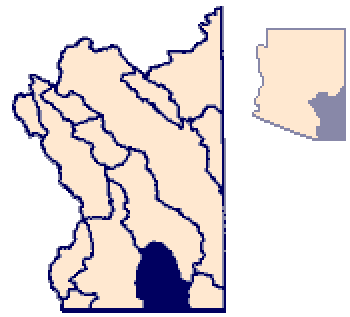
## DOUGLAS BASIN



The Douglas basin is located in southeastern Arizona and contains 750 square miles (Figure 17). The basin is part of a northwest-southeast trending structural trough that extends from the central portion of Aravaipa Canyon to the northeastern section of the State of Sonora, Mexico. The Douglas basin occupies the southern section of the trough and consists of a broad alluvial valley isolated by elongated mountain chains. The basin is bounded on the east by the Swisshelm, Pedrogosa, and Perilla Mountains, on the south by the International Boundary, and on the west by the Mule and Dragoon Mountains. The basin's northern boundary is a series of small unnamed hills which form an arc that extends from near Pearce, Arizona, to the Swisshelm Mountains.

The basin's alluvial valley is about 15 miles wide and 35 miles long. The valley slopes southward, with elevations ranging from 4,350 feet above mean sea level in the hills that form the basin's northern boundary to 3,900 feet above mean sea level along the International Boundary. The adjacent mountains have elevations ranging from 6,390 feet in the Perilla Mountains to 7,185 feet in the Swisshelm Mountains.

The basin is drained by Whitewater Draw which heads in the Chiricahua Mountains in the adjacent Willcox basin. Whitewater Draw flows westward around the north end of the Swisshelm Mountains. At this point, it enters the Douglas basin, then turns southeast towards Mexico. Whitewater Draw is ephemeral over nearly its entire reach in the United States and only flows in response to local rainfall.

Groundwater in the Douglas basin is found in both the basin-fill and in the mountain bedrock. The main aquifer in the basin is the basin-fill sediments, which supplies water to large-capacity irrigation wells. The mountain bedrock provides relatively minor amounts of water from localized sources, usually enough for low-use stock and domestic wells.

Most of the water from the main aquifer is drawn from sand and gravel lenses in the basin-fill alluvium. The presence of a regional water table shows that the sand and gravel layers are interconnected; however, the connections may be indirect or by layers that have different abilities to store and transmit water (Coates and Cushman, 1955). Well yields from the basin-fill range from a few gallons per minute in small-diameter stock and domestic wells to 2,000 gallons per minute in large-capacity irrigation wells (Mann and English, 1980). The amount of recoverable groundwater to 1,200 feet below land surface is estimated to be 32 million acre-feet (Freethey and Anderson, 1986).

Groundwater in the basin-fill is found mostly in unconfined or water-table conditions. Unlike many groundwater basins in southeastern Arizona, the Douglas basin has no well-defined confined aquifer because there is no single, regional confining layer in the basin-fill (Coates and Cushman, 1955); however, interbedded clay and silt layers in the basin-fill do result in both localized, confined conditions and perched water tables (Coates and Cushman, 1955; Mann and English, 1980). Confined conditions, more common in the southern part of the basin, occur in wells drilled between 500 and 1,000 feet deep. Water levels in these wells rise above the regional water table, but don't reach the surface (Coates and Cushman, 1955).

The sedimentary and granitic bedrock provide most of the groundwater found in the mountains because the schist and volcanic rocks are generally non-water-bearing. The water-bearing ability of the bedrock is related to the degree of fracturing or weathering the rock has undergone. Well yields in the bedrock usually range from several gallons per minute up to 50 gallons per minute (Mann and English, 1980); however, highly fractured and cavernous limestone in Bisbee, Arizona, reportedly yields up to several million gallons per day (Coates and Cushman, 1955).

Before groundwater development began in the basin, groundwater moved from recharge areas in the mountains toward the center of the basin and then south towards Mexico. Groundwater pumpage for irrigation, which started in the late 1940's, altered the regional groundwater flow by creating several cones of depression (Mann and English, 1980). The largest cone of depression is located north of Elfrida, Arizona and is centered in the southeast one-quarter of Township 19 South, Range 26 East. This cone has reversed the historic groundwater flow in the area; groundwater currently moves north from the Elfrida area towards the cone's center (Mann and English, 1980).

