EFFECTS OF GROUND-WATER DEVELOPMENT IN THE NORTH FORT HOOD AREA, CORYELL COUNTY, TEXAS

By W. M. Sandeen

U.S. GEOLOGICAL SURVEY

Water Resources Investigations Report 83-4074

Prepared in cooperation with the

U.S. ARMY CORPS OF ENGINEERS, FORT WORTH DISTRICT

Austin, Texas

1983

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METRIC CONVERSIONS

Most units of measurement used in this report are inch-pound units. For those readers interested in using the metric system, the inch-pound units may be converted to metric units by the following factors:

From	Multiply by	To obtain
foot	0.3048	meter
foot per day (ft/d)	0.3048	meter per day
foot per year (ft/yr)	0.3048	meter per year
foot squared per day (ft^2/d)	0.0929	meter squared per day
gallon per day (gal/d)	0.003785	cubic meter per day
gallon per minute (gal/min)	0.06308	liter per second
gallon per minute per foot [(gal/min)/ft]	0.207	liter per second per meter
inch	25.4	millimeter
micromho per centimeter at 25° Celsius	1.000	microsiemens per centimeter at 25° Celsius
mile	1.609	kilometer
million gallons per day (Mgal/d)	0.04381	cubic meter per second
square mile	2.590	square kilometer

National Geodetic Vertical Datum of 1929 (NGVD of 1929): A geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called mean sea level.

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SUMMARY

The U.S. Army Corps of Engineers is studying the adequacy of the existing ground-water supplies of North Fort Hood, located in Coryell County in central Texas and an important part of the U.S. Army's Fort Hood Military Reservation. The U.S. Geological Survey was requested to compile the available ground-water data, collect additional data, and assess the effects of the long-term development of ground water in the North Fort Hood area.

Nearly all ground water in the North Fort Hood area is withdrawn from the Hensell and Hosston Members of the Travis Peak Formation. The total average annual rates of ground-water withdrawals, mostly for public supply, has steadily increased from nearly 0.5 million gallons per day during 1955 to more than 1.5 million gallons per day during 1980.

The principal effect of the long-term development of ground water in the area has been a large decline of water levels in wells. The water level in a well near North Fort Hood declined from a depth of 100 feet during 1943 to nearly 480 feet during 1982. The water level in a well at Gatesville was above ground level during 1898. A nearby well had a water level of 476 feet below land surface during 1982. The long-term average of water-level declines for wells in the area ranges from 8 to more than 9 feet per year.

The historical confined (artesian) conditions of the principal aquifer have changed to water-table conditions in some areas as the artesian head drops below the base of the confining layer due to pumping. The greater storage property of the unconfined system will decrease the rate of water-level declines. However, well yields will continue to decrease in relation to the general decline of hydraulic head in the aquifer.

The ground water in the area is slightly saline and concentrations of some constituents generally exceed chemical-quality limits set by the U.S. Environmental Protection Agency for public water supplies. The historical chemical changes in the ground water generally are insignificant and appear unrelated to the large declines of water levels in wells of the area.

INTRODUCTION

North Fort Hood is located in Coryell County approximately 30 miles southwest of Waco, Texas (fig. 1). It is an important part of Fort Hood which is the U.S. Army's largest armor training center. Fort Hood has facilities for more than 176,000 military and non-military personnel. (See fig. 1 for areal extent of Fort Hood.)

The principal water supply of Fort Hood is Lake Belton on the Leon River (fig. 1). The water-supply lines have not been extended to North Fort Hood, which is the training center for Army National Guard and Reserve units and quarters as many as 10,000 personnel in barracks and tents for about 9 months during the year. The present water supply for North Fort Hood is ground water in the area, which generally is chemically inferior to water from Lake Belton.

The U.S. Army Corps of Engineers, Fort Worth District, is studying the long-term availability of the existing ground-water supplies at North Fort Hood. In connection with this study, the Corps asked the U.S. Geological Survey to compile the available ground-water data, to collect data on current conditions, and to assess the effects of ground-water development in the vicinity of North Fort Hood. These items are presented in this report.

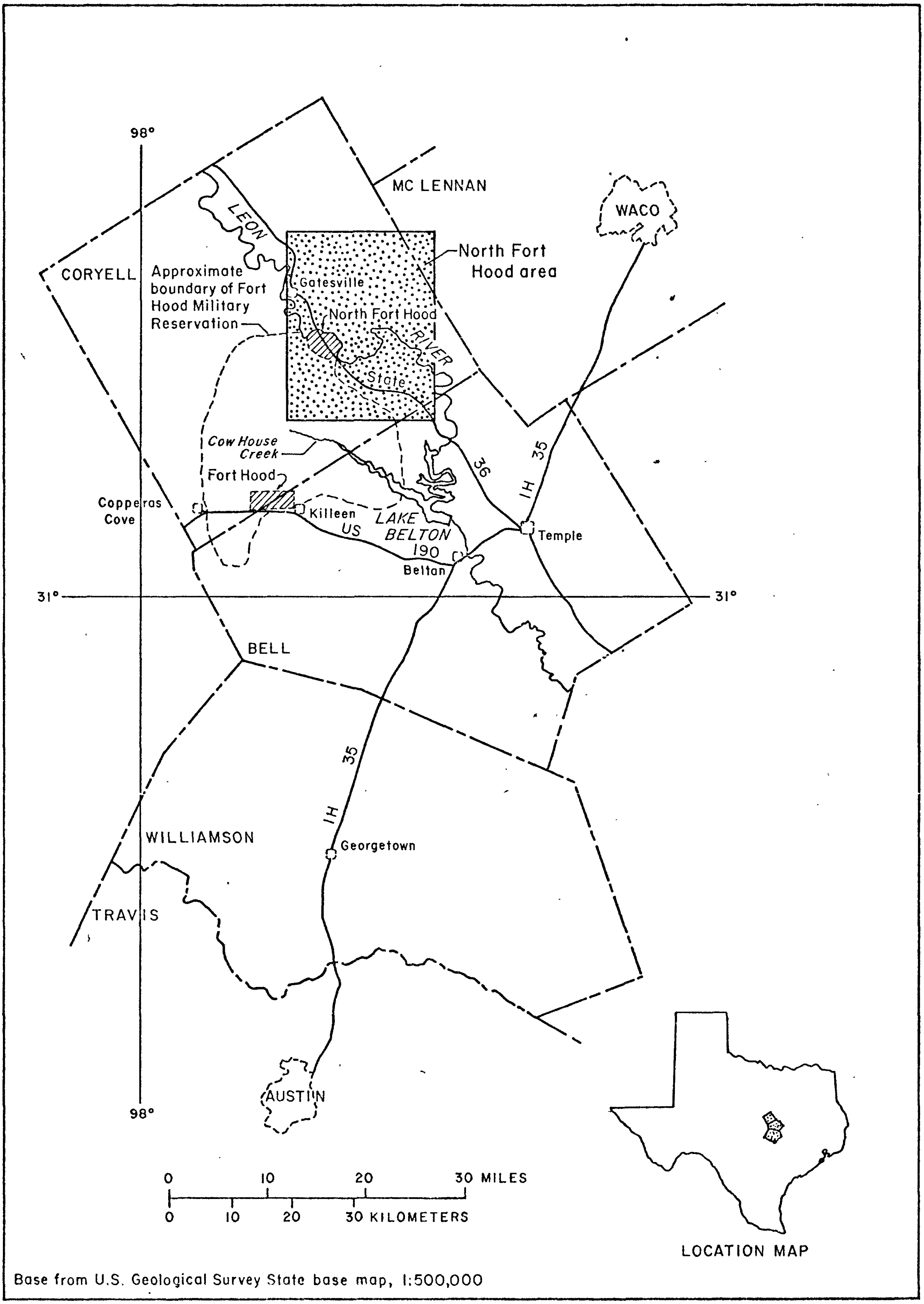

Figure 1.-Location of the North Fort Hood area.

Data collected during September-November 1982 provided important information for the study. Additional data and information were compiled from published sources listed in the references and from data files of the Geological Survey and Texas Department of Water Resources. To determine the decline of water levels in wells and possible changes in the chemical quality of water due to the historical ground-water withdrawals in the area, the following ground-water data were collected and compiled:

(1) Inventory of 37 wells, most of which were public-supply, large-capacity wells;

(2) Water samples (for chemical analysis) from 14 wells and historical chemical analyses for 33 wells;

(3) Records of ground-water withdrawals;

(4) Measurements of water levels in wells; and

(5) Records of drillers' logs for 28 wells (table 7, supplemental information).

Water-level measurements and aquifer-test information for wells that are still in use at North Fort Hood were obtained from Rose (1943). Historical water-level measurements were obtained from the regional report by Klemt, Perkins, and Alvarez (1975), who studied the Travis Peak Formation of central Texas. Historical ground-water pumpage by the City of Gatesville was obtained from Sundstrom, Broadhurst, and Dwyer (1947).

The well-numbering system used in this report is the system adopted by the Texas Department of Water Resources for use throughout the State. Under this system, each 1-degree quadrangle in the State is given a number consisting of two digits. These are the first two digits in the well number. Each 1-degree quadrangle is divided into 7-1/2-minute quadrangles that are given a two-digit number from 01 to 64. These are the third and fourth digits of the well number. Each 7-1/2-minute quadrangle is subdivided into 2-1/2-minute quadrangles and given a single-digit number from 1 to 9. This is the fifth digit of the well number. Each well within a 2-1/2-minute quadrangle is given a two-digit number in the order in which it was inventoried. These are the last two digits of the well number. The well location on a map is shown by listing only the last three digits of the well number adjacent to the well location. The second two digits are shown in the northwest corner of each 7-1/2-minute quadrangle, and the first two digits are shown by the large double-line numbers. In addition to the seven-digit well number, a two-letter prefix (HB) is used to identify Coryell County.

The Corps of Engineers, Fort Worth District, drilled two test wells at North Fort Hood to obtain stratigraphic data. Information on these and other wells were supplied by the Corps of Engineers. Other data on wells and ground-water withdrawals were supplied by officials of the Fort Hood Military Reservation and the City of Gatesville.

DESCRIPTION OF NORTH FORT HOOD AREA

The North Fort Hood area, referred to in this report as the project area, consists of about 240 square miles in central Texas (fig. 1). The area includes several communities and institutions, which are all in close proximity to North Fort Hood and obtain water from the same ground-water system as North Fort Hood.

The city of Gatesville and the small communities of Flat, Fort Gates, Mountain, The Grove, and Oglesby are in the project area. Also included are the Texas Department of Corrections institutions of Gatesville, Hilltop, and Mountain View. These communities are located in figure 2, which includes the location of wells and test holes in the North Fort Hood area. The estimated permanent population of the project area during 1982 was 10,000. The population may increase to as many as 20,000 on a seasonal basis.

The North Fort Hood area is part of the Lampasas Cut Plains of the Grand Prairie physiographic province (Hill, 1901). Altitude of the land surface ranges from about 600 to about 1,050 feet above NGVD of 1929. The lowest altitudes occur along the Leon River in the eastern part of the area, and the highest occur at Mountain community and Mountain View Unit in the northwestern part of the area.

The climate in the North Fort Hood area generally may be characterized by long, hot summers and short, mild winters. The average annual precipitation at Gatesville is nearly 32 inches (Klemt, Perkins, and Alvarez, 1975, p. 3).

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GEOLOGY OF PRINCIPAL AQUIFER SYSTEM

The principal aquifer system in the North Fort Hood area is the Travis Peak Formation of the Trinity Group of Early Cretaceous (Comanchean) age. The Travis Peak Formation crops out in the counties adjacent to and west of Coryell County, generally more than 35 miles from North Fort Hood. The formation is deposited unconformably upon a highly irregular surface of Pennsylvanian (Strawn Group) age. The geologic formations exposed at the surface of the North Fort Hood area are rocks of the Fredericksburg Group and the underlying Paluxy and Glen Rose Formations of the Trinity Group, all of which yield little or no water in the project area. The lithologic and hydrologic characteristics of the geologic units in the North Fort Hood area are shown in table 1.

On a regional basis, the Travis Peak Formation generally is composed of an upper sand unit, a middle shale unit, and a lower sandstone unit. In this report, the nomenclature of the three members of the Travis Peak Formation follows the usage of Klemt, Perkins, and Alvarez (1975), which differs from the usage of the U.S. Geological Survey (see table 1). The upper unit, termed the Hensell Member and locally called the "first Trinity sand," consists of fine to coarse grained sand with some sandy clay and sandy limestone. The middle unit is predominantly a shale called the Pearsall Member, which grades into limestone and shale units in downdip areas east of and outside the project area. The lower unit, the Hosston Member, consists of a conglomerate, fine to coarse grained sandstone, and some sandy and calcareous shales. The Hosston Member, locally called the "second Trinity sand," grades into a conglomerate of limestone and dolomite pebbles in the downdip direction outside the project area.

Table 1.--Lithology thickness and water-yielding characteristics of the geologic units

(Modified from Klemt, Perkins, and Alvarez, 1975)

System	Series	Group	Stratigraphic unit	Lithology thickness and water-yielding characteristics
Cretaceous	Comanchean	Fredericksburg	Edwards Limestone	Hard fossiliferous limestone; bioherms, shales, and dolomite. Not known to yield water in area. Maximum thickness in Coryell County is 50 feet.
			Comanche Peak Formation	Limestone and limy shale. Not known to yield water in area. Maximum thickness of Comanche Peak and Walnut Formations, undifferentiated, in Coryell County is 250 feet.
			Walnut Formation	Shale and calcareous shale. Not known to yield water in area
		Trinity	Paluxy Formation	Paluxy Formation: Fine- to medium-grained sandstone, sandy and calcareous shale, pyrite, and iron nodules. May yield small quantities of water. Maximum thickness in Coryell County is 50 feet.
			Glen Rose Formation	Glen Rose Formation: Limestone, shale, and anhydrite. Locally may yield small quantities of water. Maximum thickness in Coryell County is 450 feet.
			Travis Peak Formation 2/	Hensell Member 1/: Fine to coarse sand, sandy clay, and sandy limestone; called "first Trinity sand." Yields small to large quantities of water. Maximum thickness in Coryell County is 100 feet.
				Pearsall Member 3/: Shale, interbedded with sand; changes facies in places, almost entirely calcareous in some areas. Yields little or no water. Maximum thickness in Coryell County is 80 feet.
				Hosston Member 1/3/: Conglomerate, fine- to coarse-grained sandstone, shale, sandy and calcareous shale; called "second Trinity sand." Yields moderate to large quantities (200-500 gal/min) of water. Maximum thickness in Coryell County is 130 feet.
Pennsylvanian		Strawn	Undifferentiated	Pennsylvanian: Maroon and dark brown shale; unconformably overlain by Cretaceous rocks. Not known to yield water of usable quality in area.

1/ The Hensell and Hosston Members are regionally hydrualically connected and are treated as a single aquifer.
2/ Considerable facies changes are present on a regional basis within most members of the Travis Peak Formation.
3/ Designated Pearsall Formation, subsurface equivalent of the Travis Peak Formation, and Hosston Formation of Coahuilan age by the U.S. Geological Survey.

