UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
Water Resources Division

PROGRESS REPORT ON WATER STUDIES IN THE BLOOMINGTON-COLTON AREA, UPPER SANTA ANA VALLEY, CALIFORNIA, 1964

By

L. C. Dutcher

Prepared in cooperation with the
San Bernardino County Flood Control District

OPEN-FILE REPORT 65-48

Garden Grove, California
March 1, 1965

CONTENTS

	Page
Summary	4
Introduction	7
Location of the Bloomington-Colton area	10
Purpose and scope of the report	11
Previous work and related studies	12
Preliminary findings	13
Test-drilling program	14
Location of test wells	15
Description of wells	17
Development and completion of wells	18
Water-level-contour map	19
Source and movement of ground water	21
Studies to be completed	23
Analysis of existing water-level records	23
Possible need for estimating inflow to Chino basin	25
Examination of cuttings from drill holes	26
Geologic and chemical-quality-of-water studies	27
Unanswered problems	28
Need for additional data and test wells	29
References	30

ILLUSTRATIONS

Page 1/

Figure 1. The South Coastal Basin ---------- 4

2. Map of the Bloominton-Colton area, San Bernardino and Riverside Counties, California, showing location of observation wells, test wells, and water-level contours during 1963-64 ---------- 5

1. Both illustrations are at end of report; page numbers are the first principal reference to the illustration in the text.

PROGRESS REPORT ON WATER STUDIES IN THE BLOOMINGTON-COLTON AREA, UPPER SANTA ANA VALLEY, CALIFORNIA, 1964

By L. C. Dutcher

SUMMARY

This report, prepared in cooperation with the San Bernardino County Flood Control District, outlines the preliminary findings of a study of the Bloomington-Colton area to determine the scope of a proposed ground-water investigation.

This progress report presents the preliminary findings, including the results of a program of drilling 14 test wells, and outlines the remaining work necessary to complete the studies.

The 14 test wells were drilled by local water agencies in Rialto-Colton, Riverside, and Chino basins. They were drilled by the rotary method and an electric log was made of each well. Drill cuttings were collected for later detailed examination. The wells were completed by installing a 2-inch perforated pipe and will be useful as observation wells and for collecting water samples for analysis.

A water-level contour map was drawn, based on water-level measurements made in the test wells and other wells. On the basis of data from these wells, it appears likely that the Rialto-Colton fault strikes across the area but that it has two branches which are offset about half a mile in the vicinity of Meridian Avenue west of Colton.

The water-level contours, as drawn, show that from the northern part of Rialto-Colton basin ground water moves generally southeast toward the Santa Ana River. In the southern part of the basin ground water moves toward Colton from Bunker Hill basin. In Riverside basin ground water moves generally southwest toward the Santa Ana River. In Chino basin ground water moves generally west along the north side of the Jurupa Mountains.

The water-level contours (Fig. 2) show that during April 1964, ground water recharged from the Santa Ana River at Colton Narrows did not move into Chino basin past the ground-water flow line that extends from the northeast end of the Jurupa Mountains to the Rialto-Colton fault, and northward in Rialto-Colton basin beyond the fault.

Studies to be completed include: Analysis of existing water-level records to determine if ground water recharged from the Santa Ana River has moved into Chino basin north of the Jurupa Mountains; examination of drill cuttings from the test wells; geologic and chemical-quality-of-water studies to determine if the data support the preliminary findings which are based mainly on water-level measurements; and, if the proposed studies show that inflow from Colton Narrows has occurred during past years, quantitative estimates of ground-water inflow to Chino basin.

There are several important ground-water problems in the area which are beyond the scope of this report or the studies scheduled. Three important questions are:

1. Have all ground-water barriers in the area been discovered and mapped?

2. What is the quantity of ground-water inflow to Rialto-Colton basin from the north?

3. What is the quantity of ground-water inflow to Rialto-Colton basin from Bunker Hill basin north of Warm Creek?

Because 14 test wells were completed during the preliminary work, it appears that additional test drilling or geophysical explorations will not be needed, unless it will be necessary to make quantitative estimates of ground-water inflow to Chino basin.

