OF 55-17

1955

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

File

SUMMARY OF THE GROUND-WATER RESOURCES OF THE LARAMIE RIVER DRAINAGE BASIN, WYOMING, AND THE NORTH PLATTE RIVER DRAINAGE BASIN FROM DOUGLAS, WYO., TO THE WYOMING-NEBRASKA STATE LINE

By Edward Bradley

Open-File Report 55-17

Compiled as part of a program of the
Department of the Interior
for development of the
Missouri River basin

June 1955

CONTENTS

ILLUSTRATIONS

SUMMARY OF THE GROUND-WATER RESOURCES OF THE LARAMIE RIVER DRAINAGE BASIN, WYOMING, AND THE NORTH PLATTE RIVER DRAINAGE BASIN FROM DOUGLAS, WYO., TO THE WYOMING-NEBRASKA STATE LINE

By Edward Bradley

Introduction

This is one of several reports on investigations made by the United States Geological Survey as part of a program of the Department of the Interior for the conservation, development, and use of the water resources in the Missouri River basin. Prepared at the request of the U. S. Bureau of Reclamation, this report has a twofold purpose: (1) to present an annotated bibliography of previous reports pertaining to ground water in the area and an analysis of data on wells used for public, industrial, and irrigation supplies; and (2) to indicate local areas where further large-scale development of ground water appears feasible or in which additional detailed ground-water studies should be made.

This reconnaissance was made under the general direction of A. N. Sayre, chief of the Ground Water Branch, U. S. Geological Survey, and G. H. Taylor, regional engineer in charge of ground-water investigations in the Missouri River basin. Supervision was by H. M. Babcock, district engineer for Wyoming.

Previous investigations

The area described in this report and other areas in southeastern Wyoming in which studies have been made of the source, occurrence, and quality of the ground water are shown in figure 1. The only part of the report area not covered by previous studies is small, largely mountainous, and affords very little prospect for large-scale ground-water development. Reports based on previous investigations pertaining to the geology and ground water of the region are described briefly as follows:

1. Adams, G. I., 1902, Geology and water resources of the Patrick and Goshen Hole quadrangles in eastern Wyoming and western Nebraska: U. S. Geol. Survey Water-Supply Paper 70, 50 p.

    Describes the geology of the two quadrangles; contains maps showing the areal geology and areas under irrigation; gives information on springs and wells.