For the purpose of this report, the Hensell and Hosston Members comprise the principal aquifer system in the North Fort Hood area. The general ground-water movement in the aquifer is from its areas of outcrop eastward through Coryell County to areas of discharge east of the project area. Additional information on the regional geohydrology may be found in Klemt, Perkins, and Alvarez (1975).

HYDRAULIC PROPERTIES OF AQUIFER SYSTEM

The principal hydraulic properties of an aquifer are its capacity to store water (storage coefficient) and its ability to transmit water (transmissivity). These may be determined through aquifer tests using wells. Additional information on these terms and on the well-hydraulics techniques used in aquifer tests may be found in Lohman (1979).

Aquifer tests were conducted by Rose (1943) to determine the transmissivity and the storage coefficient for the principal aquifer system in the North Fort Hood area. Four aquifer tests were performed using nine producing wells at North Fort Hood during January-March 1943. The results indicate a variation of transmissivity from about 800 to more than 2,500 ft^2/d; the hydraulic conductivity, determined by dividing transmissivity by saturated thickness, varied from about 8 to more than 25 ft/d. The approximate value determined for the storage coefficient was 0.0001, which is typical of a confined aquifer. The values determined for the hydraulic properties were used by Rose (1943) to predict drawdowns for the wells at North Fort Hood.

The specific capacity of a well (discharge rate per foot of drawdown for a specified pumping period) is an indication of the transmissive and storage properties of an aquifer. The production data and the specific capacities determined for selected wells in the North Fort Hood area are shown in table 2. The information used in the preparation of the table is from Rose (1943) and Klemt, Perkins, and Alvarez (1975). Most of the average well yields were between 200 and 500 gal/min, although some were less than 200 gal/min and one was more than 900 gal/min; however, during 1982 the yield of only one well exceeded 300 gal/min. The specific capacities generally were between 1 and slightly more than 5 (gal/min)/ft of drawdown after pumping periods of 24 to 37 hours. Information on wells HB-40-43-204 and HB-40-43-206 includes 1981 data, which indicate large declines in static and pumping levels when compared to the 1943 data.

GROUND-WATER DEVELOPMENT

The development of ground water in the North Fort Hood area is chiefly from wells completed in both the Hensell and Hosston Members of the Travis Peak Formation. Only 9 of the 37 wells listed in table 6 (supplemental information) are screened in the Hosston Member, 2 are screened in the Hensell Member, and the remainder are completed in both members. The analyses of the ground-water data indicate no significant diffe. ences in hydraulic head between the two members, therefore, it appears that regional hydraulic connection exists. In this study, the Hensell and Hosston Members are treated as a single aquifer.

Table 2.--Production data and specific capacity of selected wells

Well number	Date	Static level below land surface (feet)	Pumping level below land surface (feet)	Drawdown (feet)	Average yield (gallons per minute)	Pumping period (hours)	Specific capacity (gallons per minute per foot)
HB-40-35-104	10-25-49	272	319	47	264	24	5.6
108	11- 5-69	380	536	156	518	24	3.3
403	10- 2-64	298	420	122	550	36	4.5
409	3- 4-68	449	636	187	901	24	4.8
410	8-23-74	505	580	75	350	24	4.7
502	2- -75	640	735	95	100	37	1.0
801	6- -43	105	298	193	127	7	.7
803	10- -46	183	292	109	285	24	2.6
805	1-27-43	132	318	186	292	24	1.6
806	11-21-73	420	600	180	90	8	.5
36-602	1-31-68	790	860	70	120	24	1.7
43-201	1-16-43	104	147	43	225	24	5.2
202	2- 2-43	128	222	94	302	24	3.2
204	5- -43	194	249	55	218	24	4.0
	8- 6-81	445	494	49	295	1	6.0
206	3- -43	108	209	101	302	72	3.0
	3- -81	436	538	102	310	2	3.0
44-901	11-22-68	172	412	240	81	24	.3

The initial development of ground water in the area can be traced back to the City of Gatesville well 1, drilled to a depth of 680 feet before the turn of the century (table 6). The city has completed seven other wells since then, and six were still in operation during November 1982. The Gatesville School for Boys drilled a well during 1922 and another prior to 1939. They were replaced with four wells drilled by the Texas Department of Corrections between 1946 and 1967.

During 1942-43, 12 wells were drilled by the Army to supply the water needs at North Fort Hood. The Army was using five of these wells during 1982. Two of the remaining wells were being used by private concerns. The other five were abandoned or not in use.

Most of the remaining wells in table 6 were drilled after 1960, when various water-supply corporations were created to supply water to small communities and to rural areas.

Use of Ground Water

Practically all ground water withdrawn from the area's principal aquifer system is used for public supply. Some wells, such HB-40-35-804, have been used to supply both the domestic and stock needs in rural areas. Industrial and irrigation uses of water are nonexistent in the area.

The estimated average rates of the annual ground-water withdrawals in the North Fort Hood area for 1955-81 are shown in table 3. Actually, only the average annual rates for every fifth year between 1955 and 1975 are shown, as well as those for 1979, 1980, and 1981. Also included in the table are the 1980 population of the indicated water users and the 1980 per-capita and per-connection consumption for each water user.

Table 3.--Estimated average rates of annual ground-water withdrawals, 1955-81

(NA - not available)

Source of withdrawal	Average annual rates of withdrawal (million gallons per day)								1980 Population served	1980 Per-capita consumption (gallons per day)	1980 Per-connection consumption (gallons per day)
	1955	1960	1965	1970	1975	1979	1980	1981			
Flat Water Supply Corp.	--	--	--	0.019	0.018	0.042	0.059	0.051	210	281	401
Fort Gates Water Corp.	--	--	0.011	.038	.044	.110	.127	.126	777	163	287
City of Gatesville	0.421	0.554	.583	.700	.775	.794	.935	.785	6,260	149	348
Mountain Water Supply Corp.	--	--	--	.024	.032	.040	.047	.042	300	157	174
North Fort Hood	--	--	.138	.090	.199	.155	.146	.158	--	--	--
City of Oglesby	.023	.030	.031	.037	.033	.041	.052	.050	470	110	NA
Texas Department of Corrections:											
Hilltop Unit (Gatesville Unit) 1/	--	--	.265	.343	.085	.070	.056	.063	--	--	--
Mountain View Unit 2/	--	--	--	--	--	.079	.129	.122	--	--	--
The Grove Water Supply Corp.	--	--	--	.033	.028	.038	.042	.037	65	646	NA
TOTAL	0.444	0.584	1.028	1.284	1.214	1.369	1.593	1.434			

1/ Formerly Gatesville School for Boys.
2/ Formerly Mountain View School for Boys.

The total average annual rates of withdrawals of ground water in the area ranged from 0.444 Mgal/d during 1955 to 1.593 Mgal/d during 1980. The trend has been a general annual increase during the period, although some annual differences may reflect the effects of above- or below-average precipitation, such as that between 1980 and 1981.

The City of Gatesville is the largest single user of ground water in the area, having almost doubled its annual use of water during 1955-81. During the 1960's and early 1970's, the institutions of the Texas Department of Corrections were second only to the City of Gatesville in annual withdrawals of ground water. Their use decreased after 1975, and only recently (1980-81) have their annual withdrawals increased somewhat.

The third largest user of water in the area (second largest during 1975-79) is North Fort Hood, which has withdrawn ground water at an average annual rate ranging from 90,000 to 158,000 gal/d between 1965 and 1981. The initial development of ground water for this Army facility called for the drilling of 12 wells to supply about 4.5 Mgal/d for a camp capacity of 40,000 (Rose, 1943). Records of water use are not available for 1943-65, but it is doubtful that the maximum capacity of the well field was ever reached, even during World War II.

Decline of Water Levels in Wells

The long-term decline of water levels in wells completed in the principal aquifer system in the North Fort Hood area has been considerable. Depth to water in many wells exceeded 500 feet during September-November 1982. Direct measurement of such deep levels was obtained in only a few wells. Indirect measurements by previously installed airline equipment were obtained in other wells. The measurements of water levels in wells are listed in table 6, and the location of the wells are shown in figure 2. The historical water-level records for wells that were measured more than five times are included in table 5 (supplemental information).

Water-level measurements for City of Gatesville wells 1 and 2 (wells HB-40-35-401 and HB-40-35-402 in table 6) indicate a large long-term decline of water levels in the vicinity of Gatesville. These wells were drilled to about the same depth at locations that are about 150 feet apart and with the same surface altitude. During 1898, well HB-40-35-401 was flowing, and during 1982, the water level in nearby well HB-40-35-402 was 476 feet below land surface. Depth to water in well HB-40-35-403, City of Gatesville well 3, was nearly 300 feet during October 1964, and it was 511 feet during September 1982.

Hydrographs of the decline of water levels in selected wells in the North Fort Hood area for 1966-82 are shown in figure 3. Well HB-40-35-804 was drilled during 1943 for the Army but is now privately owned and used to supply domestic and stock needs. The hydrograph for this well indicates a long-term average decline in the water level of about 9 ft/yr. The last measurement (Oct. 1982) for well HB-40-35-804 was excluded from the long-term computations. Depth to water in this well was about 100 feet during January 1943. The long-term average decline of the water level in well HB-40-35-701, a water-supply corporation well that is located between Gatesville and North Fort Hood, is slightly more than 9 ft/yr. The hydrograph for well HB-40-35-103, a Texas Department of Corrections well located north of Gatesville, indicates a long-term average decline of water levels of about 7 ft/yr. The level measured during 1982 probably reflects some of the effects of the large withdrawals of ground water during the summer season and is therefore excluded in the computation of the long-term trend.

A hydrograph of the 1967 seasonal fluctuations of the water level in well HB-40-35-804 is shown in figure 4. The decline of the water level during the summer season probably is the typical drawdown caused by the large withdrawals of ground water in the area at this time of the year. The maximum seasonal drawdown at this point, which is located slightly north of North Fort Hood, probably was in excess of 15 feet during early October. This was approximated by taking the difference between the October measurement and the level estimated for the same time from a straight line between the early and year-end measurements. The net annual decline in the water level was approximately 20 feet.

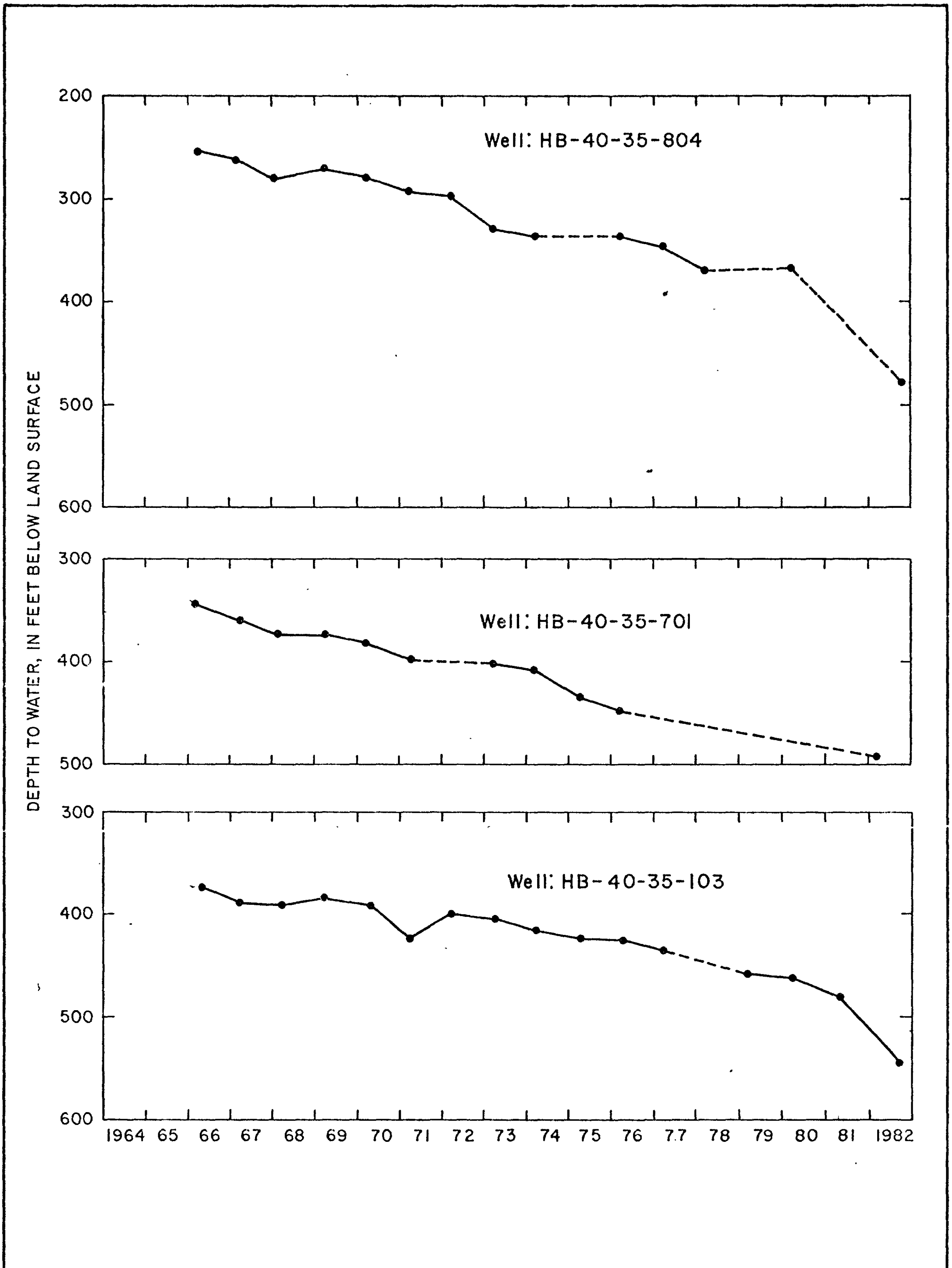

Figure 3.-Hydrographs showing decline of water levels in wells, 1966-82.