PURPOSE AND SCOPE

This report was prepared to determine the scope of a proposed ground-water study in the Bloomington-Colton area in the Upper Santa Ana Valley, Calif. (fig. 1). The project, in cooperation with the San Bernardino County Flood Control District, extended from January to July 1964. The current needs of the Flood Control District require that additional studies be completed to assist in providing the basis for the solution of the problems listed below.

1. Where are the best places to spread, for ground-water recharge, both imported water and storm runoff?

2. In order to assess the benefits of recharge to different users, where does the spread water go once it has been induced underground?

3. To whom do the benefits of artificial recharge by water spreading accrue? For example, if one spreads water at Colton Narrows (Dutcher and Garrett, 1963, pl. 19), does it go as subsurface flow dow the Santa Ana River and ultimately flow out of the county, or does it move as subsurface flow north of the Jurupa Mountains and benefit Chino basin (fig. 2)? Also, if water is spread in San Timoteo Wash, where does it go as subsurface flow down the Santa Ana River?

4. What has been the effect, if any, of present water-spreading operations by the Flood Control District on the outflow of Chino basin for the period subsequent to the Chino basin report by the Geological Survey (Garrett and Thomasson, 1949)?

5. How can Chino basin best be used to increase the benefits from the recharge of imported water and storm runoff?

6. With regard to item 5 above, do any subsurface barriers to the movement of ground water exist in the Chino basin upstream from Prado Dam?

7. To what extent can water quality be used to determine the direction and movement of water that has recharged the aquifers.

8. What subsurface barriers to the movement of ground water exist along the south margin of San Bernardino Valley, and what is the annual ground-water outflow from the San Timoteo-Smiley Heights area?

9. What additional data, test drilling, geophysical explorations, and studies will be required to provide quantitative answers to the questions listed under items 1 through 8?

This progress report on the Bloomington-Colton area is the first of the four scheduled progress reports on studies in the Upper Santa Ana Valley and outlines the preliminary findings and studies proposed for the Bloomington-Colton area (figs. 1 and 2). The studies proposed for this area are related to the general and specific ground-water problems of the area, as listed above, with particular reference to items 1-3, 5-6, and 9.

Location of the Bloomington-Colton Area

The Bloomington-Colton area in San Bernardino and Riverside Counties, is bordered by the San Jacinto Fault on the northeast and includes parts of three major ground-water basins in the Upper Santa Ana Valley: Rialto-Colton basin, Riverside basin, and Chino basin (Fig. 2). The southern part of the area is crossed by the Santa Ana River (Fig. 2); and the Jurupa Mountains, Slover Mountain, La Loma Hills and, on the south, part of the Box Springs Mountains are important landmarks. The cities of Colton, Bloomington, Rialto, and Fontana are within the area, and the city of San Bernardino adjoins it locally on the east.

Purpose and Scope of the Report

The purpose and scope of this first progress report are, as ollows: (1) To summarize the background information for the loomington-Colton area; (2) to present the findings of the preliminary tudy, including the results of a test-well drilling program; (3) to tline the purpose and scope of studies scheduled to be completed in he area during the 1965 fiscal year; and (4) to outline additional r und-water problems which are not considered in this report and not heduled for study at this time.

The work was done by the U.S. Geological Survey, Water Resources ivision, in cooperation with the San Bernardino County Flood Control istrict, under the direct supervision of L. C. Dutcher, geologist n charge of the Garden Grove subdistrict office, and under the eneral direction of Fred Kunkel, district geologist for California.

Previous Work and Related Studies

The Bloomington-Colton area in the Upper Santa Ana Valley is within the larger areas studied by the California Water Resources Board (1951); the California Department of Water Resources (Eckis, 1934; Gleason, 1947; and Post, 1928); and the U.S. Geological Survey (Mitchner and Garrett, 1963); Lippincott, 1902; and Mendenhall, 1905).