Water levels in the basin-fill measured in 1990 ranged from 50 feet below land surface to 296 feet below land surface (Arizona Department of Water Resources, 1992). Water levels in 1990 in the cone of depression north of Elfrida ranged from 175 to 291 feet below land surface. From 1966 to 1978, Mann and English (1980) reported water-level declines of up to 97 feet in the cone of depression north of Elfrida. North of McNeal, Arizona, water-level declines of 47 feet were recorded over the same time period (Mann and English, 1980). Water-level declines have occurred since the late 1940's; prior to then, groundwater pumpage was less than recharge and had little impact on basin-wide water levels.

Precipitation in the mountains is the main source of groundwater recharge in the Douglas basin. A small amount of groundwater may enter as underflow through the course of Whitewater Draw and several other ephemeral streams that flow into the basin along its northern boundary. Water-level contours indicate that mountain-front recharge is the main component of recharge. Coates and Cushman (1955) estimated annual mountain-front recharge at 20,000 acre-feet. Very little rainfall on the valley floor is recharged into the basin-fill aquifer because of high evaporation rates and clay and caliche layers in the basin-fill, which impede downward percolation of water. Recharge of irrigation water also may be negligible because of the impermeable clay and caliche layers (Coates and Cushman, 1955). Streambed infiltration along the ephemeral washes in the valley contributes a small amount of recharge to the main aquifer. Total recharge into the basin is estimated to be 22,000 acre-feet per year (Coates and Cushman, 1955; Freethey and Anderson, 1986).

Groundwater is discharged from the basin by pumpage, underflow, stream baseflow, and evapotranspiration. The largest source of basin discharge is groundwater pumpage. From 1950 to 1989, pumpage averaged 77,000 acre-feet per year, and ranged from a low of 32,000 acre-feet per year to a high of 138,000 acre-feet per year (U.S. Geological Survey, 1986; Jeff Tannerly, Arizona Department of Water Resources, oral communication, 1991). Coates and Cushman (1955) estimated the total predevelopment underflow and stream baseflow out of the basin at 3,000 acre-feet per year and evapotranspiration at 19,000 acre-feet per year. Declining water levels caused by groundwater pumpage have reduced underflow, baseflow, and evapotranspiration out of the basin. Harshbarger (1979) estimated that underflow declined from about 1,400 acre-feet in 1952 to about 700 acre-feet in 1978. Current stream baseflow is calculated to be 400 acre-feet per year. Evapotranspiration was estimated to have declined to 8,000 to 13,000 acre-feet per year by 1952 (Coates and Cushman, 1955). Loss of native phreatophytes during extensive land clearing for crop production in the 1960's and 1970's and continued water-level declines have further reduced evapotranspiration to a negligible amount (Harshbarger and Associates, 1979).

Most groundwater pumped in the Douglas basin is used for irrigation. Stock and domestic pumpage is minor except near Douglas, Arizona, where pumpage by the City of Douglas for domestic use is significant. The basin has no surface water supplies and is totally dependent on groundwater for its water needs. Prior to 1910, cattle ranching and the copper smelter at Douglas were the main industries in the basin and water use was minimal. In 1910, the first irrigation wells were drilled. From then until the mid-1940's, pumpage was less than 5,000 acre-feet per year (Coates and Cushman, 1955; U.S. Geological Survey, 1986). Agricultural acreage increased rapidly in the late 1940's and early 1950's, growing from 3,000 acres in 1940, to 19,200 acres in 1960 (White and Childers, 1966). Groundwater pumpage peaked in the early 1970's and steadily has declined since then as farmland has been taken out of production. Groundwater pumpage for 1989 was reported to be 46,000 acre-feet (Jeff Tannerly, Arizona Department of Water Resources, oral communication, 1991).

The Douglas basin has been severely overdrafted since the late 1940's. In 1965, the State Land Commission declared much of the basin's central valley a Critical Groundwater Area due to large water-level declines associated with the severe overdraft conditions. The Commission prohibited drilling new irrigation wells except to replace existing wells. The Critical Groundwater Area became the Douglas Irrigated Non-Expansion Area with the passage of the 1980 Groundwater Code.

The chemical quality of groundwater in the basin is suitable to marginal for most uses. High concentrations of fluorides occur locally, making some water marginal for domestic uses. Total dissolved solids concentrations for samples collected from the main aquifer between 1987 and 1990, ranged from 229 to 630 milligrams per liter (mg/l) and averaged 390 mg/l (Arizona

Department of Water Resources, 1992). The recommended secondary maximum contaminant level for total dissolved solids in drinking water is 500 mg/l (U.S. Environmental Protection Agency, 1988). Fluoride concentrations in the samples collected ranged from 0.3 to 8.5 mg/l and averaged 1.1 mg/l (Arizona Department of Water Resources, 1992). The maximum contaminant level for fluoride in drinking water is 4.0 mg/l.