INTRODUCTION

The Duncan-Virden Valley basin includes about 950 square miles in eastern Arizona and western New Mexico, about 180 miles east of Phoenix. It is bounded on the north by the Big Lue Mountains, on the east by the Summit Mountains and Black Mountain, on the south by Lordsburg Mesa and the Summit Hills, and on the west by the Peloncillo Mountains. The basin is drained by the Gila River, which enters the basin from the southeast and exits in the northwest. The Town of Duncan, Arizona, is the largest community in the basin, and is centrally located. Other communities include Virden, New Mexico, and Franklin and Sheldon, Arizona. The major industries in the basin are farming and ranching. In 1987 approximately 5,000-6,000 acres were in cultivation in the basin; about 1750 acres in New Mexico, and the balance in Arizona.

Precipitation in the Duncan-Virden Valley basin averages about 10 inches per year, and is probably greater at higher elevations in the mountains that surround the basin. Most of the precipitation occurs during the months of July, August and September. Average daily maximum temperatures for the basin are 59°F in January and 95°F in July; average daily minimum temperatures are 23°F in January and 63°F in July. Extremes of -2°F in December and January and 109°F in June and July have been recorded (Sellers & others, 1985, p. 88, 91, 100, 103, 112, 132).

Irrigation in the Duncan-Virden Valley basin began in the 1870's with the diversion of surface water from the Gila River. Like most surface water supplies in the western United States, the flow of the Gila River is insufficient to meet irrigation needs in times of drought, so in 1935 wells were drilled to provide supplementary water (Halpenny & others, 1946, p. 2). In 1987 approximately 6,000 acre-feet of water were pumped in the basin (see table on sheet 2).

The New Mexico part of the Duncan-Virden Valley basin is comprised of two "underground water basins" declared by the Office of the State Engineer of New Mexico. These are the Gila-San Francisco and Virden Valley underground water basins. Both groundwater and surface water are subject to prior appropriation in New Mexico and in these two underground water basins, no new uses of water are allowed. In the Arizona part of the basin surface water is subject to prior appropriation and groundwater use is not regulated, except in that it must be put to beneficial use. Diversions of surface water from the main stream of the Gila River in both the Arizona and New Mexico parts of the Duncan-Virden Valley basin are administered by the Gila Water Commissioner in Safford, Arizona, pursuant to the Globe Equity Number 59 Decree. Diversions of groundwater in the New Mexico part of the Duncan-Virden Valley basin (the Gila-San Francisco and Virden Valley underground water basins) are administered by the Gila-San Francisco Water Master in Deming, New Mexico, pursuant to Cause No. 16290, Sixth Judicial District, State of New Mexico.

OCCURRENCE AND MOVEMENT OF GROUNDWATER

In the Duncan-Virden Valley basin three sedimentary units which comprise the water-bearing units have been identified. In ascending order they are: volcanic conglomerate, older basin fill, and tuff; the Gila Formation; and younger alluvial deposits (Morrison, 1965). The lowest unit outcrops along the basin margins and its greatest thickness in surface exposure is 250 feet. A well in T.10S., R.31E. (AZ) penetrated 610 feet of conglomerate which may be this unit (Morrison, 1965, p. 3).

The Gila Formation consists of a lower zone of fanglomerate and an upper zone of mostly unconsolidated or poorly consolidated sand and silt with some gravel (Morrison, 1965, p. 4). A number of wells are completed in this unit, but a paucity of driller's logs and shallow total depths of wells preclude anything but speculation of the unit's thickness. Halpenny and others (1946, p. 3) identified an "older alluvial fill" in the basin which is likely the Gila Formation. They estimated the thickness may exceed 1,000 feet based on deep drillings in the adjacent Safford basin. Yields from wells completed in the Gila Formation range from a few gallons per minute to nearly 200 gallons per minute.

The younger alluvial deposits constitute the principal source of groundwater in the basin. The unit consists of gravel and sand and is usually underlain by clay. These deposits vary between 1 foot and 170 feet thick. In 1984, measured discharges from wells completed in this unit ranged from 348 to 2,350 gallons per minute. Properly constructed wells completed in the younger alluvial deposits should be capable of yields in this range. In 1987, depth to water in all three sedimentary units ranged from 3 feet below land surface southeast of Virden to 600 feet below land surface in T.10S., R.31E. (AZ).