The California Department of Water Resources is presently making a study of the Chino basin area to determine suitable water-management practices. In order to avoid duplication of studies by the California Department of Water Resources, the Geological Survey met informally with representatives of the Department to discuss the scope of the Department's program in Chino basin. It was stated that their study would extend over a period of years and would attempt to refine the limits of Chino basin and the hydrologic features of the area. They, however, plan no test drilling or geophysical studies necessary to determine the hydrologic boundaries or conditions for the area north of the Jurupa Mountains, which in the Bloomington-Colton area are critical in providing answers to the problems of the San Bernardino County Flood Control District.

PRELIMINARY FINDINGS

A test-well drilling program was recently completed in the Bloomington-Colton area, financed by the Chino Basin Municipal, Orange County, San Bernardino Valley Municipal, and Western Municipal Water Districts. The drilling was undertaken to obtain additional hydrologic data in the area so that the source of ground water, direction of ground-water flow, and positions of ground-water barriers could be determined.

At the time the local agencies decided to undertake the test-drilling program, the U.S. Geological Survey was making the preliminary study of the area in cooperation with the San Bernardino County Flood Control District to determine the scope of the work needed to answer the problems of source of ground water and ground-water movement in the Bloomington-Colton area. To assure that data from the test wells would be adequate for the studies by the Geological Survey, the local agencies requested the Survey to participate in the program and to provide technical assistance.

Test-Drilling Program

The test-drilling program was a cooperative effort which involved work by several public agencies. The Geological Survey logged the wells and supplied technical guidance concerning their location, depth, and development; the Western Municipal Water District contracted with the United Geophysical Corp. for the drilling and the City of Riverside supervised the progress of the drilling rig and had its service department pump and develop the completed wells; the San Bernardino County Flood Control District surveyed the altitudes of the measuring points; the California Department of Water Resources analyzed the samples of water which were bailed from the wells by the Survey; and the San Bernardino Valley Municipal Water District assisted in collecting water samples from several wells. This cooperative effort has enabled the program to proceed rapidly and at a minimum expense to each of the agencies involved.

Location of Test Wells

The 14 test wells are in Rialto-Colton, Riverside, and Chino basins in the Bloomington-Colton area (fig. 2). The data for the test wells are summarized in the following table.

[redacted] drilled in the Bloomington-Colton area, San Bernardino County, California

Well number	Test well number	Depth (feet)	Altitude[1]	Depth to water (feet)	Date of measurement	Altitude of water surface[2]	Basin
1s/5w-26B1	1	275	1044.34	231.46	4- 9-64	812.86	Chino
1s/5w-27J1	2	a244	1007.10	185.30	4-30-64	821.38	Riverside
1s/5W-23F1	3	296	1082.20	250.00	4- 9-64	832.20	Chino
1s/5W-23C1	4	310	1098.[illegible]3	261.15	4- 9-64	835.38	Do.
1s/5W-13G1	5	329	1163.14	313.60	4- 9-64	844.54	Do.
1s/4W-19M1	6	251	1041.03	191.46	4- 9-64	849.57	Riverside
1s/4W-19D1	7	270	1061.51	216.29	4- 9-64	845.22	Transition area between basins
1s/5W-13M1	8	345	1134.66	294.52	4- 9-64	839.54	Chino
1s/4W-19K1	9	205	1005.51	149.13	4- 9-64	856.38	Rialto-Colton
1s/4W-19H1	10	222	1014.47	154.70	4- 9-64	859.77	Do.
1s/4W-17R1	11	210	1013.70	143.68	4- 9-64	870.02	Do.
1s/4W-17G1	12	231	1047.65	176.01	4- 9-64	871.64	Do.
1s/4W-16P4	13	208.5	1016.80	145.60	4- 9-64	871.20	Do.
1s/5W-11E1	17	344.5	1241.41	291	4- 9-64	950.41	Do.

1. The altitude given is the altitude of the reference point above mean sea level.
2. The altitude given is the altitude of the water surface above mean sea level.
a. Casing installed to a depth of 244 feet in 6¼-inch hole drilled to 345 feet.

