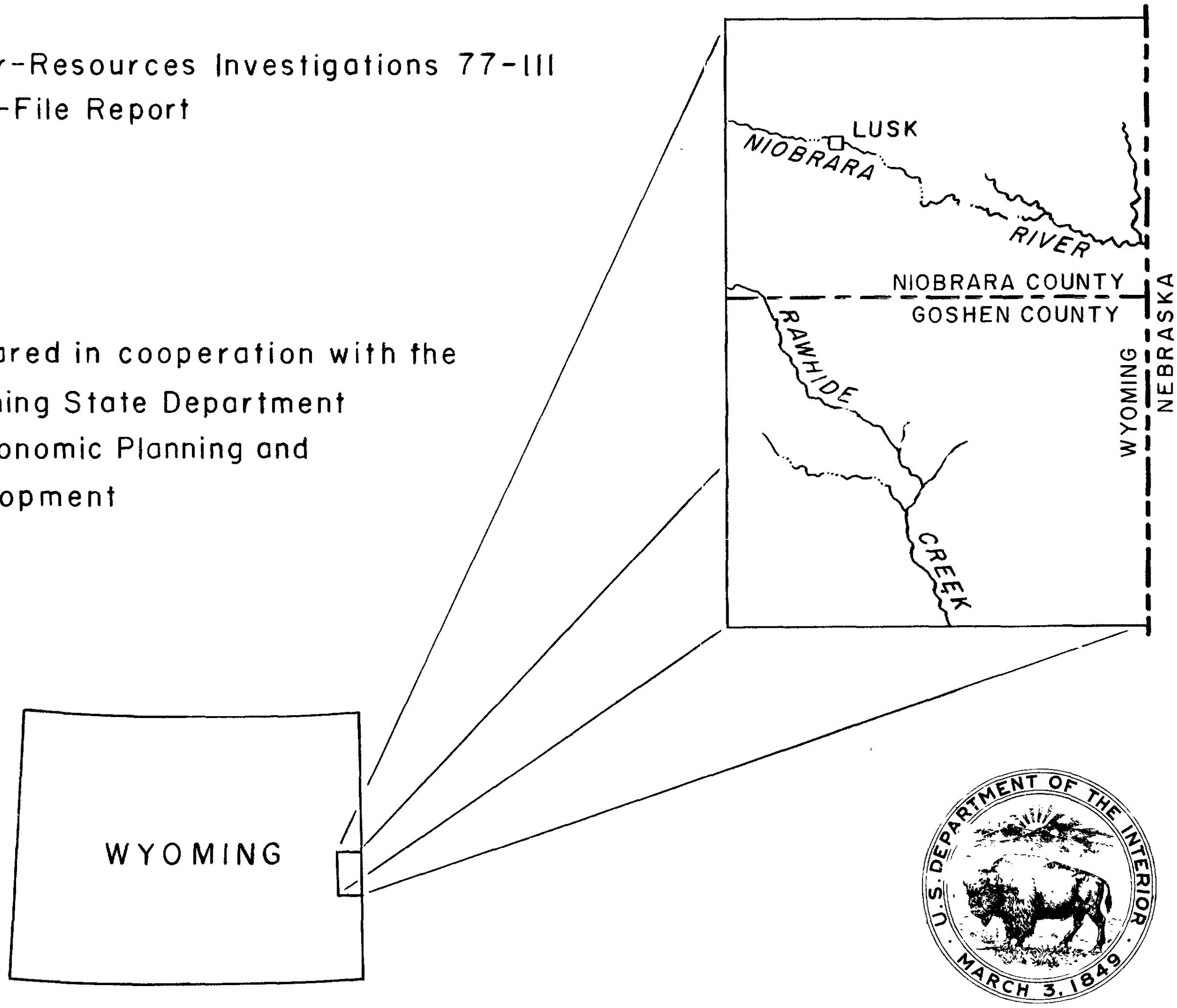
HYDROLOGIC EVALUATION OF THE ARIKAREE FORMATION NEAR LUSK, NIOBRARA AND GOSHEN COUNTIES, WYOMING

U. S. GEOLOGICAL SURVEY

Water-Resources Investigations 77-111
Open-File Report

Prepared in cooperation with the
Wyoming State Department
of Economic Planning and
Development



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Pumpage from public-supply and irrigation wells is estimated to have totaled about 48,000 acre-feet from 1938 through 1972. This pumpage did not cause any noticeable decrease in natural discharge and it is assumed there has been no significant change in ground-water storage. Pumpage is estimated to total about 39,500 acre-feet for the 3-year period 1973 through 1975.

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HYDROLOGIC ELEVATION OF THE ARIKAREE FORMATION NEAR LUSK, NIOBRARA AND GOSHEN COUNTIES, WYOMING

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ABSTRACT

The Arikaree Formation of early Miocene age is an aquifer of large areal extent and is composed of very fine grained, poorly bedded, loosely to moderately cemented sandstone and interbedded silt, limestone, and many concretionary layers. The area studied is about 800 square miles in southern Niobrara and northern Goshen Counties. Long-term average annual recharge to the aquifer from streams and precipitation is estimated to total about 24,270 acre-feet.

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A digital model was developed to simulate the ground-water system in the Arikaree Formation. The model can be used to indicate the general effect of applying hydraulic stresses to the aquifer.

INTRODUCTION

The area described in this report covers about 800 mi^2 in southern Niobrara and northern Goshen Counties, Wyoming (fig. 1). The area includes that part of the Arikaree Formation of early Miocene age between Rawhide fault and the Nebraska State line where potential exists for the development of ground water for domestic, industrial, and agricultural uses. Well yields of more than 800 gal/min are common. The number of irrigation wells in the study area has increased significantly since 1966 (fig. 2), and it is anticipated that the withdrawal of ground water will increase substantially in the next several years.

Surface-water supply of the upper Niobrara River basin available to Wyoming and to Nebraska is allocated by the Upper Niobrara River Compact, 1962. The term "Upper Niobrara River Basin" is defined as the area west of Range 55 of the 6th principal meridian in Wyoming and Nebraska that is drained by the Niobrara River. Article VI A of the Compact states, "Nebraska and Wyoming recognize that future use of ground water for irrigation in the Niobrara River Basin may be a factor in the depletion of the surface flows of the Niobrara River and, since the data now available are inadequate to make a determination in regard to this matter, any apportionment of the ground water of the Niobrara River Basin should be delayed until such time as adequate data on ground water of the basin are available."

State water administrators need additional information about characteristics of the aquifer, rate of ground-water withdrawal, and effect of withdrawal, to help them regulate ground-water development in the area. A study was needed that would describe the ground-water system in the Arikaree Formation in sufficient detail to provide information on the effects of ground-water use.

Purpose and Scope

The purposes of this investigation are (1) to define the ground-water system in the Arikaree Formation, (2) to determine the hydrologic cause-and-effect relationships resulting from the current ground-water development, and (3) to provide a means of indicating the hydrologic effect of future ground-water development.

Data from previous investigations, along with data compiled during this study, were used to develop a digital model of the hydrologic system in the Arikaree Formation. The model is used to indicate the effect of ground-water withdrawal at the 1975 rate in future years.