The bedrock areas that surround the Duncan-Virden Valley basin are composed primarily of andesitic and rhyolitic volcanics and some granites. Many successful wells have been completed, and numerous springs issue where these rocks are sufficiently weathered, fractured or faulted. Nearly all the wells and springs in the bedrock areas are on the eastern flank of the basin. Successful wells have also been completed in stream terraces overlying the Gila Formation on the eastern flank of the basin. The potential exists to develop successful wells in the Gila Formation by drilling through these terraces. Due to the paucity of driller's logs, it is not readily apparent that any such wells have been completed, except close to the Gila River. Yields are only a few gallons per minute in the wells and springs in the bedrock and terraces, and depth to water in the wells is usually less than 100 feet below land surface.

Water from the Gila River enters the groundwater system between the eastern basin boundary and Virden, mixes with water entering the basin from Lordsburg Mesa to the south, and then flows northwest, roughly paralleling the Gila River. The shape of the water-level contours also indicates there is flow from the mountains on the eastern side of the basin towards the Gila River, suggesting a source of recharge. Some distortion is evident in the water-level contours south of Duncan. Surface water is diverted from the Gila River and applied in this area, and the contours probably reflect mounding of excess irrigation water. Other irregularities in the water-level contours likely result from local groundwater pumpage and/or poor land-surface datum control. No significant changes in water levels have been observed in wells in the Duncan-Virden Valley basin since measurements began in 1939.

SELECTED REFERENCES

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Halpenny, L. C., Babcock, H. M., Morrison, R. B., Hem, J.D., 1946, Ground-water resources of the Duncan Basin, Arizona: U.S. Geological Survey open-file report (unnumbered), 21 p.

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Ratte, J. C., Hedlund, D. C., 1981, Geologic Map of the Hells Hole further planning area (RARE II), Greenlee County, Arizona, and Grant County, New Mexico: U.S. Geological Survey miscellaneous field studies, Map MF-1344A, 1 sheet.

Sellers, W. D., Hill, R. H., Sanderson-Rae, Margaret, 1985, Arizona Climate, The First Hundred Years, 1885-1985: Institute of Atmospheric Physics, University of Arizona, 143 p., 3 figs., 18 tables.

Turner, S. F., and others, 1941, Water resources of Safford and Duncan-Virden Valleys, Arizona and New Mexico: U.S. Geological Survey open-file report (unnumbered), 108 p., 2 pls., 15 figs., 28 tables.

U.S. Environmental Protection Agency, 1976 [1978], Quality criteria for water, U.S. Environmental Protection Agency publication, 256 p.

_____, 1977a, National interim primary drinking water regulations, U.S. Environmental Protection Agency report; EPA-570/9-76-003, 159 p.

_____, 1977b, National interim secondary drinking water regulations, Federal Register, v. 42, no. 62, March 31, 1977, p. 17143-17147.

Wilson, E. D., Moore, R. T., 1958, Geologic map of Graham and Greenlee Counties, Arizona, with additional data from maps by W. Lindgren, J. M. Boutwell, J. R. Cooper, and C. S. Bromfield: Arizona Bureau of Mines, University of Arizona, 1 sheet.

EXPLANATION

220 / 3740 — WELL IN WHICH WATER WAS MEASURED IN 1987--FIRST number, 220, is depth to water in feet below land surface. Second number, 3740, is the altitude of the water level in feet above mean sea level

4970 — SPRING--Number, 4970, is the altitude of the spring in feet above mean sea level

