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UNITED STATES DEPARTMENT OF AGRICULTURE

BUREAU OF AGRICULTURAL ECONOMICS

Operations Guidance Report on

WATER FACILITIES FOR RABBIT CREEK

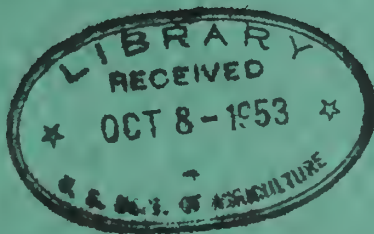
AND THUNDER BUTTE CREEK DRAINAGES

MOREAU RIVER WATERSHED

SOUTH DAKOTA

WATER UTILIZATION SECTION
DIVISION OF LAND ECONOMICS

March 1940



UNITED STATES DEPARTMENT OF AGRICULTURE
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AND THUNDER BUTTE CREEK DRAINAGES

MOREAU RIVER WATERSHED

SOUTH DAKOTA

WATER UTILIZATION SECTION
DIVISION OF LAND ECONOMICS

Under the Provisions of the
Water Facilities Act
(Public Law No. 399, 75th Congress)

March 1940

BUREAU OF AGRICULTURAL ECONOMICS
Washington, D. C.

MEMORANDUM

To: Mr. M. M. Kelso, Head,
Division of Land Economics.

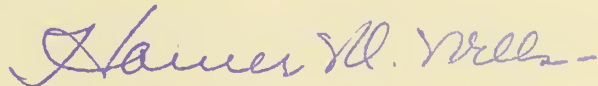
Dear Mr. Kelso:

The following Operations Guidance Report on Water Facilities for Rabbit Creek and Thunder Butte Creek Drainage, Moreau River Watershed, South Dakota, was prepared by personnel of the Water Utilization Section under the general supervision of Edward C. Gwillim, District Water Utilization Supervisor.

The following technicians of this Section assisted in the field survey of the area or in the preparation of the report: Kirk M. Sandals, Assistant Hydraulic Engineer; Wendell C. Munson, Assistant Hydraulic Engineer; George P. Lachar, Assistant Economist; Earl F. Hodges, Junior Economist; Albin S. Anderson, Engineering Aid, and Andrew J. A. Lynn, Junior Engineering Aid.

Recognition is also given to Timon J. Oltman, Junior Engineer of the Soil Conservation Service for his assistance toward this report.

Very truly yours,



Homer M. Wells, Acting in Charge,
Water Utilization Section,
Division of Land Economics

AUTHORIZATION

This report on the development of small water facilities for the Rabbit Creek and Thunder Butte Creek Drainages of the Moreau River Watershed has been prepared under the authority and provisions of the Water Facilities Act (Public No. 399 - 75th Congress) approved August 28, 1937, and the Secretary of Agriculture's memorandum of July 1, 1938, on administration of the Water Facilities Program.

Rabbit Creek and Thunder Butte Creek Drainages were authorized for concurrent planning and operations by the Water Facilities Board on September 20, 1939. Formal notification of the Board's action is contained in South Dakota State Memorandum No. 6, dated September 20, 1939.

ACKNOWLEDGMENTS

The data and material for this report were obtained from previous reports, aerial photographs, and reconnaissance field surveys. Acknowledgment is made of the information, materials, and assistance rendered by the following organizations and individuals:

Soil Conservation Service, Farm Security Administration, Agricultural Adjustment Administration, United States Geological Survey, United States Weather Bureau, United States Army Engineers, County Agricultural Agents of Harding, Perkins, and Ziebach Counties, United States Indian Service, State Engineer, State Geologist, Ralph E. Ward--Associate Agricultural Economist and Stanley W. Voelker--Assistant Economist--Division of Land Economics, Alfred Reder and Harry Kest--Members of the Perkins County Land Use Planning Committee, and numerous other residents of the area.

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SUMMARY

Rabbit Creek and Thunder Butte Creek drainages of the Missouri River Watershed are located in northwestern South Dakota. Efficient utilization of water resources and adjustments in the use of land in the area are definitely needed to establish and maintain a stable agricultural economy.