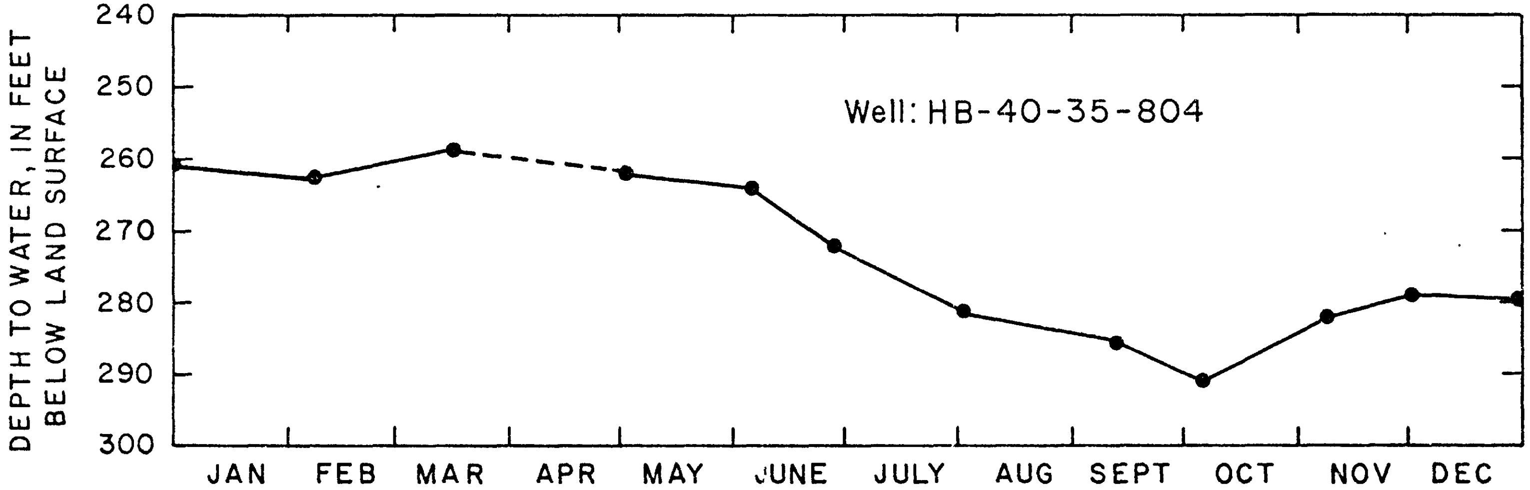

Figure 4.-Hydrograph showing the 1967 seasonal fluctuations of water level in well HB-40-35-804.

The general shape of the potentiometric surface of the principal aquifer in the North Fort Hood area during September-November 1982 is shown in figure 5. The largest cone of depression is located in the eastern part of Gatesville, and it extends into North Fort Hood, where the second largest cone of depression is located. Other cones of depression are located in the western part of the city of Gatesville and in the area north of Gatesville, where the Texas Department of Corrections units are located. The distribution and size of the water-level cones of depression coincide with the existence and use of large-capacity wells. (See table 3 for the distribution of ground-water users and the relative quantities of ground water withdrawn.)

Historically, the hydraulic head of the aquifer in the project area has been several hundred feet above the top of the Hensell Member. The long-term withdrawals have lowered the hyudraulic head so that the water levels in some wells in the project area are now at or below the top of this member. For example, the static water level in well HB-40-35-107 was slightly below the top of the member during September 1982. The pumping levels in most of the wells at or in the vicinity of North Fort Hood were below the top of the member during September-November 1982. The confined (artesian) conditions of the aquifer system will cease to exist once the regional hydraulic head has declined below the top of the member. The new unconfined (water-table) system will have a much greater storage coefficient, probably by a factor of 10^3, and the rate of the decline of water levels in wells will decrease substantially. Nevertheless, the well yields will continue to decrease in relation to the general decline of hydraulic head in the aquifer system.

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The general nature of the long-term decline of water levels in wells of the area indicates that more ground water is being withdrawn within the project area than is being recharged to the aquifer system locally or from outside the project area. Most of the recharge to the local area probably occurs as underflow from areas of recharge, mainly the outcrop areas of the Travis Peak Formation outside the project area.

QUALITY OF GROUND WATER

Chemical analyses of ground-water samples collected from selected wells in the North Fort Hood area are presented in table 8 (supplemental information). Of the 35 wells shown in table 8, 14 were sampled during September-October 1982. The table was completed by including chemical analyses obtained from water users or from published records of chemical analyses of ground water previously sampled from wells in the area (Rose, 1943; Klemt, Perkins, and Alvarez, 1975).

The ground water from the aquifer system (Hensell and Hosston Members of the Travis Peak Formation) in the area generally is a sodium bicarbonate type with considerable quantities of sulfate and chloride. Many of the analyses indicate that the accepted standards set forth by the U.S. Environmental Protection Agency (1977a) in table 4 have been exceeded, particularly in relation to sulfate, chloride, and dissolved solids. The water may be termed slightly saline under the classification sometimes used by the Geological Survey (Winslow and Kister, 1956), whereby water with a dissolved-solids concentraton between 1,000 and 3,000 mg/L (milligrams per liter) is given this classification. Chemical analyses from 34 samples collected during 1943-76 from the 12 wells at North Fort Hood were used to arrive at an average dissolved-solids concentration of 1,280 mg/L for the water used at the military base.

Table 4.--Source and significance of selected constituents and properties commonly reported in water analyses

[mg/L - milligrams per liter; µg/L - micrograms per liter; micromhos - micromhos per centimeter at 25° Celsius]

Constituent or property	Source or cause	Significance
Silica (SiO_2)	Silicon ranks second only to oxygen in abundance in the Earth's crust. Contact of natural waters with silica-bearing rocks and soils usually results in a concentration range of about 1 to 30 mg/L; but concentrations as large as 100 mg/L are common in waters in some areas.	Although silica in some domestic and industrial water supplies may inhibit corrosion of iron pipes by forming protective coatings, it generally is objectionable in industrial supplies, particularly in boiler feedwater, because it may form hard scale in boilers and pipes or pass over in steam and deposit in the tubes of heaters and on steam-turbine blades.
Iron (Fe)	Iron is an abundant and widespread constituent of many rocks and soils. Iron concentrations in natural waters are dependent upon several chemical equilibria processes including oxidation and reduction; precipitation and solution of hydroxides, carbonates, and sulfides; complex formation especially with organic material; and the metabolism of plants and animals. Dissolved-iron concentrations in oxygenated surface waters seldom reach 1 mg/L. Some ground waters, unoxygenated surface waters such as deep waters of stratified lakes and reservoirs, and waters of very low pH resulting from discharge of industrial wastes or drainage from mines may contain considerably more iron. Corrosion of iron casings, pumps, and pipes may add iron to water pumped from wells.	Iron is an objectionable constituent in water supplies for domestic use because it may adversely affect the taste of water and beverages and stain laundered clothes and plumbing fixtures. According to the National Secondary Drinking Water Regulations proposed by the U.S. Environmental Protection Agency (1977b), the secondary maximum contamination level of iron for public water systems is 300 µg/L. Iron also is undesirable in some industrial water supplies, particularly in waters used in high-pressure boilers and those used for food processing, production of paper and chemicals, and bleaching or dyeing of textiles.
Sodium (Na)	Sodium is an abundant and widespread constituent of many soils and rocks and is the principal cation in many natural waters associated with argillaceous sediments, marine shales, and evaporites and in sea water. Sodium salts are very soluble and once in solution tend to stay in solution. Sodium concentrations in natural waters have a very wide range, from less than 1 mg/L in stream runoff from areas of high rainfall to more than 100,000 mg/L in ground and surface waters associated with halite deposits in arid areas. In addition to natural sources of sodium, sewage, industrial effluents, oilfield brines, and deicing salts may contribute sodium to surface and ground waters.	Sodium in drinking water may impart a salty taste and may be harmful to persons suffering from cardiac, renal, and circulatory diseases and to women with toxemias of pregnancy. Sodium is objectionable in boiler feedwaters because it may cause foaming. Large sodium concentrations are toxic to most plants; and a high ratio of sodium to total cations in irrigation waters may reduce the permeability of the soil, increase the pH of the soil solution, and impair drainage.
Alkalinity	Alkalinity is a measure of the capacity of a water to neutralize a strong acid, usually to pH of 4.5, and is expressed in terms of an equivalent amount of calcium carbonate ($CaCO_3$). Alkalinity in natural waters usually is caused by the presence of bicarbonate and carbonate ions and to a lesser exextent to hydroxide and minor acid radicals such as borates, phosphates, and silicates. Carbonates and bicarbonates are common to most natural waters because of the abundance of carbon dioxide and carbonate minerals in nature. Direct contribution to alkalinity in natural waters by hydroxide is rare and usually can be attributed to contamination. The alkalinity of natural waters ranges widely but rarely exceeds 400 to 500 mg/L as $CaCO_3$.	High alkalinity waters may have a distinctive unpleasant taste. Alkalinity is detrimental in several industrial processes, especially those involving the production of food and carbonated or acid-fruit beverages. The alkalinity in irrigation waters in excess of alkaline earth concentrations may increase the pH of the soil solution, leach organic material and reduce permeability of the soil, and impair plant growth.

Table 4.--Source and significance of selected constituents and properties commonly reported in water analyses--Continued

Constituent or property	Source or cause	Significance
Sulfate (SO_4)	Sulfur is a minor constituent of the earth's crust but is widely distributed as metallic sulfides in igneous and sedimentary rocks. Weathering of metallic sulfides such as pyrite by oxygenated water yields sulfate ions to the water. Sulfate is dissolved also from soils and evaporite sediments containing gypsum or anhydrite. The sulfate concentration in natural fresh waters may range from zero to several thousand milligrams per liter. Drainage from mines may add sulfate to waters by virtue of pyrite oxidation.	Sulfate in drinking water may impart a bitter taste and act as a laxative on unacclimated users. According to the National Secondary Drinking Water Regulations proposed by the Environmental Protection Agency (1977b) the secondary maximum contaminant level of sulfate for public water systems is 250 mg/L. Sulfate also is undesirable in some industrial supplies, particularly in waters used for the production of concrete, ice, sugar, and carbonated beverages and in waters used in high-pressure boilers.
Chloride (Cl)	Chloride is relatively scarce in the Earth's crust but is the predominant anion in sea water, most petroleum-associated brines, and in many natural freshwaters, particularly those associated with marine shales and evaporites. Chloride salts are very soluble and once in solution tend to stay in solution. Chloride concentrations in natural waters have a very wide range, from less than 1 mg/L in stream runoff from areas of high rainfall to more than 100,000 mg/L in ground and surface waters associated with evaporites in arid areas. The discharge of human, animal, or industrial wastes and irrigation return flows may add significant quantities of chloride to surface and ground waters.	Chloride may impart a salty taste to drinking water and may accelerate the corrosion of metals used in water-supply systems. According to the National Secondary Drinking Water Regulations proposed by the Environmental Protection Agency (1977b) the secondary maximum contaminant level of chloride for public water systems is 250 mg/L. Chloride also is objectionable in some industrial supplies, particularly those used for brewing and food processing, paper and steel production, and textile processing. Chloride in irrigation waters generally is not toxic to most crops but may be injurious to citrus and stone fruits.
Fluoride (F)	Fluoride is a minor constituent of the Earth's crust. The calcium fluoride mineral fluorite is a widespread constituent of resistate sediments and igneous rocks, but its solubility in water is low. Fluoride often is associated with volcanic gases, and volcanic emanations may be important sources of fluoride in some areas. The fluoride concentration in fresh surface waters usually is less than 1 mg/L; but larger concentrations are not uncommon in saline water from oil wells, ground water from a wide variety of geologic terranes, and water from areas affected by volcanism.	Fluoride in drinking water reduces the incidence of tooth decay when the water is consumed during the period of enamel calcification. Excessive quantities in drinking water consumed by children during the period of enamel calcification may cause a characteristic discoloration (mottling) of the teeth. According to the National Interim Primary Drinking Water Regulations established by the Environmental Protection Agency (1976) the maximum contaminant level of fluoride in drinking water varies from 1.4 to 2.4 mg/L, depending upon the annual average of the maximum daily air temperature for the area in which the water system is located. Excessive fluoride also is objectionable in water supplies for some industries, particularly those involved in the production of food, beverages, and pharmaceutical items.
Dissolved solids	Theoretically, dissolved solids are anhydrous residues of the dissolved substance in water. In reality, the term "dissolved solids" is defined by the method used in the determination. In most waters, the dissolved solids consist predominantly of silica, calcium, magnesium, sodium, potassium, carbonate, bicarbonate, chloride, and sulfate with minor or trace amounts of other inorganic and organic constituents. In regions of high rainfall and relatively insoluble rocks, waters may contain dissolved-solids concentrations of less than 25 mg/L; but saturated sodium chloride brines in other areas may contain more than 300,000 mg/L.	Dissolved-solids values are used widely in evaluating water quality and in comparing waters. The following classification based on the concentrations of dissolved solids is used by the Geological Survey. Classification — Dissolved-solids concentration (mg/L) Fresh — <1,000 Slightly saline — 1,000 - 3,000 Moderately saline — 3,000 - 10,000 Very saline — 10,000 - 35,000 Brine — >35,000

Table 4.--Source and significance of selected constituents and properties commonly reported in water analyses--Continued

Constituent or property	Source or cause	Significance
Dissolved solids --continued		The Environmental Protection Agency National Secondary Drinking Regulations (1976) set a dissolved-solids concentration of 500 mg/L as the secondary maximum contaminant level for public water systems. This level was set primarily on the basis of taste thresholds and potential physiological effects, particularly the laxative effect on unacclimated users. Although drinking waters containing more than 500 mg/L are undesirable, such waters have been used in many areas where less mineralized supplies are not available without any obvious ill effects. Dissolved solids in industrial water supplies can cause foaming in boilers; interfere with clearness, color, or taste of many finished products; and accelerate corrosion. Uses of water for irrigation also are limited by excessive dissolved-solids concentrations. Dissolved solids in irrigation water may adversely affect plants directly by the development of high osmotic conditions in the soil solution and the presence of phytoxins in the water or indirectly by their influence on soils.
Specific conductance	Specific conductance is a measure of the ability of a water to carry an electrical current and depends on the concentrations of ionized constituents dissolved in the water. Many natural waters in contact only with granite, well-leached soil, or other sparingly soluble material have a conductance of less than 50 micromhos. The specific conductance of some brines exceed several hundred thousand micromhos.	The specific conductance is an indication of the degree of mineralization of a water and may be used to estimate the concentration of dissolved solids in the water.
Hardness as $CaCO_3$	Hardness of water is attributable to all polyvalent metals but principally to calcium and magnesium ions expressed as $CaCO_3$ (calcium carbonate). Water hardness results naturally from the solution of calcium and magnesium, both of which are widely distributed in common minerals of rocks and soils. Hardness of waters in contact with limestone often exceeds 200 mg/L. In waters from gypsiferous formations, 1,000 mg/L is not uncommon.	Hardness values are used in evaluating water quality and in comparing waters. The following classification is used by the Geological Survey. Hardness (mg/L as $CaCO_3$) — Classification 0 - 60 — Soft 61 - 120 — Moderately hard 121 - 180 — Hard >180 — Very hard Excessive hardness of water for domestic use is objectionable because it causes incrustations on cooking utensils and water heaters and increased soap or detergent consumption. Excessive hardness is undesirable also in many industrial supplies.
pH	The pH of a solution is a measure of its hydrogen ion activity. By definition, the pH of pure water at a temperature of 25°C is 7.00. Natural waters contain dissolved gases and minerals, and the pH may deviate significantly from that of pure water. Rainwater not influenced significantly by atmospheric pollution generally has a pH of 5.6 due to the solution of carbon dioxide from the atmosphere. The pH range of most natural surface and ground waters is about 6.0 to 8.5. Many natural natural waters are slightly basic (pH >7.0) because of the prevalence of carbonates and bicarbonates, which tend to raise the pH.	The pH of a domestic or industrial water supply is significant because it may affect taste, corrosion potential, and water-treatment processes. Low pH waters may have a sour taste and favor corrosion of metals and concrete. The Environmental Protection Agency National Secondary Drinking Water Regulations (1977b) set a pH range of 6.5 to 8.5 as the secondary maximum contaminant level for public water systems.