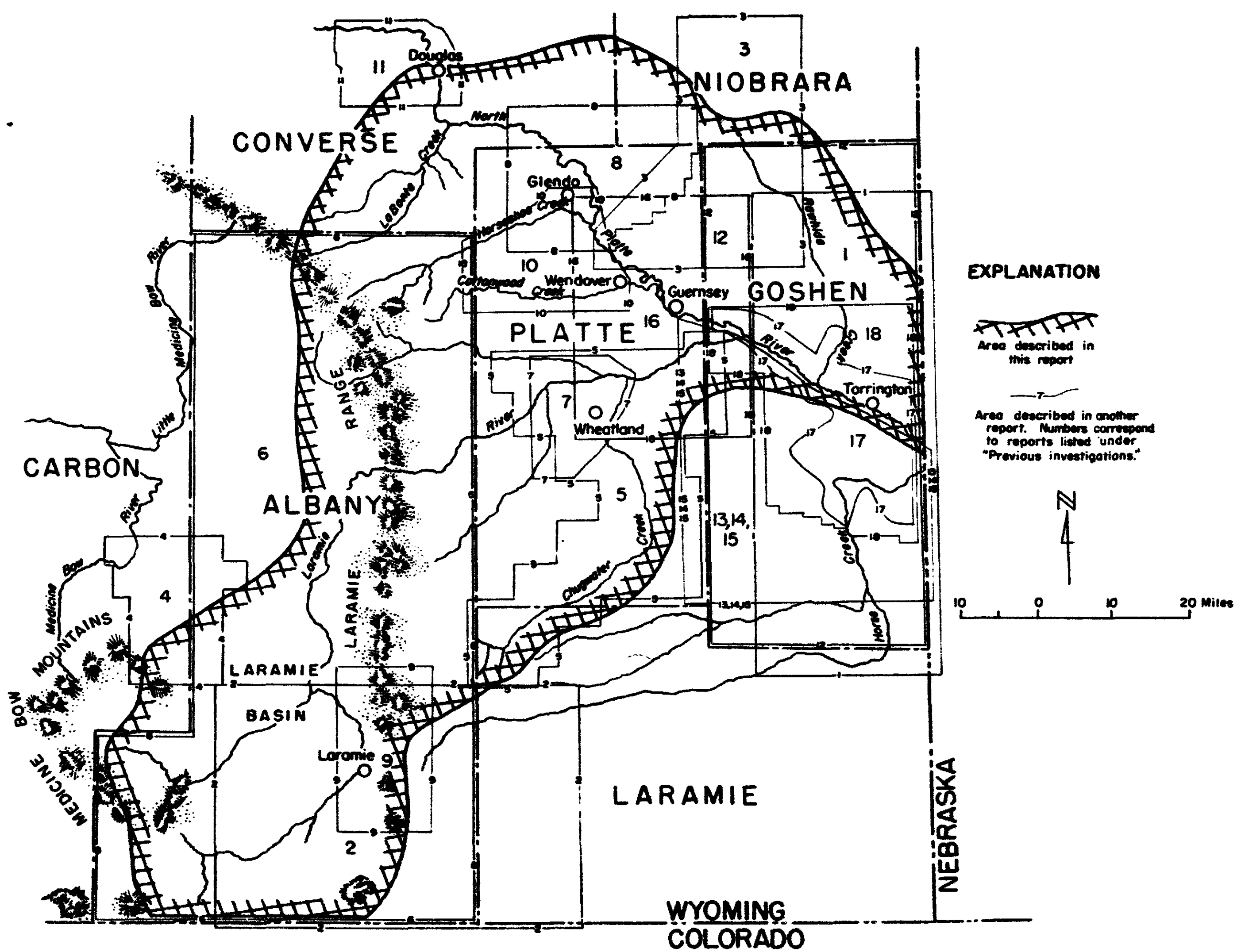

Figure 1.- Index map of southeastern Wyoming showing area described in this report and other areas in which related geologic or hydrologic studies have been made.

2. Darton, N. H., Blackwelder, Eliot, and Siebenthal, C. E., 1910, Description of the Laramie and Sherman quadrangles, Wyoming: U. S. Geol. Survey Geol. Atlas, folio 173, 18 p.

Describes the geology of the two quadrangles; discusses briefly the water-bearing properties of some of the geologic formations.

3. Denson, N. M., and Botinelly, Theodore, 1949, Geology of the Hartville uplift, eastern Wyoming: U. S. Geol. Survey Oil and Gas Inv. Prelim. Map 102.

Includes lithologic descriptions and a detailed section of the geologic formations; discusses the mineral resources and oil and gas possibilities.

4. Dobbin, C. E., Hoots, H. W., Dane, C. H., and Hancock, E. T., 1929, Geology of the Rock Creek oil field and adjacent areas, Carbon and Albany Counties, Wyo.: U. S. Geol. Survey Bull. 806-D, p. 131-153.

Describes the geology of the Rock Creek oil field and the geology and oil and gas possibilities of an adjacent 260 square-mile area in the west-central part of the Laramie Basin.

5. Edwards, Acus R., 1941, Underground water resources of Chugwater Creek, Laramie River, and North Laramie River valleys, Wyoming: Wyoming Geol. Survey Bull. 32, 32 p.

Discusses the ground-water resources of a 1,050 square-mile area in the southern half of Platte County and the extreme northwestern part of Laramie County; describes the topography and drainage, the structure, stratigraphy, precipitation, and the surface and ground water of the area; includes maps showing the geology, location of wells, and depth to water, also a table of data on wells; points out that the only wells of large discharge in the area obtain water from the unconsolidated alluvium in the stream valleys.

6. Littleton, R. T., 1950, Reconnaissance of the geology and ground-water hydrology of the Laramie Basin, Wyoming, with special reference to the Laramie and Little Laramie River valleys: U. S. Geol. Survey Circ. 80, 37 p.

Discusses geology and ground-water conditions in the Laramie Basin; makes special reference to water in the alluvium of the Laramie and Little Laramie River valleys; describes artesian water in permeable stratified bedrock units; includes map showing the geology of Albany County and the location of wells in part of the Laramie Basin, a generalized section across the Laramie River basin, and figures and tables of data on precipitation, streamflow, and wells.