Climate of the area is typically semi-arid with widely varying and extreme temperatures and highly variable and erratic precipitation.

Excepting the area of Pierre shale exposures, ground waters are generally available in this area to springs or pumped wells at depths not exceeding 350 feet.

There are no perennial streams in the area and with wide variations in run-off there is no assured water supply available for irrigation or storage. Gaging stations should be established in the area to permit the determination of water supply available.

The waters of South Dakota are public and subject to appropriation for beneficial use. Prior use establishes prior right. There are numerous filings on Rabbit Creek which should be considered before planning construction of any development.

Existing water facilities consist of stock water ponds, farmstead and range wells, a few storage reservoirs, pumping plants, and numerous small flood irrigation facilities.

As of May 1939, 16 per cent of the land in Perkins County is in county ownership and an additional 22 per cent is subject to tax deed.

About 40 per cent of the operators in the Perkins County portion of the area have received loans and grants from the Farm Security Administration.

The area is a high-risk area for cash crop production. Cash grain and livestock, in combination, and livestock are the general types of farming in existence.

In general the area is best suited for the production of livestock and major reliance for farm income should be placed on cattle and sheep production. Greater adjustment in size of operating unit is necessary in the section of the area recommended for livestock-cash grain type of farming than in the section recommended for livestock production.

Land use adjustment in the area may create a need for additional development of livestock and farmstead water supplies. There is a need for the repair and improvement of farmstead wells, stock water ponds, and range wells. Irrigation of family-sized gardens where possible, is recommended. Opportunities in excess of the water supply for water spreading, flood irrigation and sub-irrigation for feed production exist in the area. Care should be exercised to prevent over development.

Most water facility developments can and should be made by the individual operators using their own equipment and labor with the technical assistance offered under the Water Facilities Program.

The value of water facilities in this area lies in the benefits derived from the irrigation of family-sized gardens and in the added assurance of the production of supplemental feed during dry years.

I

PURPOSE AND SCOPE

The purpose of this report is to furnish guidance to the operating agencies of the Water Facilities Program in the development of water facilities on Rabbit Creek and Thunder Butte Creek Drainages of the Moreau River Watershed, South Dakota.

The scope of this report is limited to indicating the physical limitations of the development of water facilities in accordance with the proper utilization of land and water resources of the area.

II

DESCRIPTION OF AREA

Location and Size

The Rabbit and Thunder Butte Creek drainages, which are located in northwestern South Dakota and occupy portions of Harding, Perkins, and Ziebach counties, are adjacent basins tributary to the Moreau River. This area is bounded on the north by the Grand River drainage, on the south by the Moreau River and on the west by other tributaries of the Moreau River. The area comprises approximately 1295 square miles of which 739 square miles are within the Thunder Butte Creek drainage.

Topography

The principal topographic expressions of these drainages are those of rolling plains interrupted occasionally by undulating to heavily rolling areas. Other features are small badland areas and steep-sided buttes and ridges. Elevations vary from about 3,000 feet above sea level at the headwaters to about 2,100 feet at the eastern edge of the area.

Major stream valleys are broadly concave in their upper portions but become wide, flat-bottomed and commonly steep sided in

their lower reaches. Existing channels meander within the confines of the valley wells, dissecting the alluvial flats into small acreages of bottom land.

Tributary valleys although shallow at their heads and having no defined channels, become deep, narrow U shaped drains containing small channels which meander similarly to those of the major streams. Headwater areas of both the tributaries and the major drainages in some instances are occupied by saucer-shaped, undrained or poorly drained depressions. The lower portion of Thunder Butte Creek and its tributaries have established a heavily rolling to rough and broken topography. Elsewhere inter-stream areas are undulating to rolling.

Climatic Conditions

The climate of the area is typically semi-arid with widely varying and extreme temperatures and highly variable and erratic precipitation. Periods of drought alternate irregularly with periods of about average rainfall.