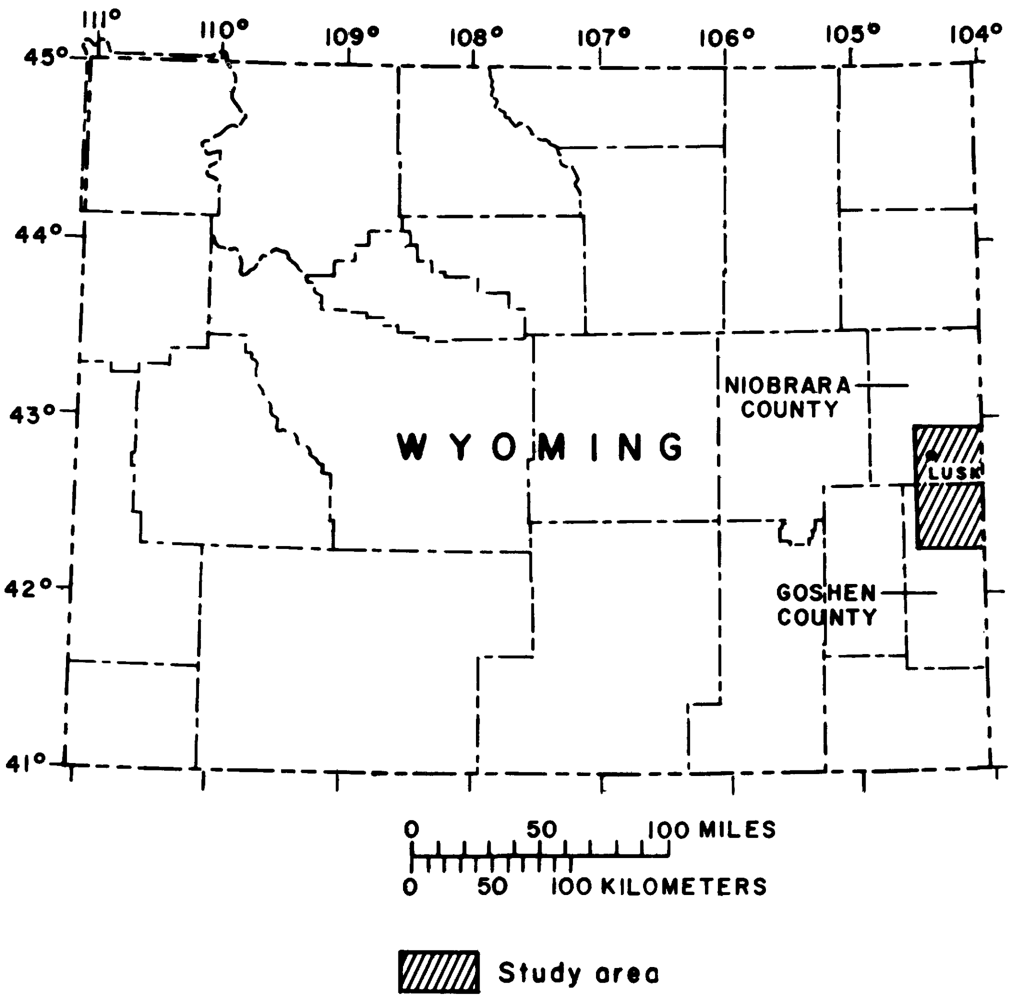

Figure 1.—Location of the study area.

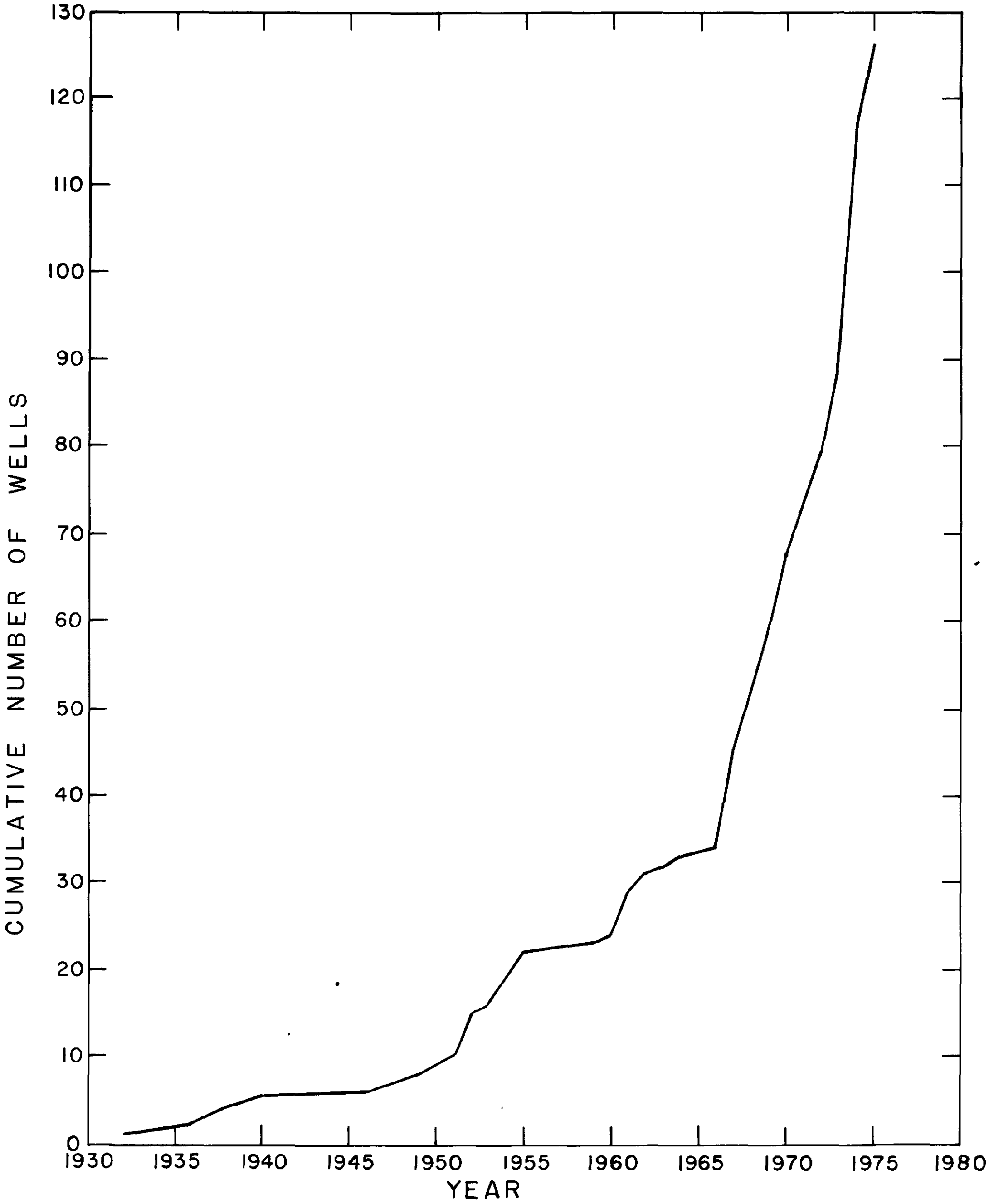

Figure 2.—Cumulative number of public-supply and irrigation wells in the study area.

Method of Investigation

The inventory of wells used for irrigation and public supplies was updated in 1975. Annual pumpage from irrigation wells was estimated on the basis of pump effeciency tests and power records, and pumpage from public-supply wells was estimated from records maintained by the town of Lusk.

The potentiometric surface was mapped using water levels measured in about 300 wells. The majority of the water levels were measured in June 1973; however, some water levels (beyond the influence of irrigation wells) were measured at other times of the year. Because of only minor seasonal water-level fluctuations in these wells, all are considered to be representative of the potentiometric surface in June 1973. Water levels measured periodically in 34 observation wells were published by the U.S. Geological Survey (Ballance and Freudenthal, 1975-76). Land-surface altitudes of all wells were determined by instrument leveling from control points established by the U.S. Air Force and the U.S. Geological Survey.