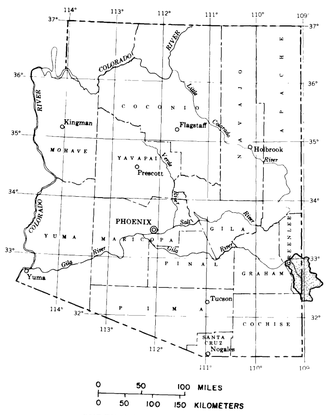
BEDROCK (VOLCANIC, GRANITIC, METAMORPHIC, OR CRYSTALLINE SEDIMENTARY ROCK)--Water may occur in weathered or fractured zones, joint systems, or thin veneer of alluvial or fluvial sediment overlying consolidated rock

WATER-BEARING UNITS (CONGLOMERATE, CLAY, SILT, SAND, GRAVEL)

WATER-LEVEL CONTOUR--Shows approximate altitude of the water level. Contour interval 50 feet datum is mean sea level

DUNCAN-VIRDEN VALLEY BASIN BOUNDARY

ARIZONA-NEW MEXICO STATE BOUNDARY



INDEX MAP SHOWING AREA OF REPORT (SHADED)

For readers who prefer to use metric units rather than inch-pound units, the conversion factors for the terms used in this report are listed below:

METRIC CONVERSION TABLE

Multiply inch-pound unit	By	To obtain metric unit
square mile	2.590	square kilometer
mile	1.609	kilometer
acre	0.4047	square hectometer
acre-foot	0.001283	cubic hectometer
foot	0.3048	meter
gallon per minute	0.06309	liters per second
inches	25.4	millimeters

5 0 5 MILES
5 0 5 10 KILOMETERS

CONTOUR INTERVAL 200 FEET
WITH SUPPLEMENTARY CONTOURS AT 100-FOOT INTERVALS
DATUM IS MEAN SEA LEVEL
SCALE 1:125,000

BASE FROM U.S. GEOLOGICAL SURVEY
CLIFTON, ARIZONA; NEW MEXICO, 1954, REV. 1978, 1:250,000
SILVER CITY, NEW MEXICO; ARIZONA, REV. 1962, 1:250,000

MAPS SHOWING GROUNDWATER CONDITIONS IN THE DUNCAN-VIRDEN VALLEY BASIN GREENLEE AND COCHISE COUNTIES, ARIZONA, AND HIDALGO AND GRANT COUNTIES, NEW MEXICO--1987

BY

W. H. REMICK

These hydrologic maps are available upon request from the Department of Water Resources, Basic Data Section, 2810 South 24th Street, Suite 122, Phoenix, Arizona, 85034. The hydrologic data on which these maps are based are available, for the most part, in computer-printout form and may be consulted at the Department of Water Resources and at the U.S. Geological Survey offices located at: Federal Building, 301 West Congress Street, Tucson, Arizona, and 3738 North 16th Street, Suite E, Phoenix, Arizona.

WATER QUALITY

Groundwater in the Duncan-Virden Valley basin is generally of good quality for most uses. Specific-conductance values determined from chemical analyses of water from wells and spring range from 170 to 3,580 microsiemens per centimeter(µS/cm). Dissolved-solids concentration may be approximated by multiplying specific conductance values by 0.6, which is the approximate ratio of dissolved solids (in mg/L) to specific conductance (in µS/cm). The recommended maximum contaminant level for dissolved solids is 500 mg/L (833 µS/cm), as proposed in the secondary drinking water standards of the U.S. Environmental Protection Agency (1977b, p. 17146, in accordance with the provisions of the Safe Drinking Water Act (Public Law 93-523). Thirty-three of the 108 samples tested exceeded this limit. The wells with analyses that exceeded the dissolved-solids standards are distributed fairly evenly throughout the basin, except for the extreme northern part of the basin where no samples exceeded the standard.