Twenty-five of the wells listed in table 8 have been sampled 2 or more times for chemical analysis at different time periods, 14 have been sampled 3 or more times, 11 have been sampled 4 or more times, and 8 have been sampled 5 or more times. Comparison of the historical analyses available for each well indicates that the changes in the chemical quality of the ground water in the area generally are insignificant. The small changes that do occur are somewhat inconsistent and appear to be unrelated to any effects due to the large historical decline of hydraulic head in the aquifer system.

CONCLUSIONS

The principal effect of the long-term development of ground water from the Travis Peak Formation in the North Fort Hood area has been the large decline of water levels in wells. During 1898 a City of Gatesville well was flowing, but during 1982 the depth to water in this vicinity was 476 feet. Depth to water in a well near North Fort Hood was about 100 feet during 1943 and nearly 480 feet during 1982. The variation of the long-term average of water-level declines in the area is from about 8 to more than 9 ft/yr. This indicates that more ground water is being withdrawn from the aquifer than is being recharged to the system locally and outside the project area. Historically, the aquifer in the Travis Peak Formation has been under artesian conditions. However, the water levels have declined to near the top of the upper water-bearing unit in parts of the area. The static water level is below the top of this unit in one well, and the pumping levels in most of the wells at or in the vicinity of North Fort Hood also were below the top. As a result, the aquifer is now under water-table conditions locally, and the rate in the decline of water levels will decrease due to the greater storage properties of the unconfined aquifer. However, the well yields will continue to decrease in relation to the general decline of hydraulic head in the aquifer.

The total average annual rates of ground-water withdrawals in the area have steadily increased from nearly 0.5 Mgal/d during 1955 to more than 1.5 Mgal/d during 1980. If the latter rate is maintained or increased, the decline of water levels in wells is expected to continue, and the well yields will decrease.

The ground water in the area is termed slightly saline with the concentrations of some constituents generally exceeding the chemical-quality standards set forth by the Environmental Protection Agency, particularly in relation to sulfate, chloride, and dissolved solids. The historically small and inconsistent chemical changes in the ground water appear to be unrelated to any effects due to the long-term withdrawals and the accompanying decline of hydraulic head.

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SUPPLEMENTAL INFORMATION

Table 5. - Water levels in selected wells in the North Fort Hood area

Note: All measurements are listed in feet below land surface. Reported levels and those by airline are shown to the nearest foot; measured levels are shown to to the nearest tenth of a foot.

Well HB-40-35-103

Owner: Hilltop Unit

Altitude: 890 feet Total Depth: 771 feet

Date	Water level
July 8, 1952	290
Apr. 5, 1966	374.1
Mar. 16, 1967	390.0
Mar. 14, 1968	391.0
Mar. 18, 1969	385.0
Mar. 4, 1970	392.3
Mar. 4, 1971	424.2
Mar. 16, 1972	400.2
Mar. 7, 1973	405.1
Mar. 4, 1974	414.6
Mar. 10, 1975	424.4
Mar. 17, 1976	425.9
Mar. 9, 1977	437.3
Mar. 26, 1979	459.0
Mar. 10, 1980	463.3
Apr. 3, 1981	481.8
Sept. 23, 1982	545

Well HB-40-35-401

Owner: City of Gatesville, No. 1

Altitude: 755 feet Total Depth: 680 feet

Date	Water level
1898	+
1933	82
1934	130
1937	130
1939	110
1946	138
1955	292
1959	290

+ Flowing, hydraulic head unknown.

Well HB-40-35-402

Owner: City of Gatesville, No. 2

Altitude: 755 feet Total Depth: 680 feet

Date	Water level
Nov. 6, 1939	110
June 4, 1946	138
Oct. 2, 1964	298
Apr. 5, 1966	257.8
Aug. 25, 1966	295.0
Sept. 22, 1982	476

Well HB-40-35-403

Owner: City of Gatesville, No. 3

Altitude: 825 feet Total Depth: 828 feet

Date	Water level
Oct. 2, 1964	298.0
Mar. 11, 1966	372.5
Apr. 5, 1966	255.3
Mar. 22, 1967	342.0
Mar. 15, 1968	338.6
Mar. 5, 1973	410.5
Apr. 4, 1974	411.6
Apr. 9, 1975	424.0
Apr. 18, 1976	432.6
Mar. 9, 1977	442.6
Mar. 14, 1979	467.4
Mar. 26, 1980	492.8
Apr. 3, 1981	439.0
May 13, 1981	478.0
Mar. 12, 1982	504.0
Sept. 22, 1982	511.5
Nov. 3, 1982	470.

Well HB-40-35-404

Owner: City of Gatesville, No. 4

Altitude: 823 feet Total Depth: 755 feet

Date	Water level
July 18, 1955	292
Mar. 16, 1967	342.5
Mar. 15, 1968	354.5
Mar. 4, 1970	359.6

Well HB-40-35-701

Owner: Fort Gates Water Supply Corporation

Altitude: 840 feet Total Depth: 821 feet

Date	Water level
Jul. 21, 1964	390.0
Mar. 10, 1966	344.5
Dec. 29, 1966	357.4
Feb. 7, 1967	360.2
Mar. 10, 1967	358.4
May 2, 1967	362.8
June 28, 1967	382.4
Oct. 4, 1967	388.7
Nov. 6, 1967	381.9
Feb. 13, 1968	372.8

Well HB-40-35-701 continued

Date	Water level
Mar. 14, 1968	374.4
Mar. 19, 1969	371.9
Mar. 4, 1970	380.9
Mar. 5, 1971	397.4
Mar. 5, 1973	400.8
Mar. 4, 1974	408.4
Apr. 9, 1975	434.1
Mar. 18, 1976	447.1
Mar. 11, 1982	491.2

Well HB-40-35-804

Owner: Jack Fry (formerly U.S.Army, Fort Hood)

Altitude. 750 feet Total Depth: 7

Date	Water level
Jan. 10, 1943	101
Mar. 11, 1966	252.7
Aug. 25, 1966	265.7
Sept. 29, 1966	277.1
Oct. 31, 1966	274.1
Dec. 5, 1966	258.0
Dec. 29, 1966	260.1
Feb. 7, 1967	262.5
Mar. 16, 1967	258.9
May 2, 1967	262.1
June 5, 1967	264.0
June 28, 1967	271.2
Aug. 1, 1967	281.8
Sept. 12, 1967	283.0
Oct. 4, 1967	285.9
Nov. 8, 1967	282.0
Dec. 1, 1967	278.8
Jan. 5, 1968	279.7
Feb. 13, 1968	280.1
Mar. 19, 1969	271.0
Mar. 4, 1970	279.0
Mar. 5, 1971	292.7
Mar. 16, 1972	298.5
Mar. 5, 1973	326.8
Mar. 4, 1974	335.5
Mar. 18, 1976	336.0
Mar. 9, 1977	346.8
Mar. 14, 1978	369.4
Mar. 10, 1980	368.5
Oct. 7, 1982	477.0

Table 5. - Water levels in selected wells in the North Fort Hood area - Continued

Date	Water level
Well HB-40-43-204	
Owner: U. S. Army, North Fort Hood	
Altitude: 738 feet Total Depth: 758 feet	
May, 1943	194
Mar. 28, 1981	413
Aug. 8, 1981	445
Sept. 21, 1982	481
Nov. 2, 1982	465.3
Well HB-40-43-206	
Owner: U.S. Army, North Fort Hood	
Altitude: 750 feet Total Depth: 735 feet	
Dec. 26, 1942	140
Mar. 1943	109
Sept. 23, 1981	436
Sept. 21, 1982	470
Well: HB-40-43-603	
Owner: Flat Water Supply Corporation	
Altitude: 870 feet Total Depth: 993 feet	
July 31, 1965	390
Mar. 10, 1966	379.2
Mar. 16, 1967	389.1
Mar. 15, 1968	402.0
Mar. 19, 1969	403.1
Well HB-40-44-901	
Owner: G. E. Wolfe	
Altitude: 780 feet Total Depth 990 feet	
Mar. 10, 1966	260.6
Mar. 16, 1967	285.5
Mar. 15, 1968	220.2
Mar. 3, 1970	179.0
Well HB-40-44-902	
Owner: The Grove Water Supply Corporation	
Altitude: 800 feet Total Depth 1125 feet	
Oct. 22, 1968	172
Oct. 30, 1968	173.6
May 9, 1969	354.6
May 9, 1969	343.4
Mar. 5, 1970	357.1
Mar. 3, 1971	361.2
Mar. 13, 1972	366.0
Mar. 4, 1974	398.4
Mar. 26, 1974	508
Mar. 26, 1979	508

Table 6. - Records of wells and test holes in the North Fort Hood area
(ft. - foot; gal/min - gallon per minute; in. - inch)

Water-bearing unit: Kgr, Glen Rose Formation; Ktp, Travis Peak Formation; Khe, Hensell Member of the Travis Peak Formation; Kpe, Pearsall Member of the Travis Peak Formation and Kho, Hosston Member of the Travis Peak Formation.

Method of lift and type of power: C, cylinder; S, submersible; T, turbine; E, electric; and N, none. Use of water: D, domestic; N, none; P, public supply; and S, stock

No.	Owner	Driller	Date completed	Depth of well (ft.)	Casing: Diameter (in.)	Casing: Depth (ft.)	Water-bearing unit	Altitude of land surface (ft.)	Water level: Above (+) or below land surface datum (ft.) a/	Water level: Date of measurement	Method of lift	Use of water	Remarks
HB-40-35-101	Gatesville School for Boys	--	1922	728	8	--	Ktp	890	178	Sept. 1928	N	N	Reportedly yielded 125 gal/min in 1942. Well plugged and abandoned.
102	Do	--	--	749	6	--	Do	890	180	Nov.14,1939	N	N	Reportedly yielded 100 gal/min in 1942. Well plugged and abandoned.
* 103	State of Texas, Texas Department of Corrections, Hilltop Unit	Kenton Preston	1946	771	6	--	Khe Kho	890	290 481.8 545	July 8,1942 Apr. 3,1981 Sept. 23,1982	SE,50	P	Perforated from 575 to 590, 598 to 611, 635 to 659 and 705 to 770 ft. Pumping level 302 ft. at 40 gal/min on July 8, 1952. Pump set at 570 ft, 1974. 1/ 2/ 3/
* 104	Do No. 2	Layne Texas Co.	1949	762	10 8	562 762	Do	890	290 387 470	Oct. 1949 Mar.18,1969 Feb. 1982	TE,60	P	Screened from 584 to 609, 638 to 658, and 710 to 760 ft. Reported pumping level 319 ft. at 264 gal/min after 24 hours Oct. 25, 1949. Pump set at 540 ft. Pumping 200 gal/min. Sept. 23, 1982 2/
* 107	State of Texas, Texas Department of Corrections, Mountain View Unit	J.L. Myers and Son	1961	898	18 12 8	13.8 790 --	Kho	961	419 663	Feb.10,1961 Sept.9,1982	TE,100	P	Screened from 584 to 882 ft. Measured discharge 255 gal/min. Sept. 23, 1982. Pump set at 770 ft. 2/
* 108	State of Texas, Texas Department of Corrections, Hilltop Unit	Layne Texas Co.	1969	774	12 10	645 715	Do	835	380 507 536	1969 Feb. 1982 Sept.23,1982	TE,150	P	Hackberry well. Screened from 650 to 700 and 705 to 715 ft. Reported pumping level 536 ft. at 518 gal/min after 24 hours Nov. 5, 1969. Pump set at 600 ft. 1982.
* 401	City of Gatesville No.1	--	--	680	10 8	100 --	Ktp	755	+ 138 290	1898 June 1946 July 1959	N	N	Reportedly yielded 380 gal/min. Well destroyed. 1/ 2/
* 402	Do No.2	--	--	680	8	768	Do	755	110 295 476	Nov. 6, 1939 Aug.25,1966 Sept.22,1982	T,E	P	Reported pumping level 420 ft. at 150 gal/min on Oct. 2, 1964. Pump set at 540 ft. 1/
* 403	Do No.3	Kenton Preston	1949	828	12 10	700 828	Kho	825	298.0 338.6 511.5	Oct. 2, 1964 Mar.15, 1968 Sept.22,1982	S,E	P	Screened from 702 to 802 ft. Pumping level 420 ft. at 550 gal/min on Oct. 2, 1964. Pump set at 609 ft., 1982. Cemented from 700 ft to surface. Measured discharge 105 gal/min, Sept. 22, 1982. 1/ 2/ 3/

Table 6. - Records of wells and test holes in the North Fort Hood area--Continued

	No.	Owner	Driller	Date completed	Depth of well (ft.)	Casing: Diameter (in.)	Casing: Depth (ft.)	Water-bearing unit	Altitude of land surface (ft.)	Water level: Above (+) or below land surface datum (ft.) a/	Water level: Date of measurement	Method of lift	Use of water	Remarks
*	HB-40-35-404	City of Gatesville No.4	Layne Texas Co.	1955	755	16 12 10	73 694 755	Kho	823	292 359.6	July 18,1955 Mar. 4, 1970	TE	P	Screened from 695 to 739 ft. Pumping level 386 ft. at 285 gal/min. July 21. 1955. Pumping level 602 ft., Sept. 22, 1982. Pump set at 686 ft. 1982. 1/ 2/
*	405	Do.	R.A. Adams and Son	1933	700	8 6	20 565	Ktp	785	130	July 1934	TE,25	P	Casing slotted from 425 to 565 ft. Open hole from 565 to 700 ft. Reportedly yielded 225 gal/min in 1969. 2/
*	407	Do.	--	--	700	8	300	Do	825			N	N	Reportedly yielded 300 gal/min, 1940. Plugged and abandoned. "Old Warehouse Well".
*	409	Do No.5	Layne-Texas Co.	1968	916	12 10	770 895	Kho	900	449 494	Mar.11,1968 1980	SE,150	P	Screened from 785 to 875 ft. Pumping level 636 ft. at 901 gal/min. on Mar. 4, 1968. Pump set at 700 ft., 1969; Lowered to 811 ft. by 1982. Measured discharge 445 gal/min on Nov. 3, 1982. 2/
*	410	Do No.6	J.L. Myers and Son	1974	835	16 12 10	22 755 835	Do	840	505 658	Aug.23,1974 Sept. 22,1982	SE,60	P	Screened from 755 to 805 ft. Pumping level 580 ft. at 350 gal/min on Aug. 23, 1974; pumping level 635 ft. at 500 gal/min on Aug. 27, 1974. Pump set at 800 ft. by 1982. Measured discharge 220 gal/min on Sept. 22, 1982. 2/
*	501	Mountain Water Supply Corp. No.1	Jones Drilling Co. and James Mathew Adams	1966	1045	--	--	Do	1025	527	Jan. 1967	SE,30	P	Pump set at 700 ft. by 1982
*	502	Do No.2	J.L. Myers and Son	1975	1054	12 7	20 1045	Do	1025	640	Feb. 2, 1975	SE,30	P	Gun perforated from 972 to 1000 ft. and 1007 to 1042 ft. Pumping level 735 ft. at 100 gal/min after 37 hours. Pump set at 775 ft. 2/
*	701	Fort Gates Water Supply Corp. No.1	J.B. Farquharson	1964	821	10 7	10 821	Do	840	390.0 491.2	Jul.21,1964 Mar. 3,1982	SE,30	P	Gun perforated from 700 to 750, 757 to 776 and 786 to 796 ft. Pump originally set at 504 ft., lowered to 672 ft by 1982. Measured discharge 80 gal/min. Oct. 5,1982 1/ 2/ 3/

