet, 1974; lower part of fraction, -3, is change in water level, in feet, 1969-74. R = well taps regional aquifer of great areal extent; L = well taps local aquifer of limited areal extent

◆ $\underline{90L}$ WELL IN WHICH MISCELLANEOUS WATER-LEVEL MEASUREMENTS WERE MADE—90 is depth to water, in feet, during 1969-73. Used where 1974 data are not available and changes in water levels are negligible

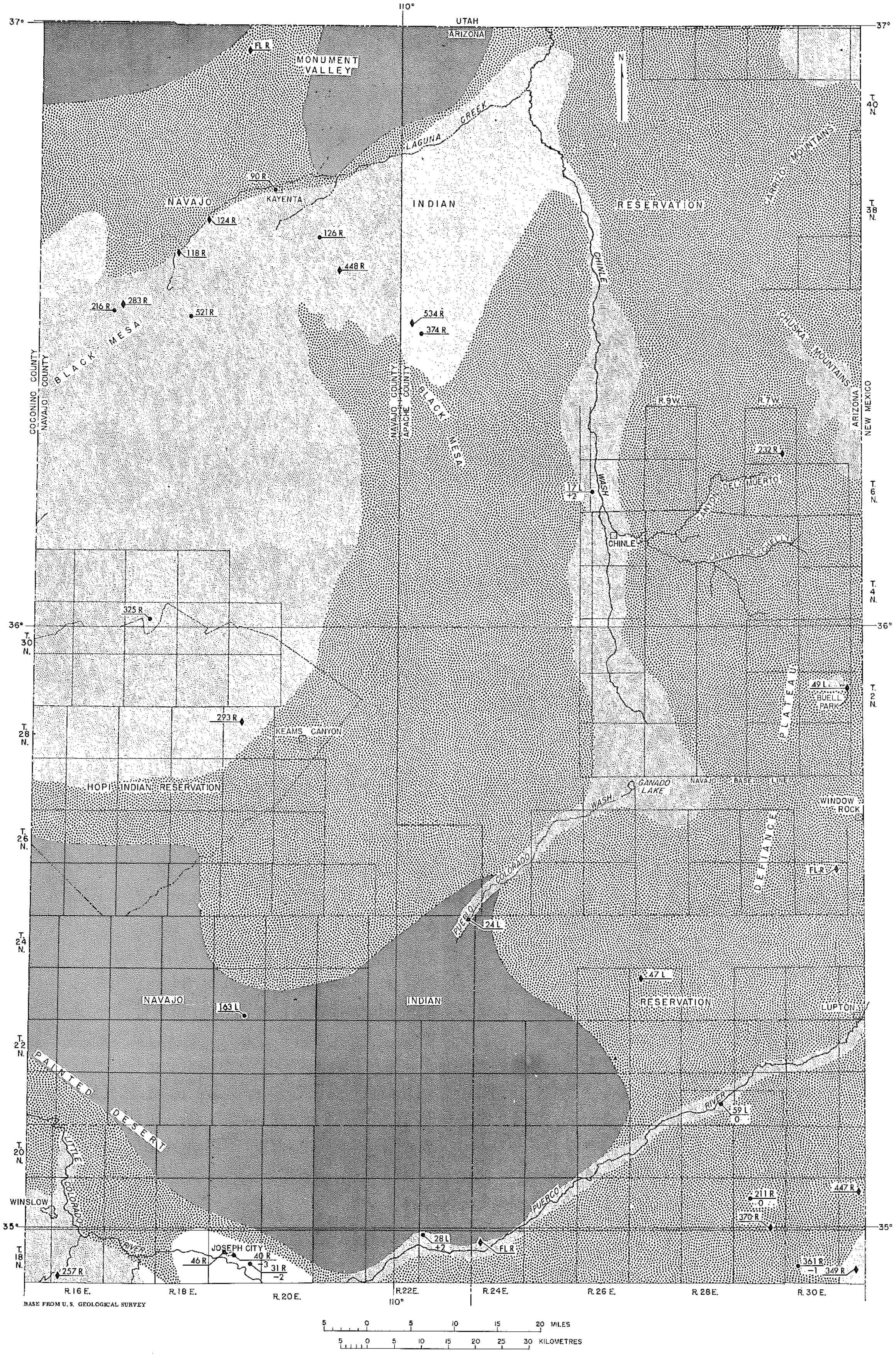


FIGURE 16.--POTENTIAL WELL PRODUCTION, DEPTH TO WATER, 1974, AND CHANGE IN WATER LEVEL, 1969-74, IN SELECTED WELLS IN THE NORTHEAST PART OF THE PLATEAU UPLANDS PROVINCE.

EXPLANATION

Figure 16

POTENTIAL WELL PRODUCTION, IN GALLONS PER MINUTE (NOTE: THE VALUES OF POTENTIAL WELL PRODUCTION ARE BASED ON THE ASSUMPTION THAT THE WELL IS LOCATED FAVORABLY, IS SUFFICIENTLY DEEP TO TAP THE AQUIFER, AND IS PROPERLY CONSTRUCTED. IN SOME AREAS, WELL PRODUCTION IN THE 0 TO 50 GALLONS PER MINUTE RANGE COULD BE INCREASED AT DEPTHS OF MORE THAN 2,000 FEET)

☐ 500 to more than 2,500—Most wells in area capable of producing 1,000 gallons per minute or more

░ 50 to 500—Most wells capable of producing 100 gallons per minute

▒ 0 to 50—Most wells capable of producing 10 gallons per minute

■ Most wells dry or yield poor-quality water

● $\frac{361\text{R}}{-1}$ INDEX WELL—Upper part of fraction, 361, is depth to water, in feet, 1974; lower part of fraction, -1, is change in water level, in feet, 1969-74. FL=flowing; R = well taps regional aquifer of great areal extent; L = well taps local aquifer of limited areal extent

◆ $\frac{47\text{L}}{}$ WELL IN WHICH MISCELLANEOUS WATER-LEVEL MEASUREMENTS WERE MADE—47 is depth to water, in feet, during 1969-73. Used where 1974 data are not available and changes in water levels are negligible