7. Littleton, R. T., 1950, Reconnaissance of the ground-water resources of the Wheatland Flats area, Wyoming: U. S. Geol. Survey Circ. 70, 32 p.

Discusses the surface- and ground-water problems in relation to the geology of the area; describes briefly the geography, geology, relation of irrigation to high ground-water levels, loss of water from canals and laterals, and possibilities for developing additional irrigation supplies from wells; includes tables of hydrologic data and map of the area showing the areal geology and location of wells.

8. Love, J. D., Denson, N. M., and Botinelly, Theodore, 1949, Geology of the Glendo area, Wyoming: U. S. Geol. Survey Oil and Gas Inv. Prelim. Map 92.

Includes detailed geologic map, lithologic descriptions and section of the formations, and discussions on mineral resources and the oil and gas possibilities.

9. Morgan, A. M., 1947, Geology and ground water in the Laramie area, Albany County, Wyo.: Unpublished report in files of U. S. Geol. Survey, Cheyenne, Wyo.

Discusses the geologic formations and their water-bearing characteristics and the occurrence, source, movement, disposal, development, and quality of ground water in the vicinity of Laramie.

10. Rapp, J. R., and Babcock, H. M., 1953, Reconnaissance of the geology and ground-water resources of the Glendo-Wendover area, Platte County, Wyo., with a section on the chemical quality of the water, by W. H. Durum: U. S. Geol. Survey Circ. 163.

Describes the geology, hydrologic properties of the principal water-bearing formations, ground-water conditions, possibilities of developing additional supplies of ground water for irrigation, and the chemical quality of the ground water; contains a map showing the geology and the location of wells and springs in the principal stream valleys; includes figures and tables showing geologic, hydrologic, and quality-of-water data.

11. Rapp, J. R., 1953, Reconnaissance of the geology and ground-water resources of the LaPrele area, Converse County, Wyo., with a section on the chemical quality of the ground water, by W. H. Durum: U. S. Geol. Survey Circ. 243.

Discusses the geology, hydrologic properties of the aquifers, ground-water conditions, and chemical quality of the ground water; contains a map showing both the geology

and location of wells and springs; includes figures and tables showing geologic, hydrologic, and quality-of-water data.

12. Rapp, J. R., Visher, F. N., and Littleton, R. T., Geology and ground-water resources of Goshen County, Wyo., with a section on the chemical quality of the ground water, by W. H. Durum: U. S. Geol. Survey manuscript report in course of review. (Not yet available for public inspection.)

Describes the exposed geologic formations and their water-bearing properties; makes special reference to the terrace and alluvial deposits; discusses recharge, discharge, seepage, and irrigation; contains profile sections and maps showing geology, depth to water, contour of the water table, and saturated thickness of the alluvium along the valley of the North Platte River; includes well records, water-level measurements, logs of wells and test holes, and results of chemical analyses.

13. Schlaikjer, E. M., 1935a, The Torrington member of the Lance formation and a study of a new Triceratops: contribution to the stratigraphy and paleontology of the Goshen Hole area, Wyoming: Harvard Coll. Mus. Comp. Zoology Bull., v. 76, no. 2, p. 31-68.

Discusses in detail the character of the materials making up the Lance formation; includes logs of test holes and measured sections.

14. Schlaikjer, E. M., 1935b, A new basal Oligocene formation: contribution to the stratigraphy and paleontology of the Goshen Hole area, Wyoming: Harvard Coll. Mus. Comp. Zoology Bull., v. 76, no. 3, p. 69-97.

Gives detailed description of the Yoder formation.

15. Schlaikjer, E. M., 1935c, New vertebrates and the stratigraphy of the Oligocene and early Miocene: contribution to the stratigraphy and paleontology of the Goshen Hole area, Wyoming: Harvard Coll. Mus. Comp. Zoology Bull., v. 76, no. 4, p. 97-189.

Describes in detail the Chadron and Brule formations (Oligocene series) and the Miocene deposits in the Goshen Hole area.

16. Smith, W. S. T., 1903, Description of the Hartville quadrangle, Wyoming: U. S. Geol. Survey Geol. Atlas, folio 91, 6 p.