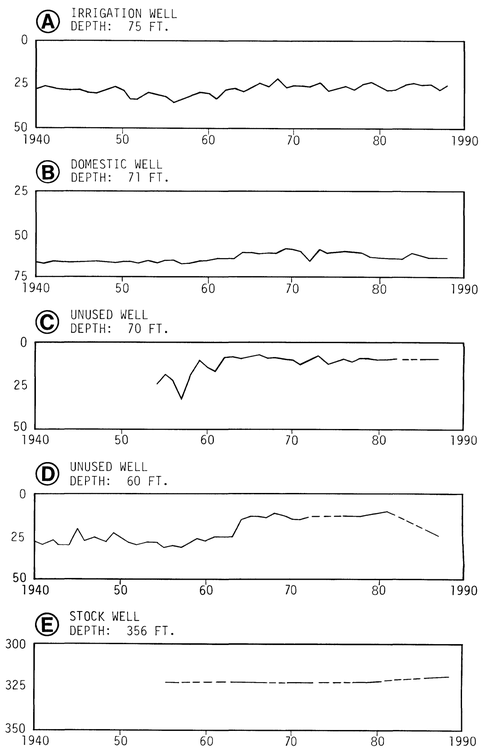
Fluoride concentration in water samples from wells in the Duncan-Virden Valley basin ranged from 0.2 to 7.0 mg/L. The maximum contaminant level for fluoride in public-drinking water supplies differs according to the annual average maximum daily air temperature (Bureau of Water Quality Control, 1978, p. 6). The annual average maximum daily air temperature for the Duncan-Virden Valley basin is about 78°F. Therefore, the maximum contaminant level for fluoride is 1.6 mg/L. Forty-nine of the 108 samples tested contained fluoride in excess of the maximum contaminant level; most occurred in that part of the basin south of Duncan.

ESTIMATED GROUNDWATER PUMPAGE IN THE DUNCAN-VIRDEN VALLEY BASIN

YEAR	PUMPAGE IN THOUSANDS OF ACRE-FEET	YEAR	PUMPAGE IN THOUSANDS OF ACRE-FEET
1935	<0.5	1962	19
1936	<0.5	1963	21
1937	<0.5	1964	22
1938	1	1965	17
1939	1	1966	13
1940	2	1967	14
1941	1	1968	12
1942	2	1969	20
1943	7	1970	18
1944	8	1971	14
1945	6	1972	23
1946	17	1973	17
1947	21	1974	29
1948	21	1975	23
1949	11	1976	28
1950	23	1977	30
1951	33	1978	26
1952	17	1979	16
1953	30	1980	18
1954	27	1981	20
1955	25	1982	16
1956	20	1983	6
1957	20	1984	11
1958	25	1985	7
1959	25	1986	7
1960	9	1987	6
1961	21	TOTAL:	828

HYDROGRAPHS OF THE WATER LEVEL IN SELECTED WELL SHOWN ON THE MAP
(Dashed line indicates inferred water level)

WATER LEVEL, IN FEET, BELOW LAND SURFACE



EXPLANATION

455 / 2.7 — WELL FOR WHICH A WATER SAMPLE WAS COLLECTED IN 1985-88--First number, 455, is specific conductance in microsiemens per centimeter at 25°C (specific conductance is an indication of the dissolved-solids concentration in water). Second number, 2.7, is the fluoride concentration in milligrams per liter

530 / 0.6 — SPRING FOR WHICH A WATER SAMPLE WAS COLLECTED IN 1985-88--First number, 530, is specific conductance in microsiemens per centimeter at 25°C (specific conductance is an indication of the dissolved-solids concentration in water). Second number, 0.6, is the fluoride concentration in milligrams per liter

Ⓐ — WELL FOR WHICH A HYDROGRAPH DEPICTING CHANGES IN DEPTH TO WATER IS SHOWN

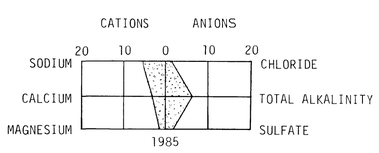
BEDROCK (VOLCANIC, GRANITIC, METAMORPHIC, OR CRYSTALLINE SEDIMENTARY ROCK)--Water may occur in weathered or fractured zones, joint systems, or thin veneer of alluvial or fluvial sediment overlying consolidated rock