Table 6. - Records of wells and test holes in the North Fort Hood area--Continued

No.	Owner	Driller	Date completed	Depth of well (ft.)	Casing: Diameter (in.)	Casing: Depth (ft.)	Water-bearing unit	Altitude of land surface (ft.)	Water level: Above (+) or below land surface datum (ft.) a/	Water level: Date of measurement	Method of lift	Use of water	Remarks
* HB-40-35-801	U.S. Army, North Fort Hood No.12	Layne-Texas Co.	1943	755	10 8	522 755	Khe Kho	731	149	June 1943	SE,75	P	Perforated from 516 to 545 and from 679 to 744 ft. Pumping level 298 ft. at 227 gal/min. June, 1943. Pump originally set at 420 ft., lowered to 600 ft. by 1982. Appears to be pumping air Sept. 21, 1982. No airline; unable to measure. 2/
* 802	Do No.2	Do	1943	690	16 10 8	27 454 690	Do	730	63 180	Jan.14,1943 Oct. 1946	--	N	Perforated from 478 to 544 and 632 to 678 ft. Pumping level 272 ft. at 242 gal/min in Oct. 1946. Reportedly yielded 300 gal/min. Cemented from 496 ft. to surface. Concrete platform around well badly cracked; twisted pipe at 328 ft; unable to get tape below 360 ft. on Sept. 15, 1982. 2/
* 803	Do No.3	Do	1943	721	10	496	Do	740	85 183 393 480.0	Feb.12,1943 Oct. 1946 Mar.28,1981 Sept.15,1982		P	Perforated from 492 to 516 and 663 to 710 ft. Pumping level 292 ft. at 285 gal/min in Oct. 1946. Reportedly yields 300 gal/min. 2/
* 804	Jack Fry (formerly U.S.Army North Fort Hood No.4)	Do	1943	745	10 8	504 745	Do	750	101 477.0	Jan.10,1943 Oct.7, 1982	SE,1½	S	Perforated from 492 to 534 and 671 to 737 ft. Reported yield 300 gal/min. Pump set at 525 ft. 1/ 2/ 3/
* 805	Fort Gates Water Supply Corp. No. 3 (formerly U.S.Army North Fort Hood No.5)	Do	1943	759	10	538	Do	783	132	Feb. 1943	SE,50	P	Perforated from 537 to 554 and 699 to 748 ft. Pumping level 318 ft. at 293 gal/min in Feb, 1943. Reported yield 292 gal/min. Pump set at 720 ft. Measured discharge 140 gal/min on Oct. 5, 1982. 2/
* 806	Fort Gates Water Supply Corp. No.2	J.L. Myers and Son	1973	805	20 8	20 782	Kho	840	420 630	Nov.21,1973 Oct.5,1982	SE,30	P	Gun perforated from 713 to 723 and 728 to 782 ft. Reported pumping level 678 ft. at 90 gal/min after 8 hours on Nov. 23, 1973. Pump set at 732 ft. Pumping 140 gal/min on Oct. 5, 1982. 2/
* 36-601	F.B. Lam (leased to Oglesby Water Supply Corp, old well No.1	E.S. and J.A.Cluck	1934	1170	10 8 6	527 988 1170	Ktp	850	326 785? 805?	Apr. 1956 Oct.6,1982 Nov.1,1982	SE,15	P	Pump set at 600 ft. Estimated yield 70 gal/min.
* 602	Oglesby Water Supply Corp. No.1	Key Water Well Drilling Co.	1967	1220	7	1100	Kpe Kho	845	790 747.3 835	Jan.31,1968 Feb.3, 1969 Nov.1,1982	SE,40	P	Slotted from 956 to 1100 ft. Pumping level 860 ft. at 120 gal/min on Jan. 31, 1968. Pump set at 935 ft. 2/

Table 6. - Records of wells and test holes in the North Fort Hood area--Continued

No.	Owner	Driller	Date completed	Depth of well (ft.)	Casing: Diameter (in.)	Casing: Depth (ft.)	Water-bearing unit	Altitude of land surface (ft.)	Water level: Above (+) or below land surface datum (ft.) a/	Water level: Date of measurement	Method of lift	Use of water	Remarks
* HB-40-43-201	U.S. Army, North Fort Hood No.1	Layne Texas Co.	1942	765	10 8	505 760	Khe, Kho	765	97 475.5 465.6	Sept. 1946 Sept. 1982 Nov.2,1982	SE,75	P	Perforated from 505 to 555 and 697 to 747 ft. Pumping level 110 ft. at 225 gal/min in Sept. 1946. Pumping level 538 ft. at 290 gal/min. after 15 minutes on Sept. 21. 1982. 2/
* 202	Do No.8	Do	1943	772	10 8	517 771	Do	782	128	Feb.2,1943	N	N	Perforated from 531 to 599 and 726 to 760 ft. Pumping level 222 ft. at 302 gal/min on Feb. 2, 1943. Reportedly yielded 300 gal/min in 1943. Cemented from 517 ft. to surface. Abandoned. 2/
* 203	Do. No.9	Do	1943	795	10 8	581 782	Do	780	150	Feb.22,1943	N	N	Perforated from 572 to 639 and 760 to 782 ft. Reportedly yielded 300 gal/min in 1943. Well plugged and abandoned. 2/
* 204	Do. No.10	Do.	1943	758	10 8	533 758	Do	738	194 481 465.3	May 1943 Sept.21,1982 Nov. 2, 1982	SE,75	P	Perforated from 533 to 550, 583 to 600, 684 to 715 and 725 to 746 ft. Pumping level 249 ft. at 218 gal/min. after pumping 24 hours in May, 1943. Measured discharge 295 gal/min on Sept. 6, 1981. Pump originally set at 400 ft. lowered to 600 ft. by 1982. Cemented from 533 ft. to surface. 1/ 2/
* 205	Do No.11	Do	1943	755	10 8	517 755	Do	728	123 459.4	June 1943 Sept.14,1982	N	N	Perforated from 518 to 550 and 681 to 745 ft. Pumping level 254 ft. at 240 gal/min in June. 1943 2/
* 206	Do No. 6	Do	1942	735	10 8	505 731	Do	750	140 109 470	Dec.26,1942 Mar. 1943 Sept.21,1982	SE,75	P	Perforated from 496 to 563 and 651 to 718 ft. Pumping level 209 ft. at 302 gal/min. after 72 hours in Mar. 1943. Pumping level 538 ft. at 310 gal/min after 2 hours on Sept. 23, 1981. Measured discharge 290 gal/min on Sept. 21, 1982. Pump set at 600 ft. Cemented from 505 ft. to surface. 1/ 2/
* 207	Do No.7	Do	1943	745	10 8	518 745	Do	727	86	Feb.26,1943	N	N	Perforated from 517 to 561 ft. Reportedly yielded 300 gal/min in 1943. Well abandoned 2/

Table 6. Records of wells and test holes in the North Fort Hood area--Continued

No.	Owner	Driller	Date completed	Depth of well (ft.)	Casing: Diameter (in.)	Casing: Depth (ft.)	Water-bearing unit	Altitude of land surface (ft.)	Water level: Above (+) or below land surface datum a/ (ft.)	Water level: Date of measurement	Method of lift	Use of water	Remarks
* HB-40-43-501	U.S. Army, North Fort Hood, Test Hole No.2	U.S. Army Corps of Engineers	1982	840	16	10	Khe Kho	778			N	N	No casing set; surface casing cemented to 10 ft.; well not developed. Measured water level Nov. 1, 1982, 79.74 ft. below land surface; not representative of Trinity aquifer conditions. Electric log completed. Well capped. 2/
* 603	Flat Water Supply Corporation	Hervey Meadows and Son Well Drillers	1965	993	7	290	Kho	870	390 403.1	Jul.31,1965 Mar.19,1969	SE,15	P	Perforated from 900 to 990 ft. Pump set at 530 ft. in 1966; lowered once since then, present setting unknown. 1/ 2/
* 604	U.S. Army, North Fort Hood. Test Hole No.1	U.S. Army Corps of Engineers	1982	628	16 6	10 627	Ktp	730	289.4	Nov. 1,1982	N	N	Screened 560-590 ft; 6" casing not cemented. Surface casing cemented to 10 ft. Well not fully developed; water level may not be representative of Trinity aquifer conditions. Electric log completed; well capped. 2/
* 44-901	G. E. Wolfe	--	---	990	6	990	Kgr Khe	780	260.6 179.0	Mar.10,1962 Mar. 3,1970	CE,3	N	Pump set at 270 ft. Former Texas Department of Water Resources observation well. 1/ 2/
* 902	The Grove Water Supply Corporation	Hervey Meadows and Son Well Drillers	1968	1125	7	1125	Kho	800	172 508	Oct.22,1968 Mar.26,1979	SE,15	P	Casing slotted from 1015 to 1125 ft. Pumping level 412 ft. at 66 gal/min on Oct. 23, 1968. Pump set at 590 ft. Reported yield 170 gal/min. 1/ 2/ 3/

a/ Reported levels and those measured by airline are shown to the nearest foot; measured levels are shown to the nearest tenth of a foot.
* For chemical analyses of water, see table 8.
1/ For additional water levels, see table 5.
2/ For drillers log of well, see table 7.
3/ Texas Department of Water Resources observation well.

Table 7. - Drillers' logs of selected wells in the North Fort Hood area

	Thickness (feet)	Depth (feet)
Well HB-40-35-103		
Owner: Hilltop Unit		
Driller: Kenton Preston		
Sandy soil	5	5
Gravel	10	15
Yellow clay	5	20
Blue shale	20	40
Gray shale	40	80
Blue shale	40	120
Gray shale	15	135
Austin chalk	123	258
Blue shale	2	260
Austin chalk	250	510
Hard sandy shale	10	520
Blue shale	10	530
Austin chalk	55	575
Sand	15	590
Shale	8	598
Sand	13	611
Shale	9	620
Red bed	4	624
Gray shale	3	627
Red Bed	8	635
Sand shale black	24	659
Gray shale	7	666
Red bed	39	705
Sand and gravel	65	770
Shale	1	771
Well HB-40-35-104		
Owner: Hilltop Unit		
Driller: Layne Texas Co.		
Shell, gravel, and clay	20	20
Hard gray shale	8	28
Gray shale	12	40
Broken lime soft	53	93
Shale	2	95
Lime	10	105
Soft broken lime	17	122
Lime	13	135
Soft broken lime	60	195
Soft broken lime	5	200
Soft lime and shale	50	250
Broken lime and shale	50	300
Broken lime	55	355
Broken lime and shale	45	400
Broken lime and hard shells	35	435
Well HB-40-35-104 continued		
Broken lime and shale	35	470
Lime, hard shells	20	490
Harder lime	7	497
Broken lime, hard shells	23	520
Broken lime	39	559
Green shale	3	562
Sand (water)	5	567
Hard sandy lime	4	571
Gray shale	9	580
Water sand	27	607
Hard sandstone	3	610
Gray shale	1	611
Shale	3	614
Red bed	23	637
Water sand	13	650
Broken sand	10	660
Red bed	40	700
Water sand	45	745
Gravel and sand	17	762
Well HB-40-35-107		
Owner: Mountain View Unit		
Driller: J.L. Myers Sons		
Lime	230	230
Broken lime	410	640
Shale	25	665
Sand and shale	25	690
Broken sand and shale	78	768
Shale	20	788
Broken sand and shale	92	880
Shale	18	898
Well HB-40-35-108		
Owner: Hilltop Unit		
Driller: Layne Texas Co.		
Surface	0	0
Top soil	4	4
Clay	9	13
Caliche and sand streaks	47	60
Caliche	5	65
Shale and lime	15	80
Lime	62	142
Lime and shale streaks	27	169
Lime and shale	82	251
Hard lime	98	349
Lime and shale	61	410

Table 7. - Drillers' logs of selected wells in the North Fort Hood area - Continued

Well HB-40-35-108 continued

	Thickness (feet)	Depth (feet)
Shale and sand streaks	20	430
Lime and shale	26	456
Sandy shale and lime	17	473
Lime and shale	43	516
Fine sand	24	540
Red, gray and brown shale and sandy shale streaks	28	568
Shale and lime streaks	52	620
Shale (red)	47	667
Fine sand	43	710
Hard red and yellow shale	64	774

Well HB-40-35-403

Owner: City of Gatesville
Driller: Kenton Preston

	Thickness (feet)	Depth (feet)
Soil	5	5
Caliche	15	20
Blue shale	40	60
Sand (dry)	10	70
Lime (chalky)	430	500
Sand, 10 bph	15	515
Shale (green)	10	525
Red bed	125	650
Red bed (broken)	20	670
Red bed (sandy)	20	690
Red sand	5	695
Sand (water)	10	705
Sand and gravel - water	97	802
Yellow clay - sandy	13	815
Yellow clay	13	828

Well HB-40-35-404

Owner: City of Gatesville
Driller: Layne-Texas Co.