Describes the geography and general and economic geology of the Hartville quadrangle; contains areal geologic map, structure sections, and detailed columnar sections of the exposed formations.

17. United States Bureau of Reclamation, 1949, Detailed status report of the North Platte Project, Soil and Moisture Conservation Program: U. S. Bur. Reclamation, 59 p.

Contains measurements of seepage from the main canals in the North Platte Irrigation District.

18. Visher, F. N., Rapp, J. R., and Babcock, H. M., 1952, Geology and ground-water resources of the North Platte Irrigation Project in Goshen County, Wyo., with a section on the chemical quality of the ground water, by W. H. Durum: U. S. Geol. Survey open-file rept.

Describes the geology of the area; makes special reference to the alluvium and terrace deposits; discusses the physical and hydrologic properties of the geologic formations; contains maps showing areal geology, depth to water, contour of the water table, and thickness of water-bearing materials; includes tables of chemical analyses, water-level measurements, logs of wells and test holes, and well records.

Geography

The area described in this report is in southeastern Wyoming and covers parts of Albany, Carbon, Converse, Goshen, Laramie, Niobrara, and Platte Counties. It includes approximately 7,000 square miles and lies in three physiographic provinces--the northwestern part of the High Plains section of the Great Plains, the eastern part of the Wyoming Basin, and the northern part of the Southern Rocky Mountains. The entire area is drained by the North Platte River, which flows in a southeasterly direction across the northern part of the area. Principal tributaries of the North Platte River are the Laramie River and LaBonte, Horseshoe, Cottonwood, and Rawhide Creeks. The Laramie Range, which borders the southern extremity of the report area, extends northward into the area to a point about 30 miles west of Wheatland, where it veers northwestward, dividing the report area into two parts--about one-third west and southwest and about two-thirds east and northeast of the range (fig. 1).

That part of the area southwest of the range is called the Laramie Basin and is bounded on the west by the Medicine Bow Mountains. Littleton (1950, p. 8-9) described the southwestern part of the report area as follows:

> The Laramie Basin is an intermontane basin open to the northwest. It is bordered on the north and east by the Laramie Range, on the south by the north end of the Front Range of Colorado, and partly on the west by the Medicine Bow Range. Along the foot of the Laramie Range are long mountain pediments (Bryan, 1925) which are covered in most places by thin sheets of coarse gravel.

The floor of the basin is a plain that ranges in altitude from 7,500 feet at the south end to about 6,900 feet where the Laramie River leaves the basin below the Wheatland Reservoir. This plain consists of broad, shallow, terraced valleys which are widely separated by low, flat-topped remnants of older terraces. The basin contains many enclosed depressions of which the most extensive are Big Hollow and Alkali Basin. These large depressions seem to be the result of wind action on the fine-grained weathered materials of the shale formations (Darton, 1910). The shape and size of the depressions seem to have been restricted in part by the surrounding deposits of gravel which prevented removal of the underlying materials by wind. These depressions probably were formed late in the Quaternary period.

The Laramie Basin is drained principally by the Laramie and Little Laramie Rivers. The Laramie River enters the basin at Woods Landing, flows northward across the basin, and leaves at the northeast corner through a canyon cut into the Laramie Range. The gradient of the river averages about 9.7 feet per mile. The Little Laramie River flows northeastward from the Medicine Bow Mountains and joins the Laramie River in sec. 6, T. 17 N., R. 74 W.

Intermittent streams that flow down the slopes of the surrounding mountains supply very little water to the principal streams. This is especially true of Lone Tree and Shell Creeks, the flows of which do not reach the Laramie River except during periods of high runoff. Dutton Creek and Cooper Creek flow into Cooper Lake. Rock Creek, formerly an eastward flowing tributary to the Laramie River, has been captured by a tributary of the Medicine Bow River.

The Laramie Range is flanked on the east by foothills that, in general, are characterized by a rugged topography formed by erosion of the pre-Cambrian and steeply-dipping Paleozoic and Mesozoic rocks. North and east of the foothills the area consists of rolling upland plains dissected by stream valleys, which upstream from the confluence of the Laramie and Platte Rivers are rather narrow and steep walled but downstream are broader and have gently sloping sides.