Acknowledgments

The author wishes to thank the many residents in the area who permitted U.S. Geological Survey personnel to measure water levels in wells and to make aquifer tests. The Niobrara Electric Association, Inc., Lusk, Wyo., and the Wyrulec Co., Lingle, Wyo., permitted access to power records for irrigation wells. Personnel from the Wyoming Department of Economic Planning and Development provided data from efficiency tests of irrigation wells in the study area.

Metric Units

For those readers interested in using the metric system, the following table may be used to convert the English units of measurement used in this report to metric units:

English	Multiply by	Metric
Acres	4.047×10^3	square meters (m^2)
Acre-feet	1.233×10^3	cubic meters (m^3)
Cubic feet per second (ft^3/s)	2.832×10^{-2}	cubic meters per second (m^3/s)
Cubic feet per second per square foot [$(ft^3/s)/ft^2$]	3.048×10^{-1}	cubic meters per second per square meter [$(m^3/s)/m^2$]. After unit cancellation = meters per second (m/s).
Feet (ft)	3.048×10^{-1}	meters (m)
Gallons per minute (gal/min)	6.309×10^{-5}	cubic meters per second (m^3/s)
	6.309×10^{-2}	liters per second (L/s)
Inches (in)	2.540×10^1	millimeters (mm)
Miles (mi)	1.609	kilometers (km)
Square feet (ft^2)	9.290×10^{-2}	square meters (m^2)
Square miles (mi^2)	1.609	square kilometers (km^2)

GEOHYDROLOGY

The Arikaree Formation is described in previous reports (Rapp and others, 1957; Whitcomb, 1965; Babcock and Keech, 1957, revised 1969; and Denson, 1974). Generally, the formation is composed of very fine grained, poorly bedded, loosely to moderately cemented sandstone with interbedded silt, limestone, and many concretionary layers. There are some channel deposits near the base that consist of medium to coarse sand and gravel. Configuration of the base of the Arikaree is shown by the structure contours in plate 1. The accuracy of the contours in the area from Rawhide Creek south to Whalen fault is questionable because of lack of control in that area.

Saturated thickness of the Arikaree, which generally contains water under unconfined conditions, was determined by superimposing the potentiometric-surface map (pl. 2) on the map showing the structure contours of the base of the Arikaree (pl. 1). For the sake of clarity, the water-level data used to construct the potentiometric-surface map are plotted on a separate map (pl. 3) and only the locations of the control data are shown in plate 2. The saturated thickness map (fig. 3) reflects some of the structural irregularities of the base of the Arikaree.

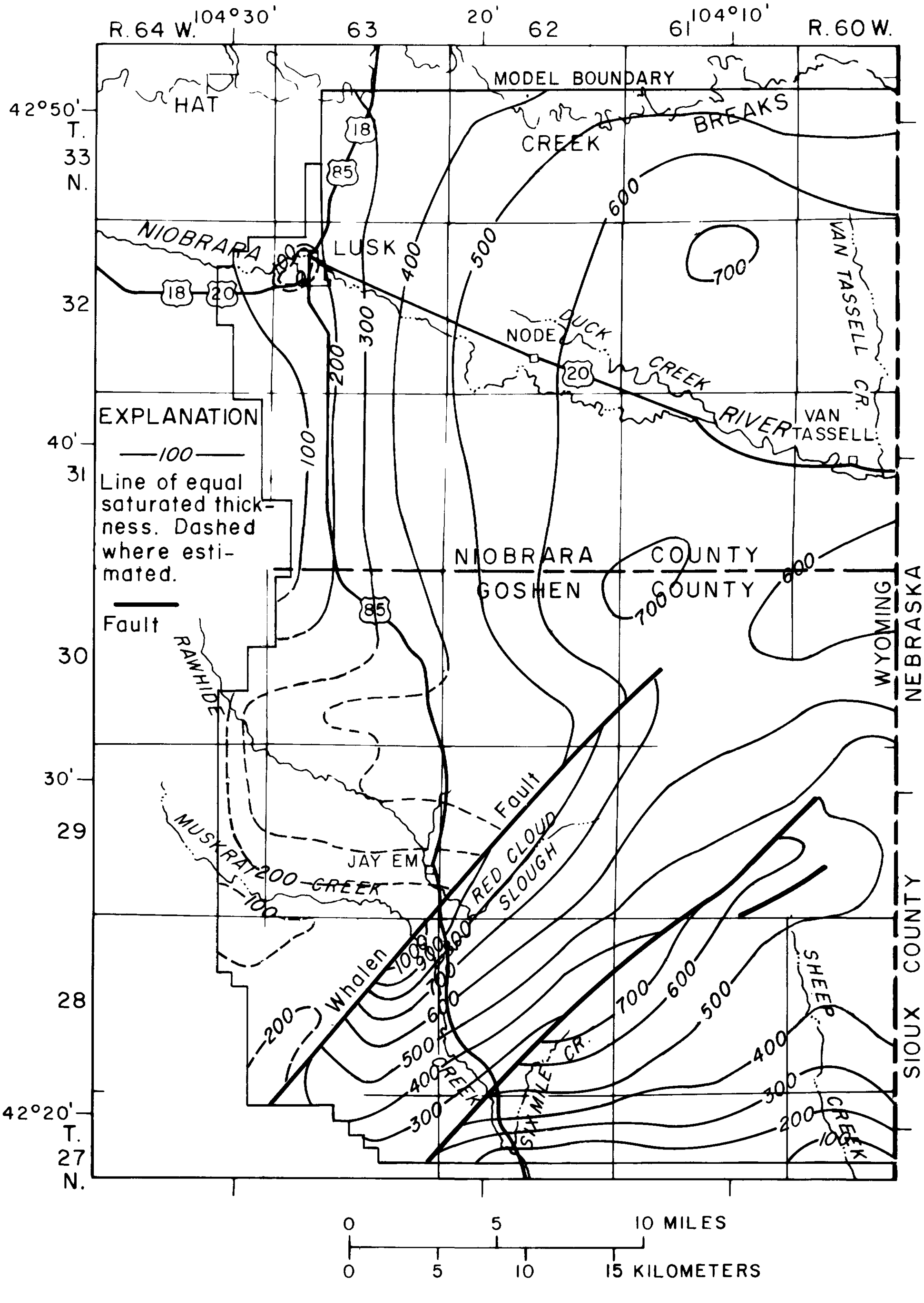

Figure 3.—Saturated thickness of the Arikaree Formation, June 1973.

The potentiometric-surface map was prepared on the assumption that there is only one potentiometric surface. This assumption may not be valid in the areas along the western and northern edge of the study area where steep gradients are indicated by the potentiometric-surface contours. Stock and domestic wells that are used for control in these areas penetrate the saturated zone only a few tens of feet; thus, the potentiometric surface mapped is the shallowest water table.

Data on the hydraulic conductivity and specific yield of the Arikaree Formation have been published by Rapp and others (1957, p. 42), Whitcomb (1965, p. 44 and 48), and Babcock and Keech (1957, revised 1969, p. 4). Hydraulic conductivity estimated from three aquifer tests made by M.E. Lowry (written commun., 1973) during this study ranged from 2.1×10^{-5} to 1.2×10^{-4} $(ft^3/s)/ft^2$. These tests were analyzed by the Theis nonequilibrium formula (Jacob, 1950, p. 368). The mean hydraulic conductivity from all these sources is about 6.0×10^{-5} $(ft^3/s)/ft^2$; however, the values of hydraulic conductivity used in the model range from 2.0×10^{-6} to 7.0×10^{-4} $(ft^3/s)/ft^2$.

The reported specific yield ranged from about 2 percent to about 46 percent with a mean value of 20 percent and a standard deviation of 14. Because of the wide range of specific yield values, 15 percent was arbitrarily selected for use in the model.