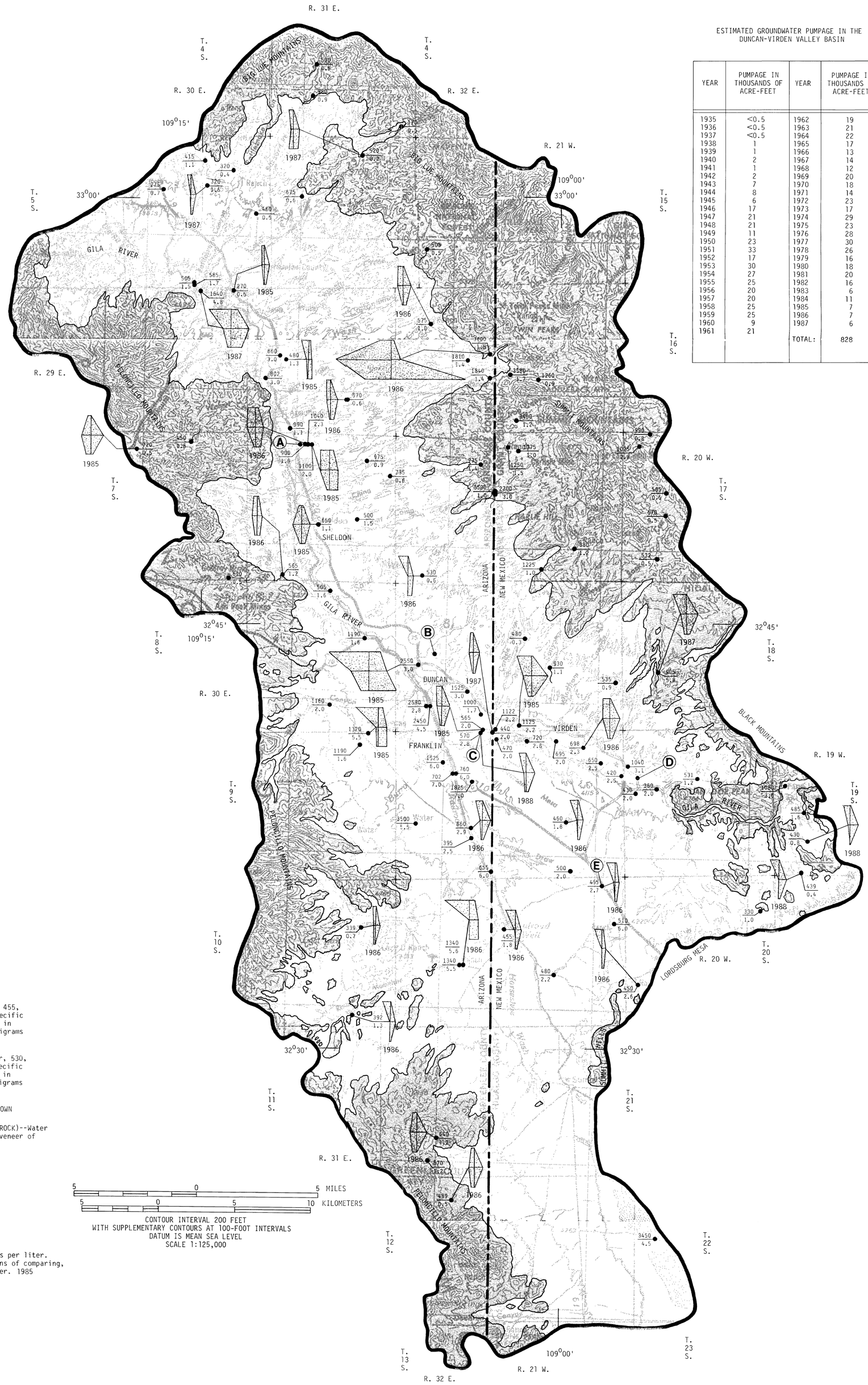
WATER-BEARING UNITS (CONGLOMERATE, CLAY, SILT, SAND, GRAVEL)

DUNCAN-VIRDEN VALLEY BASIN BOUNDARY

ARIZONA-NEW MEXICO STATE BOUNDARY

CHEMICAL QUALITY DIAGRAM--Shows major constituents in milliequivalents per liter. The diagrams are in a variety of shapes and sizes, providing a means of comparing, correlating, and characterizing similar or dissimilar types of water. 1985 below diagram, indicates year in which sample was collected





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