Between the Laramie River and Chugwater Creek, near their confluence, a system of several broad gravel-covered terraces has been formed. The terraces, known as the Wheatland Flats, slope northeastward and range in altitude from about 5,200 feet to about 4,500 feet above sea level.

In northeastern Platte County, the North Platte River cuts through the southwestern end of the Hartville uplift, which is a long, low domal mountain extending into the report area from the northeast. A sharp fold modified by minor faulting delimits the west margin of the uplift; the east margin is bounded by faults along which displacements are as much as 1,200 feet. The crest of the uplift is in northwestern Goshen County and has an altitude of about 6,100 feet.

In central Goshen County, the flood plain of the North Platte River is bordered by terraces that grade upward into a series of sweeping pediments which extend away from the river to the uplands. The North Platte River leaves the report area at an altitude of about 4,020 feet.

The climate of the report area is semiarid. Much of the land is used for livestock grazing. Wheat is grown on some of the rolling upland plains in the central and eastern parts of the area. Surface water is used for irrigation in the Laramie Basin, the Wheatland Flats area, the North Platte River valley, and some of the valleys of the larger tributaries of the North Platte River. The principal irrigated crops are hay, corn, sugar beets, beans, and small grains.

Geologic formations and their water-bearing characteristics

Structurally, the Laramie basin is a north-south trending syncline that has gentle dips on the east flank and steep dips and a large fault on the west flank. Both the Medicine Bow Mountains and the Laramie Range, which border the basin, have central cores of pre-Cambrian crystalline rocks; within the basin sedimentary rocks of Mississippian to Recent age are exposed. Littleton (1950, p. 19-20) described the possibilities of developing water supplies from bedrock sources as follows:

> Conditions are favorable for artesian wells in the Laramie Basin owing to the synclinal structure of the basin and the lithology of the stratified rocks within it. Moderate quantities of water under artesian pressure are obtained from the Casper, Satanka, Sundance, and Cloverly formations and small quantities of water are obtained from the Shannon sandstone member of the Steele shale.
>
> Where these stratigraphic units crop out, recharge is by direct penetration of rainfall and melting snow, and by percolation from overlying saturated alluvium. * * * The sandstones of the Sundance and Cloverly formations are recharged principally from saturated alluvium along the Laramie River.
>
> *   *   *   *   *   *   *
>
> Artesian wells on the east side of the basin generally flow, but not those near the center of the basin where the aquifers are deeply buried. Artesian water was encountered in well 16-74-15cca [NE¼SW¼SW¼ sec. 15, T. 16 N., R. 74 W.] at a depth of 1,035 feet in the upper sandstone of the Cloverly formation. The water was under sufficient pressure to raise it 928 feet to a level only 107 feet below land surface.

Coarse alluvial deposits underlie the principal stream valleys, but as they are relatively thin it is unlikely they would yield large amounts of water to wells.

The geology and water-bearing characteristics of the formations underlying the rolling plains east of the Laramie Range are described in reports by Edwards (1941), Littleton (1950), Rapp and Babcock (1953), and Rapp (1953).

Much of this part of the report area is underlain by a considerable thickness of sedimentary formations of Paleozoic and Mesozoic age, some of which are water bearing. However, except in northern Platte County, these water-bearing formations lie at depths so great that the drilling of wells to tap them normally is uneconomical. In northern Platte County some of these formations are sufficiently close to the surface that they can be developed as sources of water supply (Rapp and Babcock, 1953).

Rocks of Tertiary age, which overlie those of Paleozoic and Mesozoic age in this part of the report area, yield sufficient water to domestic and stock wells but not to wells of large discharge. In places, such as the Wheatland Flats area in Central Platte County, saturated terrace deposits overlie the Tertiary rocks and sufficient water for irrigation can be obtained from the combined thickness of both formations (Littleton, 1950). A future report on Platte County will give more detailed data on the geology and water supply of this part of the report area.

Water-bearing coarse alluvial fill underlies the floor of the valleys of the North Platte River and its principal tributaries. East of the Hartville uplift, the zone of saturation in the alluvial fill of the North Platte River valley is as much as 200 feet thick and can sustain continued withdrawals of large quantities of water (Visher, Rapp, and Babcock, 1952).