Ground-water movement across Rawhide fault is assumed negligible as the fault is considered a ground-water barrier. The altitude of the water table is more than 200 feet higher on the west side of the fault than on the east side. Small springs originating on the west side and flowing across the fault to the east are the only evidence of water moving across the fault. These springs are small and their total discharge probably is less than 0.1 ft^3/s. Therefore, it is assumed that all water moving eastward from Rawhide fault (pl. 2) is derived from precipitation east of the fault plus inflow from the Niobrara River.

GROUND-WATER BASIN

The 272 mi^2 area bounded by the Nebraska State line, the ground-water divides, and the ground-water barrier (pl. 2) formed by Rawhide fault (pl. 1) is referred to as a ground-water basin in this study. Ground water within this basin moves eastward and is discharged by evapotranspiration and by seepage into the Niobrara River. Water also leaves the basin by subsurface movement across the State line into Nebraska. Recharge to the basin is derived from precipitation and seepage from the Niobrara River which enters the basin from the west. All surface flow in the river is lost within 2 miles after the fault is crossed and the channel remains dry across the basin until it nears the west edge of T. 31 N., R. 61 W. From that point, the Niobrara River is perennial to the State line.

Over a period of time, recharge can be assumed to equal discharge provided that there is no change in storage. Ground-water development within the basin through 1972 has not noticeably affected the base flow of the Niobrara River at the Nebraska State line. A plot of the cumulative mean discharge versus time (fig. 4) at the State line gaging station for October, November, and December, from 1955 to 1975 indicates insignificant changes in the base flow of the river (U.S. Geological Survey, 1956-76). Baseflow period is defined as that period when the stream discharge is made up of discharged ground water. The small changes noted could be caused by the changes in precipitation indicated by the plot of cumulative annual precipitation versus time (fig. 5). Because of no significant changes in base flow, it is assumed no significant change in storage occurred in the ground-water reservoir within the basin during the years 1955-72. This assumption is supported by a test (discussed later in this report) which showed that estimated historical pumpage did not significantly affect the potentiometric-surface contours shown on plate 2.

Basin Discharge

On the basis of records at the Nebraska State line gaging station (pl. 3), the average base flow of the Niobrara River is estimated to be 3.3 ft^3/s. Examination of the potentiometric surface contours (pl. 2) indicates gaining and losing reaches in the Niobrara River above the gaging station; however, there is a net gain in streamflow for the total reach. During the baseflow period, evapotranspiration is considered minimal and is neglected.

Based on ground-water discharge to the Niobrara River in Nebraska, Babcock and Keech (1957, revised 1969, p. 11) estimated subsurface ground-water discharge across the State line within the ground-water divides (pl. 2) to be 8.2 ft^3/s. In this investigation, subsurface discharge across the State line within the ground-water divides was calculated to be the same amount by using the equation

$$Q = PIA$$

where Q = discharge (ft^3/s)
P = average hydraulic conductivity [$(ft^3/s)/ft^2$]
I = average gradient of potentiometric surface (ft/ft)
A = cross-sectional area of the saturated Arikaree at the State line (ft^2)

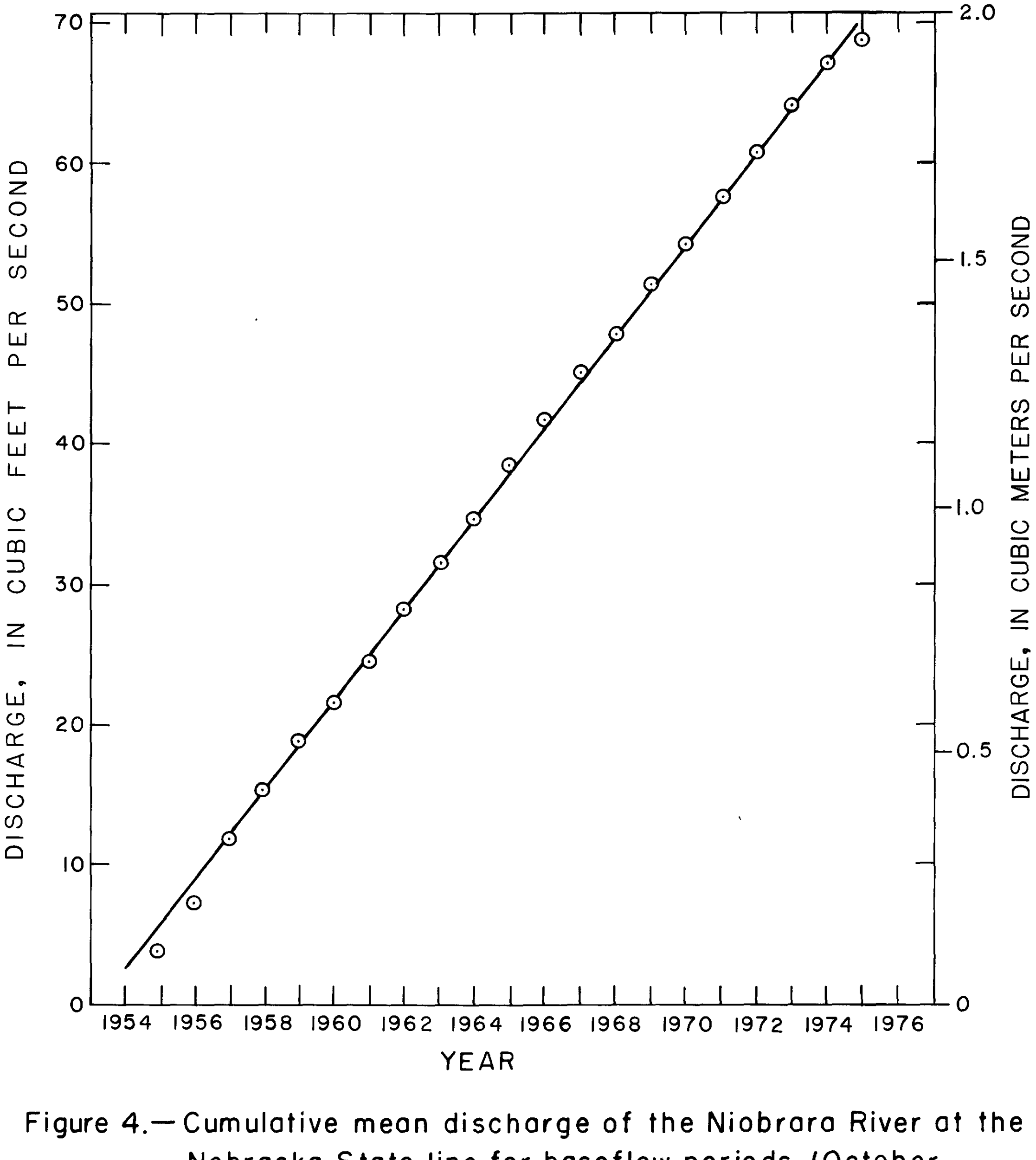

Figure 4.—Cumulative mean discharge of the Niobrara River at the Nebraska State line for baseflow periods (October, November, and December) 1955-75.