Description of Wells

The wells were drilled by the rotary method. A field lithologic log of the formations penetrated was made by J. K. Moyle, Jr., who examined the cuttings and collected ditch samples. An electric log of each well was made by BZM, Inc., and reproductions of the electric logs are available for examination at the offices of the Western Municipal Water District in Riverside and the Geological Survey in Long Beach. A detailed lithologic log of each test well will be prepared by the Geological Survey during the course of the investigation of ground-water movement in the area. The test holes were 4 3/4 to 6 1/4 inches in diameter and were cased with a 2-inch pipe.

Development and Completion of Wells

When completed, the wells were logged with an electric logger, and a 2-inch pipe, having about 21 feet of sawed perforations on the bottom end, was installed. To develop the well clear water was circulated by pumping with the mud pump in an attempt to remove the drilling mud; only commercially prepared mud was used during drilling. Generally about 2,400 gallons of clear water was circulated, but at a few wells more clear water was needed.

A compressor was then used to pump the wells for several hours. Although this method appeared at first to be successful and many wells "cleared up" and seemed to develop in a satisfactory manner, water-level measurements made later at several of the wells indicated that further development work was needed. Then a $1\frac{1}{2}$-inch bailer was constructed and used to clean the wells of all drilling mud. Bailing was continued until a stable water level was obtained, and a clear sample of water was collected for chemical analysis by the California Department of Water Resources.

Water-Level-Contour Map

Figure 2 is a map showing water-level contours in the Bloomington-Colton area. Measurements of water levels in most previously existing wells were made by several agencies during October 1963. These measurements, together with the water-level measurements made later at the test wells, were used for constructing the contours. Some mechanical work and changes at several existing wells in critical areas made it possible to obtain water-level measurements where information previously was lacking.

Previous ground-water studies in the area show the existence of the Rialto-Colton fault. Its position is shown on several published maps, either as one continuous fault across the entire valley, or as one fault ending in the valley near Meridian Avenue northwest of Colton. However, on the basis of data from the completed test wells, it now appears that the Rialto-Colton fault may consist of two main branches which strike across the valley, about as shown on previous maps, but that these two branches are offset nearly half a mile in the vicinity of Meridian Avenue (fig. 2). Water-level measurements in wells are not available in Riverside basin between the Rialto-Colton fault and Slover Mountain and between wells 1S/4W-19E1 (test well 6) and well 1S/4W-29H2. Therefore, the exact position and effectiveness of the southern branch of the Rialto-Colton fault in that area cannot now be determined.

The results of the test drilling do not demonstrate conclusively the offset of the Rialto-Colton fault. However, the water-level contours (fig. 2), as drawn, are based on the water-level control provided by the test wells and other wells in the area, and indicate clearly the direction of ground-water movement in the area and indicate less clearly the offset of the north and south branches of the Rialto-Colton fault. On the basis of water levels in the test wells (p. 16), wells 1S/5W-13G1, 13M1, 23C1, 23F1, and 28H1 (test wells 1, 3-5, and 8) are in Chino basin; wells 1S/4W-19E1 and 1S/5W-27J1 (test wells 2 and 6) are in Riverside basin; wells 1S/4W-16P4, 17G1, 17R1, 19H1, 19K1, and 1S/5W-11E1 (test wells 9-13 and 17) are in Rialto-Colton basin; and well 1S/4W-19D1 (test well 7) is near the probable ends of the north and south branches of the Rialto-Colton fault.

Source and Movement of Ground Water

In the northern and central parts of Rialto-Colton basin, ground water moves generally southeastward toward the Santa Ana River. In the southern part, ground water moves toward Colton and from Bunker Hill basin. In Riverside basin, ground water moves generally southward toward Grand Terrace or southwestward toward the Santa Ana River. In Chino basin, ground water moves generally westward along the north side of the Jurupa Mountains. A major part of the drilling program was the determination of the source of ground water and its movement, with particular reference to recharge from spreading basins in the area. Of particular importance were (1) the determination of the movement of ground water westward into Riverside and Chino basins from Rialto-Colton basin, and (2) the determination of whether ground water moves from Colton Narrows through Riverside basin into Chino basin and continues westward beyond the northeast end of the Jurupa Mountains, or moves as underflow beneath the Santa Ana River east of the Jurupa Mountains.