	Thickness (feet)	Depth (feet)
Surface soil	2	2
Gravel	2	4
Yellow clay and caliche	16	20
Blue shale	25	45
Lime	5	50
Sand (water)	6	56
Blue shale	2	58
Sand	12	70
Lime	5	75
Lime (white)	115	190
Sand	20	210

Well HB-40-404 continued

	Thickness (feet)	Depth (feet)
Lime (white)	40	250
Gray shale	100	350
Lime and shale	110	460
Shale and sandy lime	33	493
Sand (water)	32	525
Red bed	85	610
Red shale	20	630
Red bed	34	664
Gray sand	11	675
Gray sand and lime	10	685
Sand and gravel	10	695
Sand	15	710
Sand, gravel, and shale	20	730
Hard sand and gravel	5	735
Yellow clay	7	742
Blue shale	13	755

Well HB-40-35-405

Owner: City of Gatesville
Driller: R. A. Adams and Son

	Thickness (feet)	Depth (feet)
Solid clay sand	12	12
Gray lime	348	360
Sandy lime	20	380
Gray lime	5	385
Shale	5	390
Sandy lime	33	423
Sand	14	437
Sandy shale	10	447
Water sand	19	466
Sandy shale	4	470
Red bed (sand and gravel)	70	540
Water sand	10	550
Pink shale	33	583
Water sand	8	591
Sandy shale	39	630
Water sand	23	653
Red bed	17	670
Shale	30	700

	Thickness (feet)	Depth (feet)
Well HB-40-35-409		
Owner: City of Gatesville Driller: Layne Texas Co.		
Rocky lime	20	20
Blue gray shale	169	189
Sandy shale	4	193
Lime and rock	172	365
Brown shale and lime	116	481
Hard shale	40	521
Broken shale	15	536
Hard shale and lime	75	611
Broken shale	5	616
Hard shale and lime	14	630
Sand and lime	39	669
Lime layers - sand and gravel	33	702
Hard shale	8	710
Red sandy clay and shale	11	721
Hard shale	2	723
Red sandy clay and lime	50	773
Hard sandy lime	22	795
Lime	5	800
Hard sandy shale	4	804
Hard shale	2	806
Sand, shale layers - gravel	45	851
Hard lime	4	855
Hard sand and gravel	14	869
Hard shale breaks, sandy shale	47	916
Well HB-40-35-410		
Owner: City of Gatesville No. 6 Driller: J. L. Myers		
Surface soil	4	4
Shale and gravel	36	40
Lime and shale	56	96
Lime	249	345
Shale	61	406
Broken sand and shale	52	458
Shale	40	498
Sandy shale	9	507
Shale	21	528
Sand	11	539
Sandy shale	36	575
Shale	25	600
Sand and shale	35	635
Red bed	26	661
Sand	20	681
Shale	31	712
Well HB 40-35-410 continued		
Sand	23	735
Red Bed	15	750
Sand	56	806
Shale	29	835
Well HB-40-35-502		
Owner: Mountain Water Supply Corp. No. 2 Driller: J. L. Myers		
Surface soil	3	3
Clay	7	10
Broken lime	544	554
Sand	6	560
Sandy lime	26	586
Broken sand	201	787
Sandy shale	23	810
Sand	25	835
Broken sand and shale	111	946
Sand	6	952
Sandy shale	12	964
Sand	51	1015
Broken sand	5	1020
Sand	14	1034
Lime	20	1054
Well HB-40-35-701		
Owner: Fort Gates Water Supply Corp. Driller: J. B. Farquharson		
Yellow clay	18	18
Blue shale	20	38
Chalky lime with blue shale streaks	7	45
Shale with lime streaks	37	82
Blue shale with sand and lime streaks	38	120
Chalky lime with shale, bentonite, and sand streaks	324	444
Chalky lime	113	557
Blue gumbo shale	13	570
Sand	18	588
Red bed	2	590
Sand	20	610
Red bed	8	618
Sand	5	623
Red bed	11	634
Sand	5	639
Red bed	19	658
Sand	8	666

	Thickness (feet)	Depth (feet)
Well HB-40-35-701 continued		
Red bed	31	697
Sand	21	718
Red bed	3	721
Sand	8	729
Red bed	3	732
Sand	20	752
Red bed	4	756
Sand	22	778
Red bed	7	785
Sand	15	800
Blue black shale	21	821
Well HB-40-35-801		
Owner: U. S. Army Driller: Layne Texas Co.		
Surface sand	2	2
Sandy red clay	6	8
Quicksand	10	18
Yellow sand and clay	2	20
Clay and gravel	20	40
Clay and gravel	15	55
Shale	3	58
Blue shale	2	60
Gray lime	65	125
Lime and shale	85	210
Lime and shale	85	295
Lime and shale	65	360
Lime and shale	50	410
Lime and shale	55	465
Lime and shale	25	490
Shells and lime	10	500
Lime	5	505
Lime	10	515
Shell	5	520
Lime and shale (top of first Trinity sand)	2	522
Sand	13	535
Sandy lime	15	550
Shale	20	570
Red bed	40	610
Red bed	50	660
Red bed	20	680
Red bed (top of second Trinity sand	5	685

	Thickness (feet)	Depth (feet)
Well HB-35-801 continued		
Sand	30	715
Sand	25	740
Broken sand	5	745
Dark shale	10	755
Well HB-40-35-802		
Owner: U. S. Army Driller: Layne Texas Co.		
Surface soil	15	15
Gravel and water sand	12	27
Lime	3	30
Sand (dry)	25	55
Broken lime and shale	40	95
White lime	35	130
Shale	35	165
Lime	40	205
Gray shale and shells	20	225
Broken lime	45	270
White lime	45	315
Gray shale	40	355
Broken lime	10	365
Lime	40	405
Shale	10	415
Gray shale and shells	40	455
Gray shale (top of first Trinity sand)	28	483
Soft water sand (bottom of first Trinity sand)	57	540
Red bed	45	585
Red bed	60	645
Water sand	17	662
Hard broken lime	5	667
Gravel and sand (bottom second Trinity sand)	13	680
Red bed	10	690
Well HB-40-35-803		
Owner: U. S. Army Driller: Layne Texas Co.		
Surface soil	1	1
Red clay	7	8
Sand and gravel	17	25
Sand and gravel	25	50
Lime and shale	65	115
Lime and shale	40	155
Lime and shale	105	260
Lime and shale	50	310
Lime and shale	40	350

Table 7. - Drillers' logs of selected wells in the North Fort Hood area - Continued

	Thickness (feet)	Depth (feet)
Well HB-40-35-803 continued		
Lime and shale	55	405
Lime and shale	40	445
Lime and shale	40	485
Sandy shale	9	494
Sand shale (top first Trinity sand)	2	496
Sand	5	501
Sand	6	507
Sand (bottom first Trinity sand)	10	517
Sandy shale	13	530
Red bed	5	535
Red bed	20	555
Red rock and shale	20	575
Red rock and shale	22	597
Red rock and shale	13	610
Red rock and shale	25	635
Sand, shale (top second Trinity sand)	30	665
Sand (bottom second Trinity sand)	45	710
Dark shale	11	721
Well HB-40-35-804		
Owner: Jack Fry; Driller: Layne Texas Co.		
Surface soil	4	4
Yellow clay and gravel	6	10
Yellow clay	10	20
Blue rock	11	31
Lime and shale	88	119
Broken lime and shale	31	150
Glen Rose sand lime	36	186
Lime and shale	297	483
Sandy lime	15	498
Shale (top first Trinity sand)	6	504
Sand	31	535
Sand and shale (bottom first Trinity sand)	8	543
Red bed	80	623
Sand	17	640
Red bed	20	660
Sandy shale (top second Trinity sand)	20	680
Sand (bottom second Trinity sand)	51	731
Broken shale	4	735

	Thickness (feet)	Depth (feet)
Well HB-40-35-804 continued		
Dark shale	10	745
Well HB-40-35-805		
Owner: U. S. Army; Driller: Layne Texas Co.		
Surface soil (black)	5	5
Yellow clay	10	15
Yellow clay and gravel	10	25
Blue shale and shells	15	40
Gray lime and shell	85	125
Lime and shale	395	520
Sandy lime	7	527
Sandy shale (top first Trinity sand)	11	538
Sand	2	540
Sand (bottom first Trinity sand)	7	547
Lime	4	551
Red rock	5	556
Red bed	119	675
Hard, sandy shale (top second Trinity sand)	25	700
Sand	48	748
Shale	11	759
Well HB-40-35-806		
Owner: Fort Gates Water Supply Corp.; Driller: J. L. Myers		
Surface soil	3	3
Clay	13	16
Broken sand	544	560
Sandy lime	11	571
Red bed	9	580
Sandy lime	62	642
Shale	18	660
Sand and shale streaks	20	680
Lime	17	697
Well HB-40-36-602		
Owner: Oglesby Water Supply Corp.; Driller: Key Water Well Drilling Developme Corporation		
Lime	424	424
Sandy lime	314	738
Sand	382	1120
Hard lime	100	1220

	Thickness (feet)	Depth (feet)
Well HB-40-43-201		
Owner: U. S. Army Driller: Layne Texas Co.		
Yellow clay and rock	60	60
Gray lime and shell	266	326
Hard gray lime	34	360
Gray lime	65	425
Gray lime and breaks of shale	45	470
Sandy lime (top of first Trinity sand)	35	505
Sand	3	508
Sand	30	538
Sand (bottom of first Trinity sand)	14	552
Shale	13	565
Red rock	10	575
Shale	25	600
Shale	5	605
Sand	5	610
Red bed	30	640
Blue shale	25	665
Red rock	5	670
Hard shale	5	675
Red rock (top of second Trinity sand)	18	693
Sand	8	701
Gravel sand	30	731
Shale and broken sand	4	735
Sand (bottom of second Trinity sand)	13	748
Blue shale	9	757
Dark shale	3	760
Dark shale	5	765
Well HB-40-43-202		
Owner: U. S. Army Driller: Layne Texas Co.		
Yellow clay	14	14
Hard lime	35	49
Blue shale	27	76
Lime	64	140
Broken Lime	30	170
Shale and lime shells	20	190
Broken shale and sand	8	198
Sand and shells	17	215
Broken lime	45	260
White lime	15	275
Broken lime	45	320
Blue shale	15	335
Well HB-40-43-202 continued		
Broken lime and shale	30	365
Lime	31	396
Shale	4	400
Lime	25	425
Sandy shale and shells	30	455
Blue shale	5	460
Broken lime	20	480
Shale	10	490
Lime	25	515
Broken lime	10	525
Shale and lime	23	548
Blue shale (top of first Trinity sand)	4	552
Water sand	14	566
Sand and gravel (bottom of first Trinity sand)	34	600
Gray shale	5	605
Red bed	40	645
Lime	13	658
Broken lime and shale	7	665
Blue shale	5	670
Red gumbo	25	695
Red bed	10	705
Blue shale	14	719
Red bed	9	728
Water sand and gravel (second Trinity sand)	34	762
Red bed	10	772
Well HB-40-43-203		
Owner: U. S. Army Driller: Layne Texas Co.		
Yellow shale	20	20
Blue shale	53	73
Lime	4	77
Blue shale	13	90
Broken lime	15	105
Blue shale	10	115
Lime	54	169
Lime and shale	13	182
Lime	6	188
Broken lime	42	230

	Thickness (feet)	Depth (feet)
Well HB-40-43-203 continued		
Hard lime	30	260
Broken lime	21	281
Lime and shale	29	310
Lime	139	449
Hard lime	28	477
Lime	17	494
Hard lime	6	500
Broken lime	15	515
Lime	41	556
Broken lime	15	571
Lime	2	573
Gray shale	6	579
Gray sand	4	583
Shale	2	585
Blue shale	5	590
Broken sand	6	596
Sand and gravel	49	645
Red, sticky shale	3	648
Red shale	5	653
Blue shale	10	663
Gray shale	2	665
Red shale	15	680
Blue shale	10	690
Red bed	22	712
Red shale	44	756
Red and blue shale	9	765
Sand, second Trinity sand	20	785
Red bed	10	795
Well HB-40-43-204		
Owner: U. S. Army Driller: Layne Texas Co.		
Red and yellow clay	20	20
Lime and blue shale	55	75
Gray lime and shale	90	165
Lime and shale	120	285
Gray lime and shale	60	345
Gray lime and shale	15	360
Lime	25	385
Lime and shale	148	533
Shale (top of first Trinity sand)	15	548
Red bed	7	555
Sandy shale	10	565
Red rock	10	575
Well HB-40-43-204 continued		
Shale	20	595
Sandy shale	5	600
Red bed	35	635
Red bed (hole caving)	15	650
Red bed	35	685
Sand (top of second Trinity sand)	27	712
Shale	1	713
Red rock	12	725
Sand	23	748
Sandy lime	5	753
Sand	5	758
Well HB-40-43-205		
Owner: U.S. Army Driller: Layne Texas Co.		
Sandy soil	2	2
Sandy clay	5	7
Quicksand	23	30
Blue rock	10	40
Lime and shale	450	500
Shell	10	510
Lime and shale (top of first Trinity sand)	7	517
Sand	8	525
Broken sand	5	530
Sand	3	533
Lime	4	537
Red rock and lime	133	670
Broken sand	2	672
Sandy shale (top of second Trinity sand)	3	675
Sand	55	730
Shale (break in sand)	5	735
Coarse sand	10	745
Sandy shale	5	750
Dark shale	5	755
Well HB-40-43-206		
Owner: U. S. Army Driller: Layne Texas Co.		
Yellow clay and gravel	30	30
Blue shale	30	60
Sand	15	75
Lime	12	87
Sandy lime and shale	43	130
Broken lime	20	150
Blue shale	20	170
Sand	5	175

Table 7. - Drillers' logs of selected wells in the North Fort Hood area - Continued

Well HB-40-43-206 continued

	Thickness (feet)	Depth (feet)
Sandy shale	7	182
Sandy shale and lime	8	190
Lime (soft)	45	235
Gray shale	20	255
Blue shale and shells	5	260
Gray shale	10	270
Sand	5	275
Gray shale	33	308
Hard lime	7	315
Broken lime	25	340
Hard lime	7	347
Hard lime	23	370
Sandy shale and shells	32	402
Lime	8	410
Broken lime and shale	15	425
Broken lime	35	460
Gray shale	5	465
Lime	10	475
Sandy shale and shells	30	505
Broken sand and shale	30	535
Sand (water)	27	562
Sand	15	577
Red bed	28	605
Lime	5	610
Blue shale	5	615
Blue shale	15	630
Red bed	10	640
Red bed	18	658
Blue shale	5	663
Red bed	5	668
Blue shale	14	682
Sand and shale	8	690
Soft water sand	15	705
Sand and gravel	15	720
Brown shale	15	735

Well HB-40-43-207

Owner: U. S. Army
Driller: Layne Texas Co.