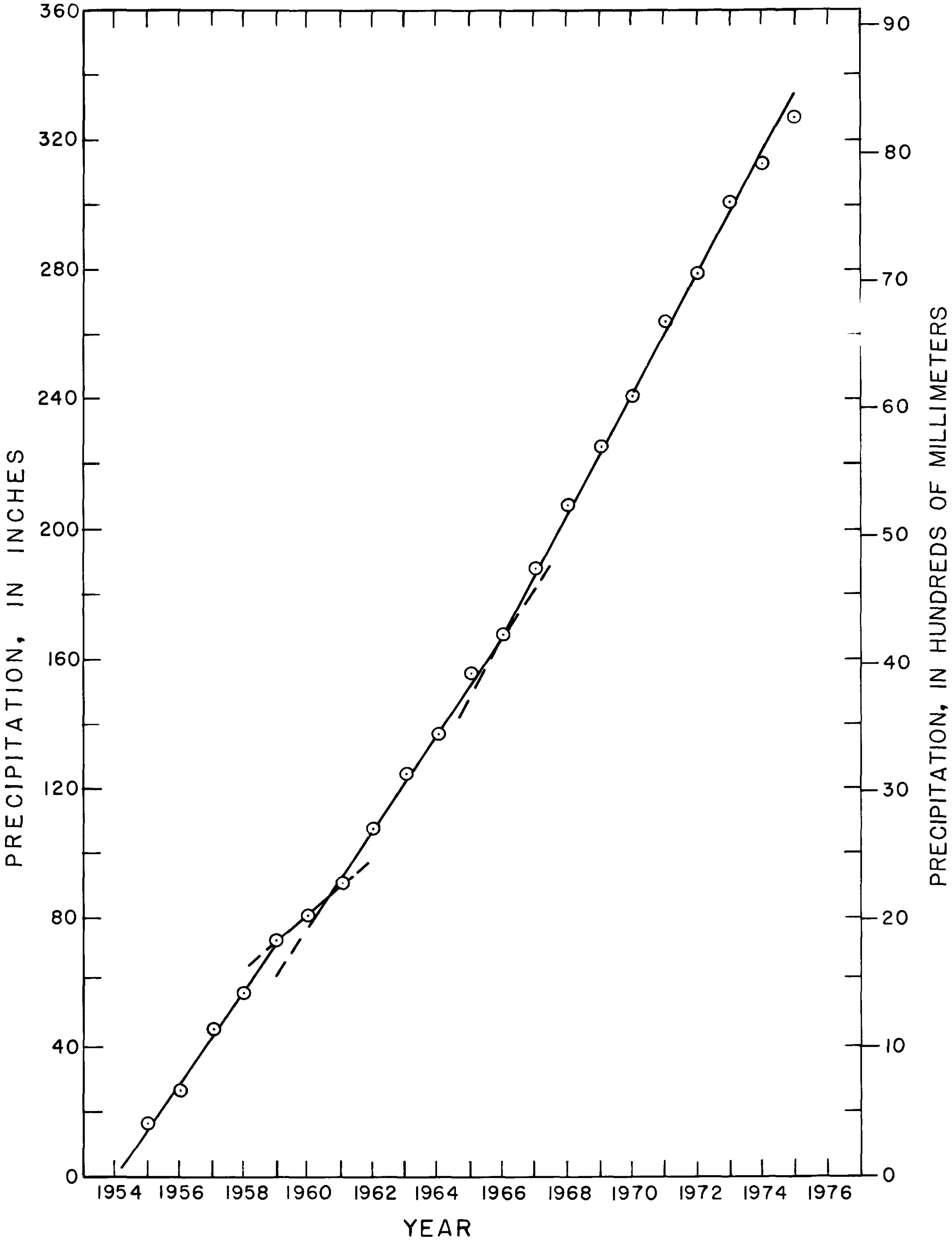

Figure 5.—Cumulative annual precipitation at Lusk, Wyoming, 1955-75.

The weighted mean value of saturated thickness, 532 feet, and the average gradient, 10 ft/mi, were estimated using plates 1 and 2. The average hydraulic conductivity was assumed to be the same as the mean value of hydraulic conductivity determined by aquifer tests, 6.0×10^{-5} $(ft^3/s)/ft^2$. The average transmissivity calculated by this method (P x mean thickness) agrees favorably with the average of the modeled transmissivities along the State line (shown later in fig. 8). Babcock and Keech (1957, revised 1969, p. 5) also estimated subsurface discharge across the State line using the equation Q = PIA. They estimated discharge to be 11.5 ft^3/s.

In this investigation total discharge from the basin is estimated to be 11.5 ft^3/s. This is the sum of the subsurface discharge (8.2 ft^3/s) and the base flow of the Niobrara River at the State line (3.3 ft^3/s). These discharges are based on forementioned assumptions and available data and are used to estimate recharge for modeling purposes.

Basin Recharge

Annual recharge to the ground-water basin from the Niobrara River, plus recharge from precipitation, must equal the annual discharge if there is no change in storage. Average recharge from the Niobrara River after it crosses Rawhide fault is estimated to be about 0.3 ft^3/s. Average annual recharge from precipitation on the ground-water basin must then equal 11.2 ft^3/s. This is equal to about 0.56 inch per year or about 3.6 percent of the normal annual precipitation of 15.64 inches (U.S. Department of Commerce, 1973). The average annual recharge of 11.5 ft^3/s is estimated to be the long-term average annual recharge for modeling purposes and may or may not occur at any given time. Babcock and Keech (1957, revised 1969) estimated recharge from precipitation to be 0.33 inch annually using the estimated surface drainage area of the upper reach of the Niobrara River. Mapping the potentiometric surface in more detail in this investigation showed that the ground-water basin does not coincide with the surface drainage basin, but is smaller.

MODELED AREA

The modeled area (pl. 1) extends from Rawhide fault and the outcrops of Mesozoic, Paleozoic, and Precambrian rocks on the west to the Nebraska State line and from the Hat Creek breaks on the north to near the edge of the aquifer on the south. No ground water is assumed to cross the western boundary. This assumption is supported by the fact that modeled steady-state conditions indicate that recharge from precipitation is sufficient to maintain water levels along the western boundary. The model boundary on the east (about 16 miles east of the State line) was selected because it was beyond the effect of anticipated pumping in the 20-year simulated model. The northern boundary is the Hat Creek breaks, a topographic feature with about 500 feet of relief to the north within a distance of about 2 miles. A few small seeps and springs occur at the base of the breaks, however all this discharge is assumed to be lost to evapotranspiration because there is no continuous flow beyond the area of the seeps and springs.

The model is constructed so that ground water is allowed to move out across the northern and southern boundaries commensurate with the transmissivity and gradient. Because these boundaries are near the edge of the aquifer, it is assumed that a negligible amount of water is in storage outside the boundaries. If the gradient should ever be reversed along these boundaries, the edge of the model would then become a noflow boundary. It is believed that this is a valid simulation of the physical system.

Leakage in the model occurs between the streams and the ground-water reservoir; however, only the perennial reaches are modeled to be hydraulically connected to the aquifer. The configuration of the potentiometric surface is used to indicate the losing and gaining reaches.

Recharge

Recharge to the modeled area is from precipitation and from the Niobrara River and Rawhide Creek. Long-term average annual recharge from precipitation and streams is estimated to total about 24,270 acre-feet. Recharge by subsurface flow is assumed negligible.

Discharge

Prior to development of wells, the long-term average annual discharge was equal to the long-term average annual recharge. Pumpage from public-supply and irrigation wells, from 1938 through 1972, is estimated to total about 48,000 acre-feet. The amount of estimated pumpage is about 6 percent of the estimated recharge during the 35-year period. Because this difference is within the accuracy of the estimates and no decrease in natural discharge (seepage to streams and subsurface flow) is distinguishable, any decrease in aquifer storage is considered negligible. Even though the effect of pumpage may not be noticeable through 1972, pumping is removing water from storage or is intercepting water that originally was discharged by evapotranspiration, subsurface movement, or leakage to streams. Eventually, the natural ground-water discharge will be reduced by the amount of ground water lost from the reservoir as a result of use. All ground-water withdrawals may not be lost but some may seep back into the ground-water reservoir.