I can't believe that much water from the River gets to the water table yet not contoured - water infiltrated from the R. must make out as underflow!

The water-level contours (fig. 2) show that during 1963-64 ground water recharged from the Santa Ana River at Colton Narrows did not move into Chino basin past the ground-water divide (ridge) that extends from the northeast end of the Jurupa Mountains to the Rialto-Colton fault and northward into Rialto-Colton basin beyond the fault. The water-level contours also indicate that outflow from that part of the Rialto-Colton basin east of the ground-water divide, as drawn on figure 2, moves southward to the Santa Ana River east of Slover Mountain and La Loma Hills or west of Slover Mountain.

> WL is 100' below river!

From the contours it looks to me like all the water from the area underlying the narrows, and part from the Rialto-Colton Basin, ends up at Highgrove — pa

STUDIES TO BE COMPLETED

Analysis of Existing Water-Level Records

When the preliminary studies in the Bloomington-Colton area were started, it was believed possible that the source of some of the ground-water inflow to that part of Chino basin north of the Jurupa Mountains might be from ground-water outflow from Colton Narrows (fig. 2) or, downstream from the Narrows, from flow in the Santa Ana River. Data from the test wells recently completed, however, indicate that all ground-water inflow to Chino basin is derived from the north and central parts of Rialto-Colton basin.

During the study an examination will be made of all available records of water levels in wells to determine whether the present pattern of ground-water flow through the area has persisted during the past. It is particularly important to determine whether the movement of ground water during periods of high water levels in wells has been the same as is shown by the water-level contour map for 1963-64 (fig. 2). That map shows the general conditions during the autumn season for a year of record- or near-record-low water levels.

A map showing water-level contours for April 1964 will also be compiled. Only the wells which penetrate the principal water-bearing zones in the older alluvium of Pleistocene age (Dutcher and Garrett, 1963, p. 29) will be used, except in Colton Narrows where water levels in shallow wells which penetrate the younger alluvium of Recent age (Dutcher and Garrett, 1963, p. 25) will be used to draw water-level contours for the shallow zone. Thus, two sets of contours must be shown along the Santa Ana River in Colton Narrows and for a short distance downstream.

Possible Need for Estimating Inflow to Chino Basin

If the water-level studies indicate that ground-water inflow to Chino basin has not been from Colton Narrows or the vicinity of the river, it will not be necessary to make quantitative estimates of inflow to Chino basin during the scheduled studies. If, on the other hand, the studies indicate that such inflow has occurred during past years, the San Bernardino County Flood Control District reportedly will desire to have the Geological Survey complete the studies by making quantitative estimates of that inflow.

Estimates could be made of the underflow passing through the permeable deposits along a section extending from the northeast end of the Jurupa Mountains north to the small buried bedrock hill in Chino basin on the west side of the Rialto-Colton fault and east of Fontana (fig. 2). These estimates could be made by using data from geologic studies and pumping tests, and water levels in wells. Data from existing wells would not be adequate to complete the quantitative estimates of underflow, however, and it would probably be necessary to drill at least one deep test well, complete seismic explorations, and do other geophysical work to provide additional data and information. The possible costs of completing such studies were not estimated--if quantitative estimates of underflow are needed, the cost of the studies, including the drilling of needed deep test wells and the seismic explorations, should be estimated before the scope of the project is expanded.

Examination of Cuttings from Drill Holes

During the test-drilling program bore-hole cuttings from the 14 test wells were collected by the Geological Survey and examined in the field. These cuttings will be studied in the laboratory and detailed lithologic logs of each test well will be prepared during the investigation.