Ground water

Recharge to the ground-water reservoir in the report area is by infiltration of precipitation and irrigation water and by seepage from canals and laterals. Although recharge from precipitation is general throughout the area, the amount that reaches the zone of saturation in any given locality is small. In the Laramie Basin, the Wheatland Flats area, and most of the North Platte River valley, where large quantities of surface water are diverted for irrigation, much water is added to the ground-water reservoir by seepage from canals or laterals and by infiltration of water applied to irrigated crops. In discussing ground water in the terrace deposits in the Wheatland Flats area, Littleton (1950, p. 15) made the following observation:

> Long-time residents in the area report that the unconsolidated rocks contained little water prior to irrigation. Continued irrigation on Wheatland Flats has partly saturated the deposits

> and caused the water table to rise. * * * Recharge to the unconsolidated deposits is from irrigation and canal losses, and in small part from precipitation.

The direction of ground-water movement in the alluvium of the stream valleys generally is downstream and toward the stream, and most streams in the area derive some of their flow from ground water. Ground water in terrace deposits generally moves in the same direction as the downward topographic slope, and in the water-bearing sedimentary rocks of Tertiary and pre-Tertiary age it generally moves in the direction of the dip of the formations.

Present development

Large-discharge irrigation wells are relatively numerous in the North Platte River valley in Goshen County; data on these wells are given in the report on Goshen County by Rapp, Visher, and Littleton (manuscript rept.). Elsewhere in the area there are only a few widely scattered irrigation wells--about 10 in the North Platte River valley and the lower segments of some of its tributary valleys upstream from Wendover, and about 40 in the Wheatland Flats area. The yield of the former ranges from about 75 to about 1,500 gallons per minute, and that of the latter from about 200 to about 700 gallons per minute.

Potential development

In several parts of the report area additional irrigation supplies could be developed from ground-water sources. Rapp and Babcock (1953, p. 21) discuss the possibilities of developing additional supplies in the Glendo-Wendover area as follows:

> The best localities for successful irrigation wells are in the alluvial fill of parts of the North Platte River valley and at the lower ends of Cottonwood, Bear, and Horseshoe Creek valleys, where the thickness of the alluvium is the greatest. Wells that yield 500 to 1,000 gpm probably could be developed in some places where there is a substantial saturated thickness of alluvium. * * *
>
> Irrigation wells of smaller yield probably could be developed from the "Converse sand" of the Hartville formation [Pennsylvanian and Permian(?) age] in parts of the area; these wells could be used to irrigate some of the small plots of land along the stream valleys. Considerable test drilling would be necessary to determine the lateral extent and the depth of the formation, although it is likely that the "Converse sand" underlies a large part of

> the area. Additional wells that yield 100 gpm, or more, probably could be developed in this "sand." Water in the formation is confined under artesian pressure; hence it would rise appreciably above the point at which it is encountered, and in some parts of the area it would flow at the land surface. In areas where the water is not under sufficient pressure to flow at the surface, water could be obtained by pumping.

The feasibility of additional ground-water development for irrigation in the Wheatland Flats area and other parts of Platte County is being investigated at the present time. In the Wheatland Flats area increased pumping of ground water not only would make possible the irrigation of more land but would lower the water table and thereby restore to productivity some of the land now waterlogged.

Visher, Rapp, and Babcock (1952, p. 83) describe, as follows, the possibility of additional ground-water development in the North Platte River valley in Goshen County:

> A large amount of additional ground water could be developed from sand and gravel of the flood plain and third-terrace deposits. Wells capable of yielding 1,000 to 3,000 gpm probably could be developed from these deposits in most places.
>
> * * * In general, the amount of water that can be pumped depends upon the saturated thickness. The performance of existing wells indicates that wells having a capacity of 1,000 gpm or more probably can be developed at almost any place in the flood-plain deposits along the North Platte River where the saturated thickness exceeds 50 feet. * * *

Summary

Except in the Laramie Basin, sufficient geologic and hydrologic data already have been collected to delineate those parts of the report area where large supplies of ground water can be developed. The selection of sites for the installation of wells of large discharge, however, should be based on subsurface information gained from test drilling. The feasibility of developing large ground-water supplies from the Paleozoic and Mesozoic sedimentary formations underlying the Laramie basin remains to be determined.