All water pumped for irrigation is assumed to be lost from the ground-water reservoir, that is, consumed by plants or lost by evapotranspiration. Standard irrigation practice in the area is to apply water through a sprinkler system, achieving nearly even application. Irrigation by means of letting the pumped water run down furrows in the field is not practiced; therefore, return of irrigation water to the ground-water system is considered to be negligible. Of the water pumped for public supply (Lusk), about 22 percent of the total withdrawal is estimated to be consumed or lost by evapotranspiration (Murray and Reeves, 1972, p. 4). Estimates, considered to be conservative, of pumpage from public-supply and irrigation wells in the study area are given below for the years 1973-75.

Year	Estimated pumpage (acre-ft)
1973	8,400
1974	15,200
1975	15,900

The 45-percent increase in estimated pumpage between 1973 and 1974 is partly because of an increase in the number of wells pumping but is principally because of below normal precipitation during 1974. At Lusk, total precipitation was 22.34 inches in 1973 and 11.32 inches in 1974 (U.S. Dept. of Commerce, 1973-75). Precipitation in 1975 was 15.02 inches, which is near the normal annual precipitation.

DIGITAL MODEL

The Arikaree Formation is an aquifer of large areal extent in which the vertical-flow velocity within the aquifer is assumed to be negligible in comparison to the horizontal-flow velocity. Therefore, flow can be considered as two dimensional and can be described by the partial differential equation (Pinder and Bredehoeft, 1968)

$$\frac{\partial \left(T_{ij} \frac{\partial h}{\partial x_j}\right)}{\partial x_i} = S \frac{\partial h}{\partial t} + W\ (x,y,t)$$

where
- T_{ij} is the transmissivity (L^2/T)
- h is the hydraulic head (L)
- S is the storage coefficient (dimensionless)
- t is time (T)
- W is the volume flux per unit area (L/T)

Ground water in the Arikaree Formation generally is not confined. Under water-table conditions, transmissivity is a function of head and the flow equation is expressed as

$$\frac{\partial\left(K_{ij}\, b\, \frac{\partial h}{\partial x_j}\right)}{\partial x_i} = Sy\, \frac{\partial h}{\partial t} + W\ (x,y,t)$$

where K_{ij} is the hydraulic conductivity (L/T)
Sy is the specific yield of the aquifer (dimensionless)
b is the saturated thickness of the aquifer (L)

The general computer program for the model was written by Trescott and Pinder (written commun., 1975). A simplified flow chart of the steps taken in the calculation of head distribution and leakage is given in figure 6. Data that describe the aquifer (hydraulic properties, head distribution in the aquifer, recharge, and discharge) are supplied as initial conditions at the start of simulation. Head distribution and leakage are calculated for each of several time steps. The size of each time step is increased by a factor of 1.5 from a specified initial time step until the end of the simulation period. Printouts of the calculated head distribution in the aquifer and the leakage to the streams are obtained at the end of each simulation period. A rectangular grid (fig. 7) is used to subdivide the study area into small regions or cells. (The grid east of the State line is not shown so that the grid could be shown on a page-size illustration.) The center of each small region is called a node. The finite-difference approximation of the partial differential flow equation is written for each node and these equations are solved by the strongly implicit procedure (SIP), (Stone, 1968). Simulation is started from initial conditions on June 1, 1973.

Calibration

Calibration is defined in this report as the process of adjusting parameters so that the model-calculated values of head and discharge are an acceptable representation of the real, physical system. Transmissivity and specific yield were estimated on the basis of a few aquifer tests and laboratory analyses. Specific yield was assumed to be a uniform value of 15 percent. Sensitivity tests (discussed later) were made of specific yield.

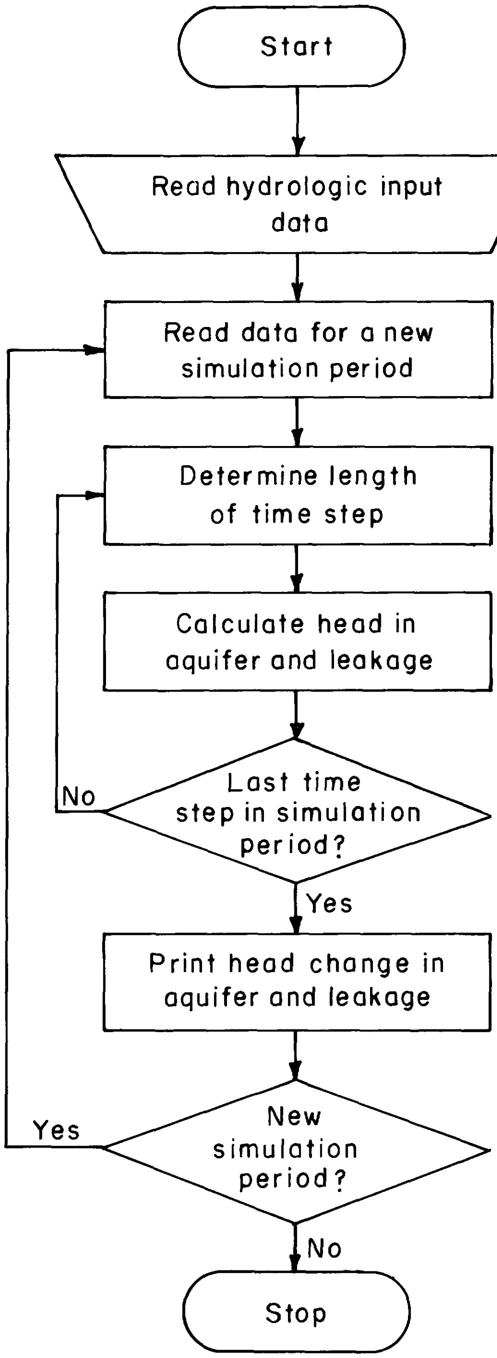

Figure 6.—Simplified flow chart showing the procedure of operations in the digital model.