Geologic and Chemical-Quality-of-Water Studies

During the remaining period of investigation a geologic map will be compiled from existing mapping and new information. This map will show the location of known and postulated faults and ground-water barriers, consolidated rocks, and the water-bearing deposits.

Water samples were bailed from the test wells by the Geological Survey and were analyzed by the California Department of Water Resources. The results of these analyses will be tabulated in the final report and they will be studied to determine if they support the hydrologic findings concerning the source and movement of the ground water in the area.

UNANSWERED PROBLEMS

Several important ground-water problems in the Bloomington-Colton area remain unanswered, but these are beyond the scope of the present study. Probably the most critical questions of concern to water users in the area are, as follows: (1) Have all ground-water barriers been mapped or do others exist which have not yet been discovered; (2) what is the annual quantity of ground-water inflow to Rialto-Colton basin from the north; and (3) how much ground water annually enters Rialto-Colton basin as underflow across the San Jacinto fault north of Warm Creek?

Problems of ground-water recharge, who benefits from recharge, and where the recharge goes, are directly related to these questions. Based on the water-level record for well 1S/4W-7C1, it appears likely that a ground-water barrier (presumed to be a fault) may strike northwest from the San Jacinto fault near Warm Creek and pass between wells 1S/4W-7C1 and 1S/5W-2K1. Additional test wells and data would be needed to confirm or disprove the existence of this possible barrier and to answer questions concerning the quantities of ground-water inflow and outflow.

NEED FOR ADDITIONAL DATA AND TEST WELLS

An important part of the scope of the preliminary study of the Bloomington-Colton area was to determine the need and select sites for test wells. Because the local water agencies contracted to drill 14 test wells during the preliminary studies, additional data and wells will not be needed at this time. However, if it is determined, during the investigation of historic conditions of groundwater movement through the area, that inflow to Chino basin from Colton Narrows has occurred during previous years, the Geological Survey will discuss with the San Bernardino County Flood Control District the possible need for deep test wells for use in making quantitative estimates of that inflow. Data from geophysical explorations may also be required if quantitative estimates of inflow are desired.

REFERENCES

California Water Resources Board, 1951, Water resources of California Bull. 1-1956, Santa Ana River Investigation: Bull. 15.

Dutcher, L. C., and Garrett, A. A., 1963, Geologic and hydrologic features of the San Bernardino area, California, with special reference to underflow across the San Jacinto fault: U.S. Geol. Survey Water-Supply Paper 1419, 114 p., 19 pls., 7 figs.

Eckis, Rollin, 1934, Geology and ground-water storage capacity of valley fill, South Coastal Basin Investigation: California Dept. Pub. Works, Div. Water Res. Bull. 45, 273 p.

Garrett, A. A., and Thomasson, H. G., Jr., 1949, Ground-water outflow from the Chino basin, California, and the controlling geologic and hydrologic conditions: U.S. Geol. Survey open-file report, 143 p., 19 figs.

Gleason, G. B., 1947, South coastal basin investigation, overdraft on ground-water basins: California Dept. Pub. Works, Div. Water Res. Bull. 53, 256 p.

Ippincott, J. B., 1902, Development and application of water near San Bernardino, Colton, and Riverside, California, pt. 1: U.S. Geol. Survey Water-Supply Paper 59, 95 p.