	Thickness (feet)	Depth (feet)
Surface soil	2	2
Yellow clay	5	7
Yellow lime	18	25
Blue rock	35	60
Gray lime and shale	40	100
Gray lime and shale	130	230
Lime and shale	265	495

Well HB-40-43-207 continued

	Thickness (feet)	Depth (feet)
Sandy lime	10	505
Sandy shale (top of first Trinity sand)	13	518
Sand	32	550
Sand, coarse (bottom of first Trinity sand)	12	562
Shale	3	565
Bed rock and shale	55	620
Shale (top of second Trinity sand)	40	660
Sand	5	665
Broken sand	25	690
Sand	35	725
Sand, coarse (bottom of second Trinity sand	10	735
Shale	10	745

Well HB-40-43-501

Owner: U. S. Army
Driller: U. S. Army Corps of Engineers

	Thickness (feet)	Depth (feet)
Clay	4	4
Clay, gravel, etc.	6	10
Limestone, yellowish	20	30
Limestone, gray, with streaks of shale	455	485
Shale	5	490
Limestone, gray	70	560
Reddish purple shale or clay	10	570
Limestone	15	585
Very small streak of sand	1	586
Limestone, reddish brown with greenish color	34	620
Limestone with sandstone streaks (hard material 630-640 ft)	22	642
Brown shale, flakey	32	674
Sandstone	2	676
Brown shale, flakey with sandstone streak	15	691
Limestone, gray, hard (drills slowly)	7	698
Shale, reddish brown with sandstone streaks	46	744
Shale with small streaks of sand and small quartz grains	6	750
Sandstone quartz and limestone, very hard (drills slowly)	22	772
Shale, brown	32	804
Brown shale with very hard sandstone streaks	26	830
Blue shale, with hard streaks	10	840

Table 7. - Drillers' logs of selected wells in the North Fort Hood area - Continued

Well HB-40-43-603

Owner: Flat Water Supply Corp.
Driller: Hervey Meadows and Son Well Drillers

	Thickness (feet)	Depth (feet)
Soil	3	3
Rock and chalk	17	20
Blue rock	40	60
Lime	55	115
Shale mixed with lime	380	495
Glen Rose lime	293	788
Hensell sand	85	873
Red bed - peat gravel	22	895
Red bed, peat gravel, quartzite, pyrites, and shale	75	970
Hosston sand	20	990
Shale	3	993

Well HB-40-43-604

Owner: U. S. Army
Driller: U. S. Corps of Engineers

	Thickness (feet)	Depth (feet)
Clay	3	3
Clay, gravel	3	6
Limestone with shale streaks	60	66
Shale with lignite streaks	4	70
Limestone	400	470
Shale	9	479
Limestone	83	562
Coarse sand	13	575
Limestone, gray brown	30	605
Reddish brown shale (red bed)	5	610
Limestone, gray brown	17.5	627.5

Well HB-40-44-902

Owner: The Grove Water Supply Corporation
Driller: Hervey Meadows and Son Well Drillers

	Thickness (feet)	Depth (feet)
Black soil	2	2
Chunk and white rock	18	20
Blue rock	35	55
Blue shale	5	60
White rock	50	110
Bluish gray shale	40	150
Lime	30	180
Dark Gray shale	179	359
Glen Rose lime	511	870
Green shale	5	875
First Trinity sand	45	920
Black shale	75	995
Red bed	64	1059
Second Trinity sand	61	1120
Hard black shale glassy	6	1126

Table 8.--Water-quality data for ground-water samples from wells in the North Fort Hood area

(All analyses are by the U.S. Geological Survey or Texas State Department of Health except where noted. Sodium and potassium are calculated as sodium except where a value for potassium is listed. Bicarbonate is adjusted to carbonate by using a factor of 0.4917 in the calculation of dissolved solids used from reported analyses.)

Water-bearing units: Kgr - Glen Rose Formation, Khe - Hensell Member of the Travis Peak Formation; Kho - Hosston Member of the Travis Peak Formation; Kpe - Pearsall Member of the Travis Peak Formation; Ktp - Travis Peak Formation

(mg/L -milligrams per liter; µg/L -micrograms per liter; micromhos - micromhos per centimeter at 25° Celsius; °C -degrees Celsius)

WELL	DEPTH OR PRODUC-ING INTERVAL (feet)	WATER-BEARING UNIT	DATE	SILICA (SIO_2) (mg/L)	IRON (FE) (µg/L)	MANGA-NESE (MN) (µg/L)	CAL-CIUM (CA) (mg/L)	MAGNE-SIUM (MG) (mg/L)	SODIUM (NA) (mg/L)	POTAS-SIUM (K) (mg/L)	BICAR-BONATE (HCO_3) (mg/L)	ALKA-LINITY AS CALCIUM CAR-BONATE ($CACO_3$) (mg/L)	SUL-FATE (SO_4) (mg/L)	CHLO-RIDE (CL) (mg/L)	FLUO-RIDE (F) (mg/L)	NITRATE (N) (mg/L)	DIS-SOLVED SOLIDS (SUM OF CONSTIT-UENTS (mg/L)	HARD-NESS (CA,MG) (mg/L)	PER-CENT SODIUM	RE-SIDUAL SODIUM CAR-BONATE (RSC)	SODIUM AD-SORP-TION RATIO (SAR)	SPECIFIC CONDUCT-ANCE (micro-mhos)	PH (units)	TEM-PERA-TURE (°C)
58-40-35-101	728	Ktp	8- -42	13	50	--	8	5	400	--	451	--	291	191	2.2	1	1,100	--	95	6.5	27	--	8.1	--
103	575-770	Khe Kho	7- 9-52	21	60	--	18	29	285	--	483	--	283	181	2.8	1.3	1,181	141	79	4.6	10	--	8.4	--
104	584-760	Khe Kho	7- 9-52	6	20	--	19	17	359	--	445	--	269	181	2.6	.4	1,074	118	87	4.9	14	--	8.4	--
			9-23-82	--	--	--	--	--	--	--	--	330	--	180	--	--	--	--	--	--	--	1,850	8.2	26
107	584-882	Kho	12- 6-64	0	0	--	5	3	367	--	447	--	183	176	2.3	3	959	27	97	6.8	32	1,804	8.1	--
			9-23-82	11	--	--	6	2	360	3	--	330	180	75	2.1	--	972	23	97	--	36	1,600	8.3	27
108	650-715	Kho	11- 6-69	--	10	--	7	4	395	--	364	--	212	222	2.0	2.8	1,024	34	96	5.2	30	1,550	8.3	--
			6- 8-78	--	20	2	7	3	394	4	431	353	214	242	1.9	0	1,080	30	--	--	--	2,016	8.3	--
401	680	Ktp	5-25-42	32	20	--	16	6	423	--	415	--	210	277	2.2	.4	1,172	65	93	5.5	23	--	8.3	
			6- 3-46	10	10	--	8	4	457	--	448	--	211	293	3.0	4.0	1,211	38	96	6.6	33	2,070	8.0	--
			7- 2-53	25	0	--	21	5	415	--	458	--	207	273	2.0	.4	1,173	73	93	6.0	21	--	7.9	--
			4-24-64	--	0	--	13	8	468	--	467	--	382	213	.9	.4	1,314	67	94	6.3	25	2,519	8.3	--
402	680	Ktp	8-15-42	--	--	--	8	5	455	--	447	--	234	296	--	.0	1,217	39	96	6.5	31	--	8.0	--
			6- 3-46	3	10	--	8	5	461	--	442	--	233	286	4.0	2.2	1,219	40	96	6.4	31	2,120	7.6	--
			7- 2-53	18	0	--	24	4	413	--	458	--	206	273	2.0	.4	1,165	77	92	5.9	20	--	7.9	--
			10-24-64	--	0	--	20	14	435	--	442	--	357	234	.7	1.5	1,279	107	90	5.0	18	2,442	8.0	--
			10-12-65	--	20	--	16	9	464	--	467	--	384	201	4.6	.4	1,310	75	93	6.1	23	2,496	8.0	--
			9-22-82	--	--	--	--	--	--	--	--	400	--	220	--	--	--	--	--	--	--	2,170	8.0	27.0
403	702-802	Kho	11- 6-57	--	10	--	7	4	425	--	460	--	188	300	2.0	.4	1,153	35	95	6.8	32	1,900	7.7	--
			7- 2-63	14	60	--	27	11	383	--	439	--	249	231	1.8	.4	1,139	113	88	4.9	15	--	8.0	--
1/ 404	695-739	Kho	7-21-55	14	10	--	9	4	453	--	415	--	202	320	--	--	1,212	39	96	6.0	32	--	8.4	--
			4-24-64	--	0	--	8	5	435	--	428	--	201	288	.4	.4	1,148	39	96	6.2	20	2,244	8.0	--
			9-22-82	--	--	--	--	--	--	--	--	360	--	300	--	--	--	--	--	--	--	1,940	8.2	--
405	425-565	Ktp	4-24-64	--	0	--	7	4	435	--	428	--	202	298	.4	1.5	1,158	33	97	6.3	32	2,277	8.0	--
407	700	Ktp	4-27-40	16	10	--	12	8	432	--	380	--	216	280	2.6	3.0	1,157	64	94	4.9	24	--	8.2	--
409	735-875	Kho	10-18-73	11	--	--	7	3	394	--	426	--	220	218	2.1	2.7	1,067	29	97	6.3	31	1,660	7.8	--
			7-24-74	13	--	--	12	4	383	--	439	--	200	218	2.2	3.7	1,051	44	95	6.2	24	1,700	8.0	--
2/ 410	755-805	Kho	3-26-74	--	10	0	7	4	395	--	408	358	219	220	1.5	--	1,062	34	--	--	--	1,600	8.3	--
			9-22-82	11	--	--	6	3	390	3	--	360	200	240	2.1	--	1,070	28	96	--	35	1,810	8.0	27

See footnotes at end of table.

Table 8.--Water-quality data for ground-water samples from wells in the North Fort Hood area--Continued

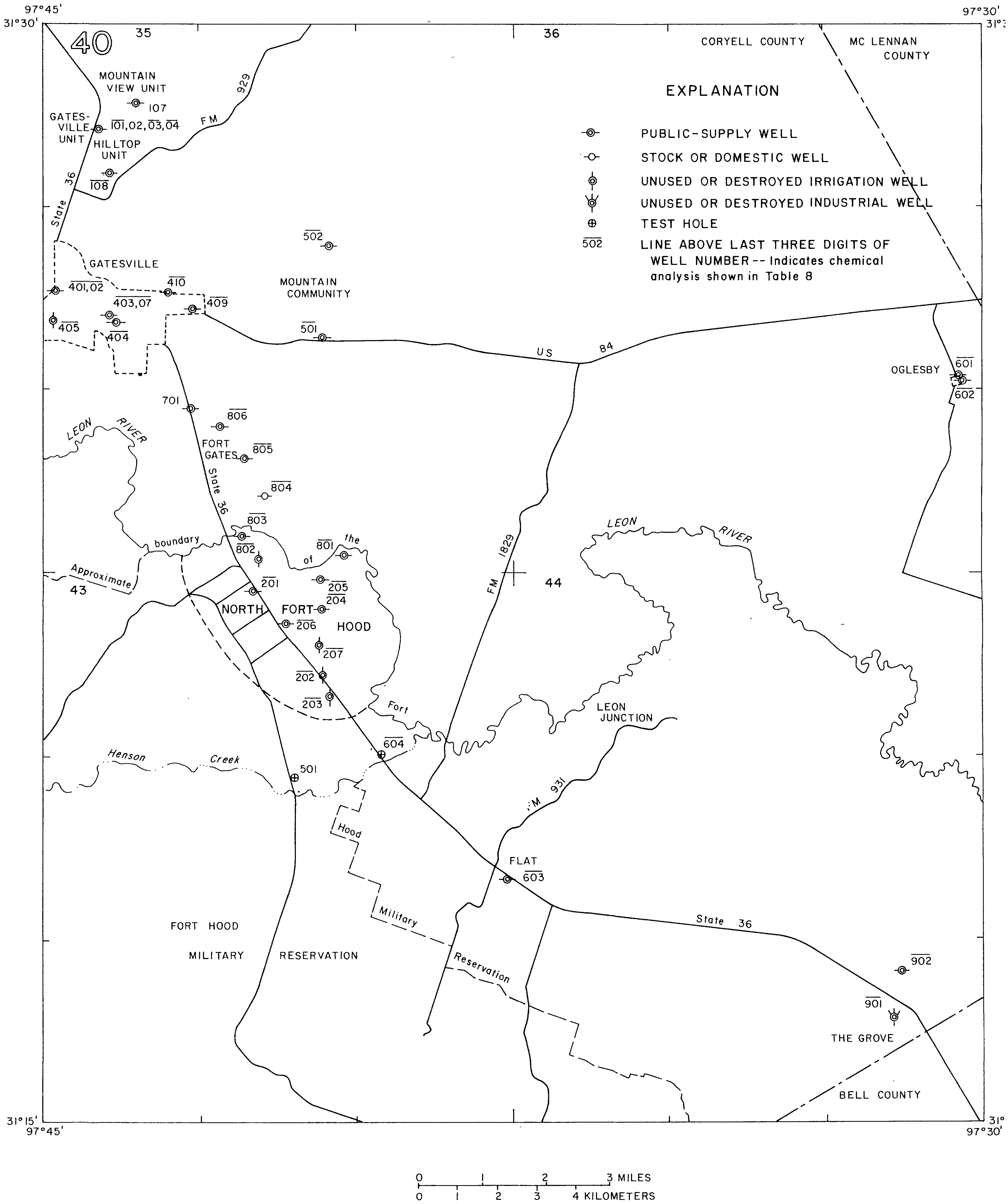
WELL	DEPTH OR PRODUC- ING INTERVAL (feet)	WATER- BEARING UNIT	DATE	SILICA (SIO_2) (mg/L)	IRON (FE) (µg/L)	MANGA- NESE (MN) (µg/L)	CAL- CIUM (CA) (mg/L)	MAGNE- SIUM (MG) (mg/L)	SODIUM (NA) (mg/L)	POTAS- SIUM (K) (mg/L)	BICAR- BONATE (HCO_3) (mg/L)	ALKA- LINITY AS CALCIUM CAR- BONATE ($CACO_3$) (mg/L)	SUL- FATE (SO_4) (mg/L)	CHLO- RIDE (CL) (mg/L)	FLUO- RIDE (F) (mg/L)	NITRATE (N) (mg/L)	DIS- SOLVED SOLIDS (SUM OF CONSTIT- UENTS (mg/L)	HARD- NESS (CA,MG) (mg/L)	PER- CENT SODIUM	RE- SIDUAL SODIUM CAR- BONATE (RSC)	SODIUM AD- SORP- TION RATIO (SAR)	SPECIFIC CONDUCT- ANCE (micro- mhos)	PH (units)	TEM- PERA- TURE (°C)
HB-40-35-501	1,045	Kho	1-14-76	--	0	5	6	3	354	--	448	367	280	184	1.8	4	1,180	26	--	--	--	1,796	8.3	--
2/ 502	972- 1,042	Kho	2- 3-75	--	10	--	6	3	366	--	444	380	186	177	1.7	0	975	27	--	--	--	1,175	8.1	--
			1-14-76	--	10	5	5	4	347	--	434	362	180	176	1.5	3.3	1,160	29	--	--	--	1,769	8.4	--
2/ 701	700-796	Kho	8- 3-64	--	10	--	7	4	453	--	400	--	214	308	.5	--	1,184	36	97	5.8	34	--	8.4	--
			10-21-64	--	10	--	8	4	435	--	426	--	195	298	2.0	.4	1,152	37	96	6.2	31	2,222	8.3	--
			1-14-76	--	0	5	8	3	422	--	422	352	187	295	1.7	<.4	1,340	34	--	--	--	2,240	8.4	--
			3-10-80	11	--	--	9	4	437	--	422	--	219	302	1.7	4.2	1,195	37	96	6.1	30	1,600	8.2	--
			10- 5-82	--	--	--	--	--	--	--	--	350	--	290	--	--	--	--	--	--	--	2,050	8.3	27
801	516-744	Khe Kho	6-25-43	34	20	--	7	5	412	--	462	--	230	222	2.0	.0	1,141	40	96	6.8	29	1,870	8.5	--
			9- 9-55	14	0	--	7	4	402	--	438	--	236	210	2.0	2.5	1,092	34	96	6.5	30	1,820	7.5	--
			9-21-82	--	--	--	--	--	--	--	--	390	--	220	--	--	--	--	--	--	--	2,200	8.0	25
802	478-678	Khe Kho	5-19-43	12	10	--	12	7	487	--	461	--	298	298	2.8	1.5	1,345	58	95	6.3	28	--	8.5	--
			11- 3-43	12	10	3	12	7	487	5	461	389	314	292	3.2	.8	1,350	62	--	--	--	2,650	7.8	--
			9- 9-55	14	10	--	13	7	483	--	445	--	309	295	3.0	4.0	1,347	62	94	6.0	27	2,250	7.5	--
3/			11- 3-76	12	30	3	16	9	460	5	--	389	294	276	4.5	--	4/1,450	77	--	--	--	2,492	8.0	--
803	492-710	Khe Kho	5- 1-43	12	10	--	10	6	469	--	456	--	256	300	--	.5	1,277	50	95	6.4	29	--	--	--
			8-30-46	12	0	--	10	5	463	--	448	--	246	300	2.4	2.0	1,260	46	--	--	--	2,520	7.8	--
			7-10-52	14	20	--	9	6	465	--	450	--	240	305	2.0	.0	1,264	44	96	6.4	29	2,210	8.5	--
3/			11- 3-76	12	30	--	16	9	460	5	--	358	296	297	4.5	--	4/1,492	75	--	--	--	2,547	7.9	--
804	492-737	Khe Kho	7- 2-43	26	10	--	9	5	428	--	454	--	219	262	1.6	.0	1,174	41	96	6.5	28	1,930	8.3	--
			3-10-80	10	--	--	17	8	479	--	471	--	407	232	4.0	1.5	1,390	77	93	6.2	24	1,760	8.0	--
805	537-748	Khe Kho	2-22-43	15	10	--	8	5	419	--	432	--	215	259	2.2	1.0	1,137	40	96	6.2	29	1,137	8.3	--
			10- 5-82	--	--	--	--	--	--	--	--	360	--	240	--	--	--	--	--	--	--	1,920	8.2	--
806	713-782	Kho	10- 5-82	--	--	--	--	--	--	--	--	390	--	220	--	--	--	--	--	--	--	2,200	8.1	--
36-601	988- 1,106	Ktp	4-30-42	11	0	--	4	2	303	--	477	--	95	129	1.3	.0	779	20	97	7.4	31	--	8.2	--
			5-19-42	18	30	--	14	6	318	--	427	--	138	144	1.2	.4	852	60	92	5.8	18	--	8.4	--
			6- 3-46	14	20	--	8	7	429	--	493	--	300	166	2.2	1.5	1,172	50	95	7.1	27	2,020	8.5	--
			2- 5-61	--	10	--	7	4	345	--	467	--	195	129	1.4	.4	912	35	96	6.9	26	1,624	8.2	--
			1-27-64	--	10	--	4	6	359	--	472	--	209	146	1.8	.4	959	35	96	7.0	26	1,870	8.2	--
			2-17-65	12	--	--	8	4	361	--	482	--	197	149	2.1	.4	970	39	96	7.1	26	,610	7.8	--
			7-23-80	13	--	--	4	2	298	--	434	--	142	110	1.3	.1	785	19	97	6.7	30	1,128	8.6	--
2/ 602	956- 1,100	Kpe Kho	1-13-68	--	20	--	5	1	312	--	439	404	88	140	1.2	1.6	798	14	97	--	--	1,230	8.7	--
			10- 6-82	--	--	--	--	--	--	--	--	380	--	110	--	--	--	--	--	--	--	1,320	8.4	--
43-201	505-747	Khe Kho	5- 1-43	11	50	3	8	4	430	--	470	--	200	262	2.8	1.0	1,150	36	96	6.9	31	--	--	--
			8-30-46	12	16	--	16	10	535	--	430	--	408	320	4.8	1.0	1,520	79	--	--	--	2,910	7.5	--
			5-11-51	13	40	--	15	9	529	--	420	370	400	321	4.0	1.8	1,500	74	--	--	--	2,470	7.8	--
			7-10-52	13	20	--	8	6	454	--	442	--	245	285	3.2	4.0	1,237	44	96	6.3	30	2,150	8.2	--
			5-25-54	13	15	--	15	10	537	--	418	350	402	335	4.4	.2	1,490	78	--	--	--	2,530	8.1	--
			9- 9-55	14	0	--	11	6	472	--	431	--	291	290	3.2	4	1,360	--	--	--	--	2,270	--	--
			11- 3-76	10	10	3	16	9	460	4	--	350	334	308	4.2	--	4/1,430	69	--	--	--	2,427	--	--
			9-21-82	--	--	--	--	--	--	--	--	350	--	300	--	--	--	--	--	--	--	2,200	7.9	26.5