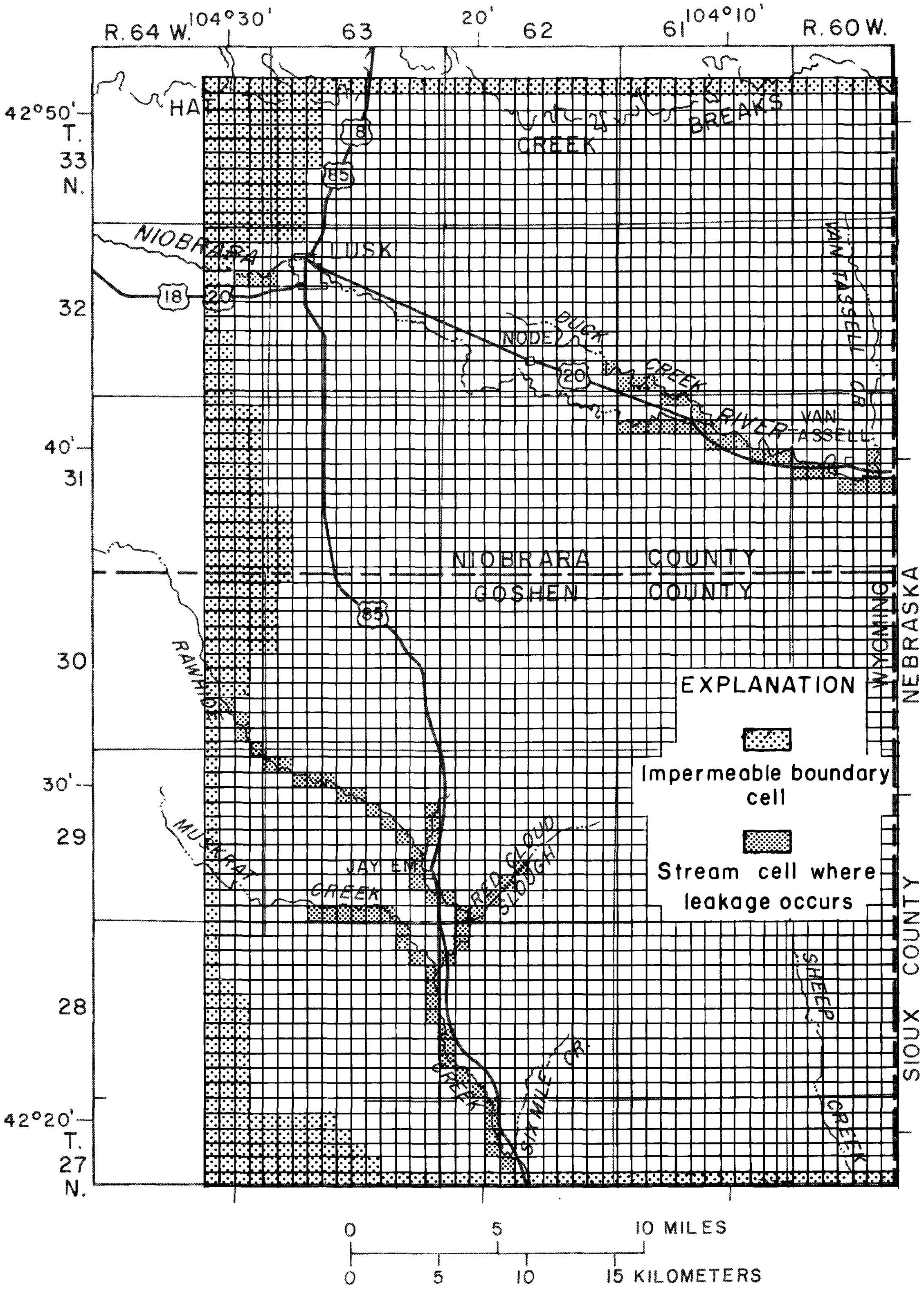

Figure 7.—Rectangular grid used to model the Arikaree Formation.

Transmissivity is the product of saturated thickness and hydraulic conductivity and is estimated by assuming values of hydraulic conductivity at each node. Areal distribution of hydraulic conductivity was determined by trial and error in order that the calculated head distribution is an acceptable reproduction of the potentiometric surface under steady-state conditions. In this model, the calculated heads were within 5 feet of the starting head (potentiometric surface) at 93 percent of the nodes. Aquifer transmissivity estimated to exist in June 1973 is shown in figure 8.

The largest deviations between calculated head and measured head were noted in the area west of Rawhide Creek, where control is not adequate for mapping the base of the Arikaree Formation. It is possible that the measured water levels in this area represent the hydraulic heads in different zones. If so, this could account for the steep gradients and variable direction of ground-water movement indicated by the potentiometric surface contours. Because of these conditions, it is doubtful that the model simulates existing physical conditions. Consequently, head calculations from the model for this area are questionable.

Most of the modeled area is not affected by the questionable southwestern part of the model. Because the potentiometric surface contours are spaced at 10-foot intervals, reproduction of the potentiometric surface within 5 feet over 93 percent of the area is deemed acceptable.

Earlier in this report an assumption was made that pumping prior to 1973 had not significantly affected the potentiometric surface. This was checked by assuming that the potentiometric surface as constructed in 1973 was identical to that in 1938. A simulation run was made using the estimated historical pumpage for the 35-year period (48,000 acre-ft). It was found that no significant change occurred in the potentiometric surface as a result of this stress. Total pumpage prior to 1973 was small in relation to the total amount of water in storage and a large error in the estimated historical pumpage would have made only a small change in the potentiometric surface as contoured.

One conclusion that might be reached from the result of this test is that the calibration of the model is good. However, it must be emphasized that calibration accuracy cannot be determined unless the model can reproduce a known change induced by a known stress in the actual hydrologic system. Until such a change can be measured in the actual system as a result of a known stress and these changes reproduced by the model, the accuracy of calibration cannot be stated.

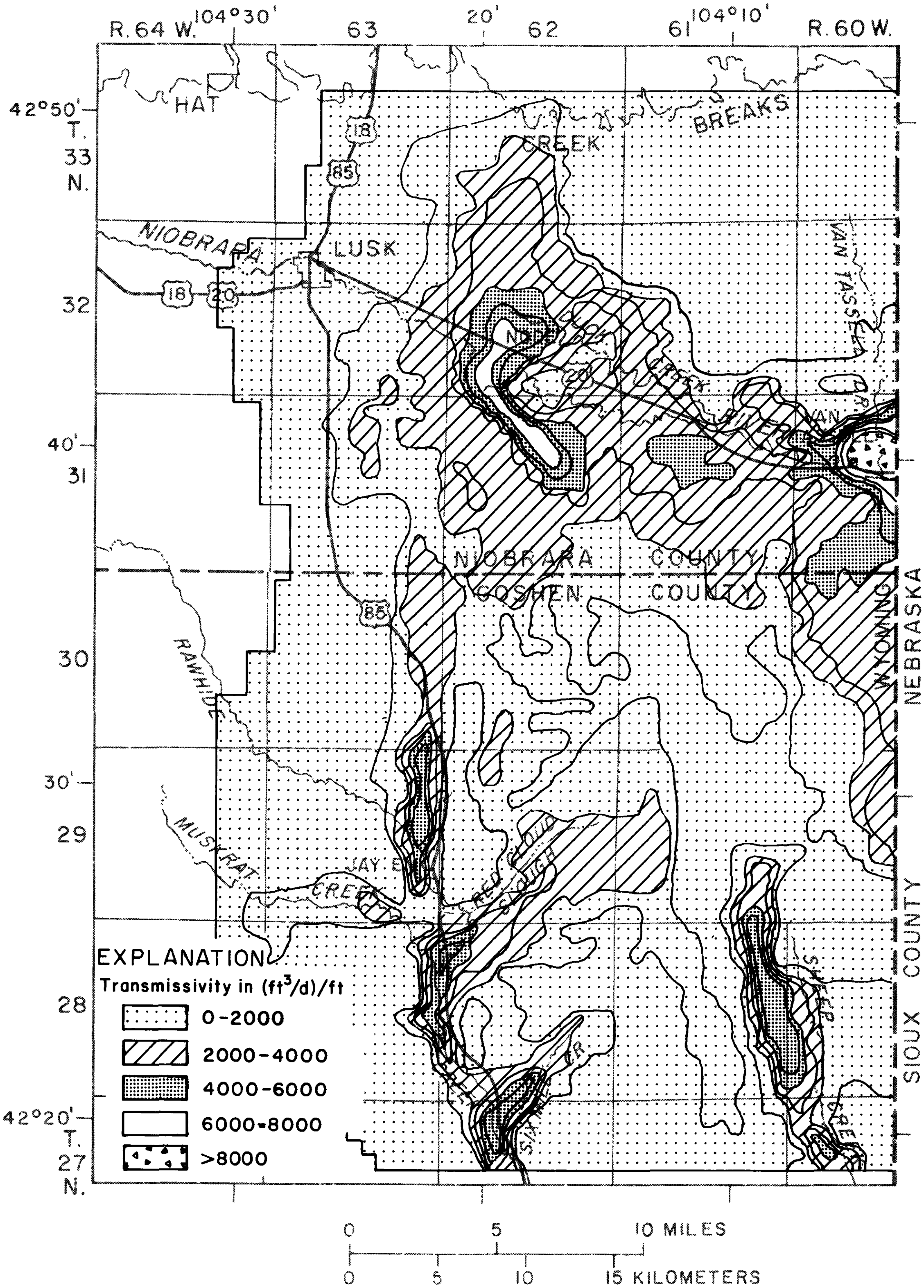

Figure 8.—Transmissivity calculated for the Arikaree Formation, June 1973. Lines within a pattern are midrange values.