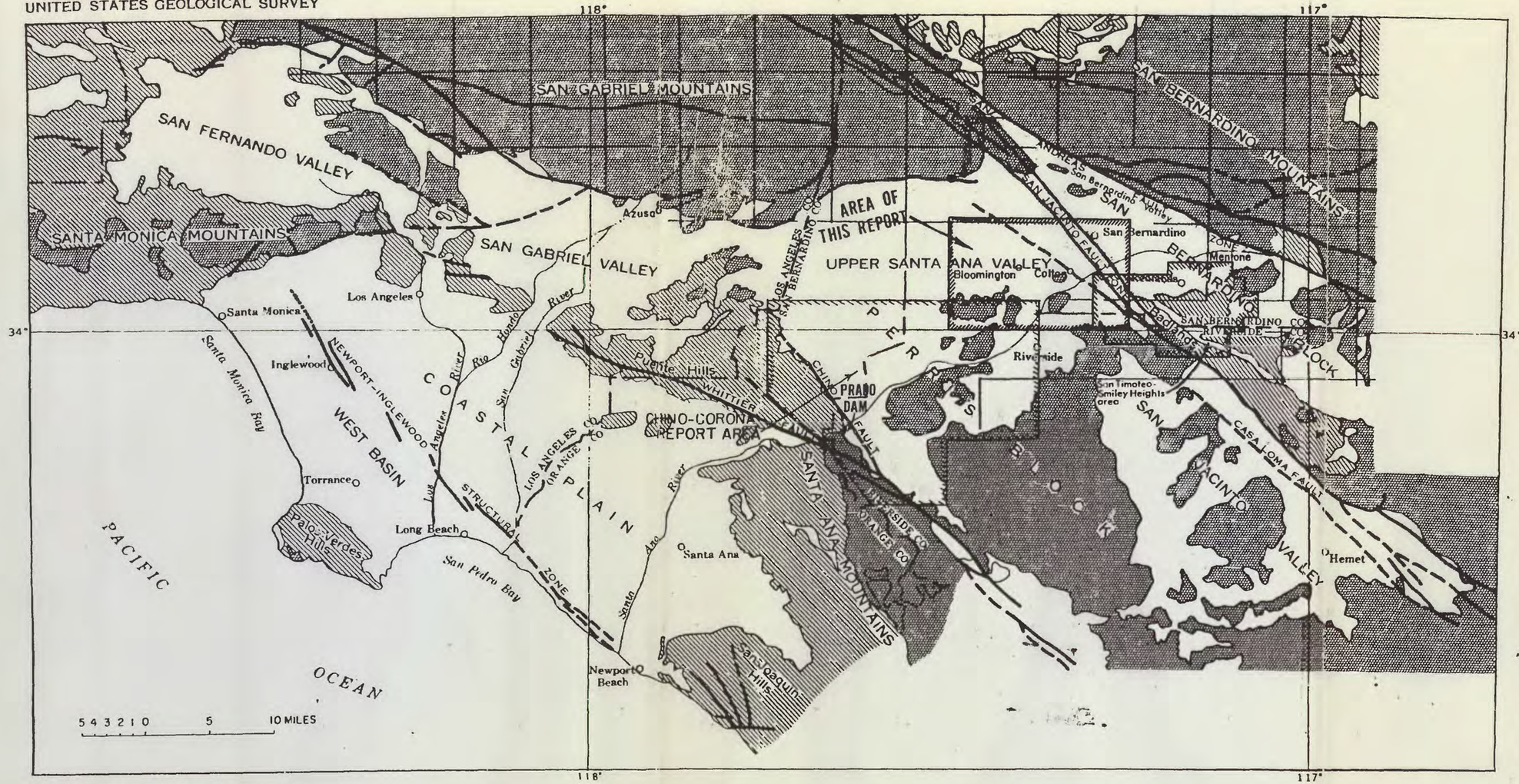
Mendenhall, W. C., 1905, The hydrology of San Bernardino Valley, California: U.S. Geol. Survey Water-Supply Paper 142, 124 p.

West, W. S., 1928, Santa Ana investigation: California Dept. Pub. Works, Div. Water Res. Bull. 19, [illegible] p.

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

65-48

FIGURE 1



Base map after Dutcher and Garrett (1963, pl. 2)

EXPLANATION

Alluvium and associated deposits of Recent or Pleistocene age

Sedimentary rocks of marine origin; largely of Tertiary age but in part of Cretaceous or Triassic age

Crystalline and metamorphic rocks of Jurassic or greater age; some volcanic rocks of Tertiary age

Contact

Fault
Dashed where inferred; dotted where concealed

Boundary of project area

THE SOUTH COASTAL BASIN IN THE LOS ANGELES AREA, CALIFORNIA

Showing generalized geology and extent of the Bloomington-Colton area