See footnotes at end of table.

Table 8.--Water-quality data for ground-water samples from wells in the North Fort Hood area--Continued

WELL	DEPTH OR PRODUC-ING INTERVAL (feet)	WATER-BEARING UNIT	DATE	SILICA (SiO_2) (mg/L)	IRON (FE) (µg/L)	MANGA-NESE (MN) (µg/L)	CAL-CIUM (CA) (mg/L)	MAGNE-SIUM (MG) (mg/L)	SODIUM (NA) (mg/L)	POTAS-SIUM (K) (mg/L)	BICAR-BONATE (HCO_3) (mg/L)	ALKA-LINITY AS CALCIUM CAR-BONATE ($CaCO_3$) (mg/L)	SUL-FATE (SO_4) (mg/L)	CHLO-RIDE (CL) (mg/L)	FLUO-RIDE (F) (mg/L)	NITRATE (N) (mg/L)	DIS-SOLVED SOLIDS (SUM OF CONSTIT-UENTS (mg/L)	HARD-NESS (CA,MG) (mg/L)	PER-CENT SODIUM	RE-SIDUAL SODIUM CAR-BONATE (RSC)	SODIUM AD-SORP-TION RATIO (SAR)	SPECIFIC CONDUCT-ANCE (micro-mhos)	PH (units)	TEM-PERA-TURE (°C)
HS-40-43-202	531-760	Khe Kho	3-10-43	8	0	--	10	6	460	--	446	--	246	298	2.6	.5	1,250	48	95	6.3	28	--	--	--
203	572-782	Khe Kho	5- 1-43	9	10	--	11	6	480	--	456	--	272	305	2.8	.8	1,310	66	94	6.4	29	--	7.9	--
204	533-746	Khe Kho	5- 6-43	10	40	--	13	8	505	--	439	--	293	350	2.2	0	1,402	66	94	5.8	27	--	7.9	--
			8-30-46	14	20	--	11	6	475	--	418	--	211	362	2.4	3.9	1,290	48	--	--	--	2,650	7.7	--
			9- 9-55	14	10	--	10	5	460	--	415	--	214	338	1.4	4.0	1,252	46	96	5.8	30	2,140	7.5	--
			11- 3-76	11	30	3	8	6	440	4	--	350	243	281	2.3	--	4/1,524	49	--	--	--	2,361	8.1	--
			9-21-82	--	--	--	--	--	--	--	--	350	--	290	--	--	--	--	--	--	--	2,050	7.9	26.0
205	518-681	Khe Kho	6- 4-43	10	10	--	10	7	437	--	446	--	239	270	1.8	0	1,195	49	95	6.2	26	--	8.5	--
			8-30-46	11	50	--	17	6	523	--	480	--	443	238	4.4	4.7	1,480	68	--	--	--	2,710	7.6	--
			9- 9-55	13	0	--	10	6	441	--	436	--	265	262	2.0	3.5	1,219	46	95	6.1	27	2,040	7.6	--
206	496-718	Khe Kho	3- 4-43	13	0	--	8	5	423	--	468	--	205	260	2.8	.5	1,153	38	95	6.8	29	--	--	--
			8-30-46	14	20	--	8	5	441	--	456	--	229	270	4.0	3.7	1,200	40	--	--	--	2,410	7.8	--
			9- 9-55	14	0	--	8	4	454	--	451	--	239	280	2.8	3.5	1,227	38	96	6.6	33	2,080	7.7	--
3/			11- 3-76	12	50	3	17	10	490	5	--	383	394	246	4.0	--	4/1,414	--	--	--	33	2,449	8.0	--
			9-15-82	--	--	--	--	--	--	--	--	360	--	--	--	--	--	--	--	--	--	2,070	8.2	26.0
207	517-733	Khe Kho	7- 2-43	14	10	--	10	5	458	--	450	--	221	309	2.2	1.0	1,242	46	96	6.4	30	2,080	8.4	--
3/			11- 3-76	8	30	3	14	8	440	4	--	392	366	219	3.6	.1	4/1,520	--	--	--	--	2,295	8.1	--
603	900-990	Kho	8-22-65	--	--	--	21	11	540	--	471	--	450	295	--	--	1,548	52	92	5.7	24	--	7.9	--
			9-29-65	--	10	--	8	3	351	--	445	--	183	183	1.8	2.0	964	34	96	5.5	27	1,226	8.3	--
			3-27-66	--	20	--	8	3	371	--	418	--	192	192	2.0	1.4	979	34	95	6.2	29	1,370	8.7	--
			11-13-79	--	20	2	8	3	372	2	447	--	201	196	1.8	.1	1,000	30	--	--	29	1,277	8.2	--
			10- 4-82	--	--	--	--	--	--	--	--	370	--	180	--	--	--	--	--	--	--	1,720	8.2	26.5
604	628	Ktp	9-14-82	--	--	--	20	17	620	6	--	330	520	460	3.3	1.5	1,850	120	91	4.2	25	2,990	8.2	--
44-901	990	Kgr Khe	1-24-61	9	0	--	34	24	503	--	428	--	704	134	4.5	7.4	1,636	184	86	3.3	16	2,450	8.0	--
4/ 902	1,015-1,125	Kho	10-25-68	--	--	--	9	2	335	--	425	--	178	150	.7	.0	883	23	96	6.3	26	--	8.2	--
			10-12-73	12	--	--	16	2	336	--	447	366	168	152	1.5	2.1	909	22	94	6.3	21	1,450	8.3	--
			7-24-74	13	--	--	5	2	330	--	440	361	172	153	1.9	1.3	894	21	97	6.7	31	1,440	8.1	--
			1-13-76	--	10	5	5	1	335	--	464	366	156	150	1.3	0	1,120	19	--	--	--	1,561	8.6	--
			3-10-80	12	--	--	5	2	338	--	427	362	180	150	1.2	.1	897	18	98	6.6	36	1,220	8.5	--

1/ Analysis by Curtis Laboratories.
2/ Analysis by Pope Testing Laboratory.
3/ Analysis by U.S. Army.
4/ No bicarbonate reported; total dissolved solids not reported as sum of constituents.
5/ Analysis by Trinity Testing.



Base from U.S. Geological Survey
Gatesville, 1958

Figure 2.-Location of wells and test holes.

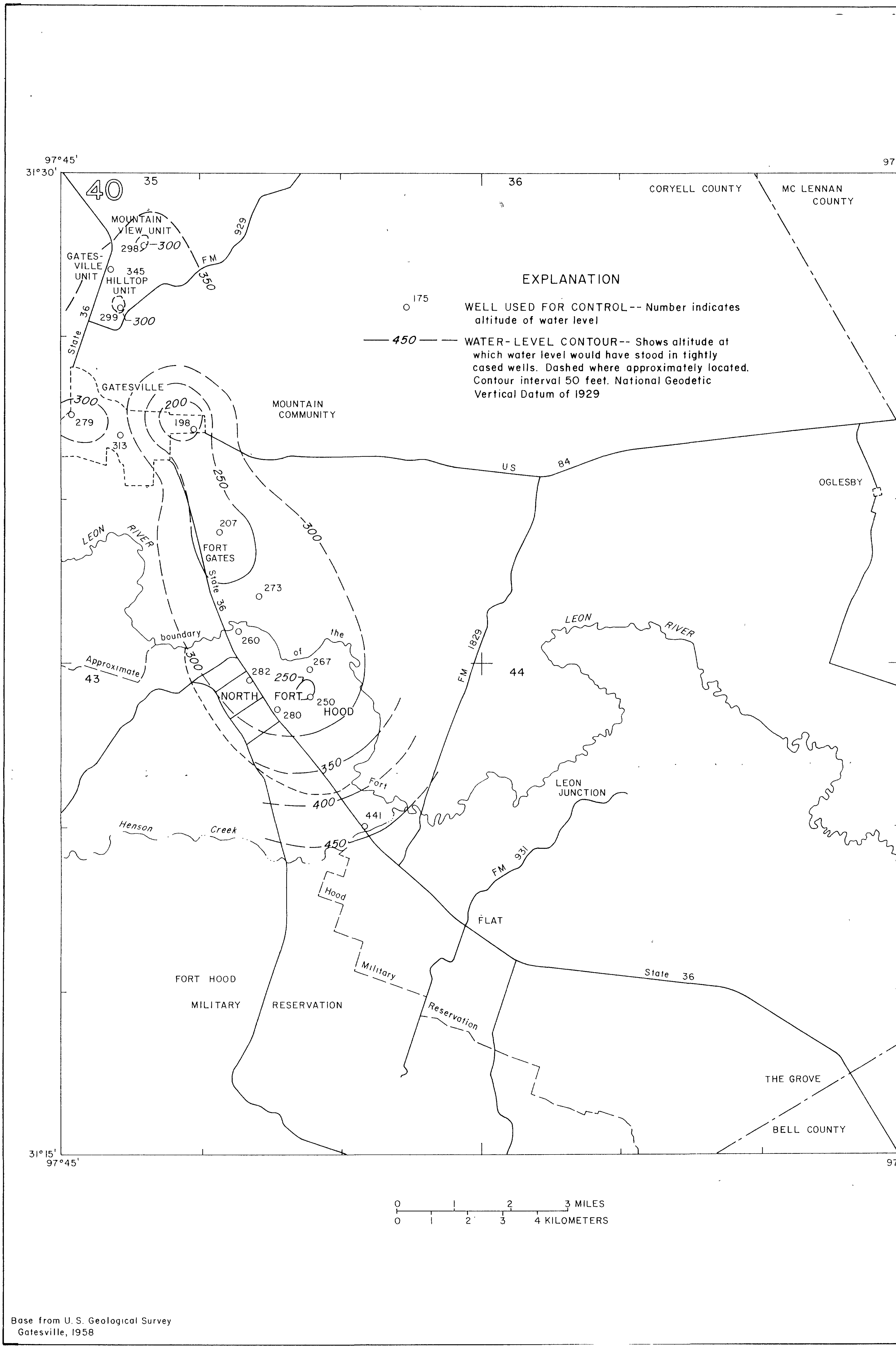


Figure 5.–Altitude of approximate water levels in wells screened in the Hensell and Hc Members of the Travis Peak Formation (of Klemt, Perkins, and Alvarez, 1975), September–November, 1982.