Sensitivity

Calculated values of head are dependent upon recharge, discharge, transmissivity, and specific yield. The model is sensitive to changes in stress such as pumping. Doubling pumpage would double the drawdown if all other parameters remain the same.

Transmissivity values used in this model are those that are necessary to reproduce the potentiometric surface under set conditions of constant recharge and specific yield. As a test of the sensitivity of the model to transmissivity, the values of transmissivity were reduced by 50 percent. This reduced the mobility of ground water which reduced the area influenced by pumping. Drawdowns within the cone of influence, however, ranged about 10 to about 30 percent greater.

Reduction of specific yield from 15 to 10 percent increased the area influenced by pumping, and also increased drawdown within the cone of influence. Whatever change is made in specific yield directly affects the drawdown because water is being removed from storage. In general, the model is more sensitive to errors in specific yield than to errors in transmissivity.

Simulation Results

The model was used to indicate results of the 20-year period of pumping 1973 through 1993. Annual pumpage for 1973, 1974, and 1975 was estimated from electric-power records. For the years after 1975, annual pumpage was assumed to be equal to the annual pumpage estimated for 1975. Pumpage for irrigation was scheduled to occur in the period June through September. Public-supply wells were simulated as pumping continuously throughout the year. The result of the simulated pumping period ending in 1993 is indicated by the water-level declines shown in figure 9.

Because the model is most sensitive to pumpage and specific yield, values different from those used in this study would result in substantially different indicated water-level changes. The numeric values of the indicated water-level declines, therefore, probably should not be emphasized.

Qualitative information obtained from the model is useful. The model results indicate which areas are likely to be affected most in the future if annual pumpage remains the same as in 1975. On the basis of the model calculations, it appears that some areas, such as the southwest corner of T. 30 N., R. 63 W. and T. 29 N., R. 61 W. could not support a high density of wells without substantial drawdown. In other areas, such as in T. 31 N., R. 62 W., large water-level declines are not indicated even though irrigation wells are quite concentrated.

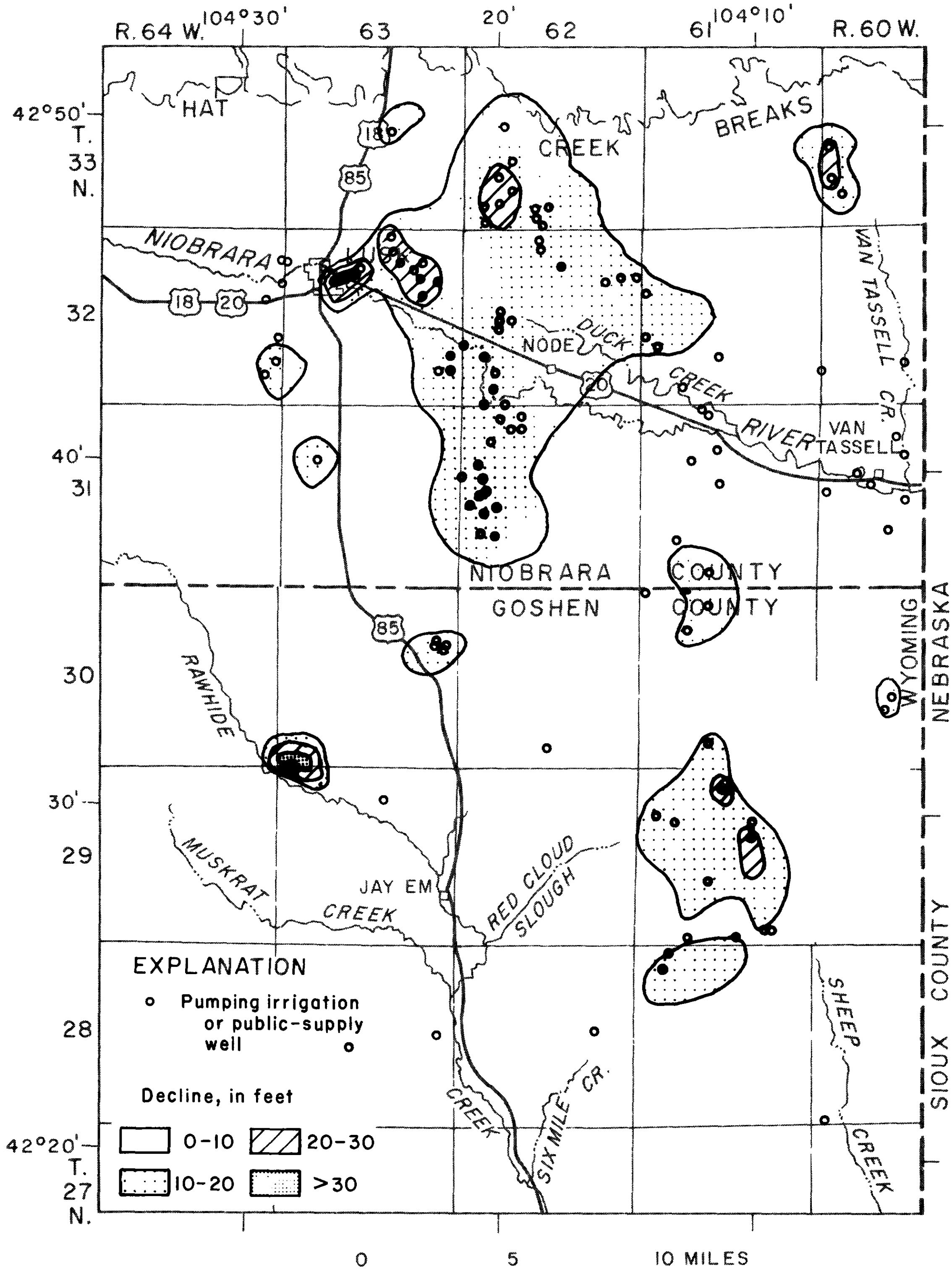

Figure 9.—Water-level declines calculated to occur by the end of 1993, assuming annual pumpage after 1975 equals the annual pumpage estimated for 1975 at the specified well locations.

SUMMARY AND CONCLUSIONS

The ground-water system in the Arikaree Formation in southern Niobrara County and northern Goshen County is simulated by a digital model. Long-term average annual recharge to the modeled area from streams and precitation is estimated to total about 24,270 acre-feet. Discharge by pumpage from public-supply and irrigation wells is estimated to total about 48,000 acre-feet from 1938 through 1972. Any decrease in storage or of natural discharge caused by pumping during this period is not distinguishable and is considered negligible. Simulation of historical pumpage with the model did not significantly affect the potentiometric surface as determined by water levels measured in June 1973. Because pumping prior to 1973 did not produce significant drawdown in the area, the accuracy of the model cannot be checked.

Pumpage from public-supply and irrigation wells has increased each year since 1972. For the period 1973 through 1975, pumpage is estimated to total 39,500 acre-feet.

The 20-year period 1973 through 1993 is simulated with the model, assuming the annual pumpage after 1975 to be equal to the pumpage during 1975. Although water-level declines of more than 30 feet are indicated in two areas, the numeric values of decline probably should not be emphasized but rather the areas where significant declines occur.

It is concluded that the model can be used to indicate the general effect on the aquifer of applying hydraulic stress and therefore to indicate areas best suited for increased development of irrigation wells. Results of longterm simulation periods should be used as a guide for determining the locations of observation wells to measure water-level fluctuations.

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