Records of United States Weather Bureau stations within the area at Bison and near Strool indicate that the average annual precipitation at Bison for the 17 year interrupted record, 1909 to 1919 and 1932 to 1937, was 13.85 inches and at the station near Strool for the 27 year period 1911 to 1937 inclusive was 16.16 inches. About 75 per cent of the average annual precipitation occurred during the growing season, April to September inclusive.

Summer rains are usually local and are occasionally of cloudburst intensity. Summer storms are frequently accompanied by high winds and severe electrical disturbances and occasionally by severe hail storms. Snow fall in the area averages about 36 inches and drifts considerably.

Temperatures vary from 111 degrees above to 38 degrees below zero. The mean temperature is about 45 degrees. The average maximum temperature is about 57 degrees and the average minimum about 33 degrees. The frost-free period is approximately 135 days.

The prevailing wind in the area is from the northwest and is frequently of sufficient intensity to cause considerable soil movement. Chinook winds occur occasionally during the late winter months and cause sudden and sharp rises in temperature. The area is subject to occasional hot summer winds which are very destructive to growing crops.

Geology and Ground Water

The geologic materials exposed in the area consist of gumbo and shale alternating with beds of sandstone, silt, clay, and shale. This alternation occurs between and to a large extent within the formations. The ease or difficulty with which these materials may be eroded are largely responsible for the present topographic and drainage pattern. Likewise the relationship of the geology to topography and drainage determines the occurrence and availability of ground water in this area. Rough broken localities, badland areas

and "scabby land" are associated with the Pierre and Upper Hell Creek formations. Useable quantities of ground water are uncommon in these formations. Undulating to rolling topography predominates on exposures of the Fox Hills, Lower Hell Creek, and Ludlow formations, although locally, incipient badlands and "scablands" may be in evidence. Ground waters of variable quality, but in most instances suited to livestock and farmstead uses, occur in moderate quantities in these formations.

Excepting the area of Pierre shale exposure (Map 1) ground waters are available everywhere in this area to springs or pumped wells. Drilling depths to encounter satisfactory¹ supplies generally will not exceed 350 feet depending mainly upon topography, and few wells will exceed 150 feet.

There are a few flowing wells in the vicinity of the confluence of Rabbit and Antelope Creeks. Insufficient data are available to define the artesian basin but it is believed to be small. Detailed information concerning the geology and existing wells is necessary to delimit the probable area of artesian flow. Careful consideration must be given the possibility of interference between individual wells and possible excessive withdrawals from the area as a whole when additional wells are contemplated.

Ground waters in the area contain varying concentrations of mineral salts. The better quality ground waters occur in the Fox Hills and Lower Hell Creek formations. These can be encountered

1 Not less than three gallons per minute and suited chemically for livestock and farmstead uses.

most economically in Ground Water Area B (Map 1). Waters in the Ludlow formation which is exposed mostly in Ground Water Area A are of inferior quality to others just mentioned but are satisfactory with very few exceptions.

Soils and Vegetative Cover

The most extensively developed soils, the Morton series, in the area, are derived mainly from sandstones and friable clays and shales of the Fox Hills, Hell Creek, and Ludlow formations. They range in texture from fine sandy loam to clay or gumbo with the heavier textured soils occurring in the headwater areas. Morton loam, the most extensive soil in the area, is well drained and retentive of moisture and is not as susceptible to wind action as the lighter soils. Morton gumbo occupies the headwaters and poorly drained areas and contains large amounts of alkali.

Other soils in the area are derived from shales of the Pierre formation which occupy small areas of badlands and from materials deposited in the stream beds by stream action.

The vegetative cover of the area is primarily composed of short grasses. On the uplands the predominant grasses are blue grama and niggerwool. On the terraces sandgrass and needle grass predominate whereas on the creek bottoms the cover consists of a mixture of the above grasses and western wheat grass.

The present carrying capacity of the grassland of the area is about 30 surface acres per animal unit on a year long basis. The grazing period varies from 9 to 10 months per year.

Surface Water

There are no stream gaging stations in the area. The nearest station is at Promise on the main stem of the Moreau River, about sixty miles east of its confluence with Thunder Butte Creek. Stream discharge records for the 10 year period, 1929 to 1938, were available at this station and are shown in Table 1.

Table 1.--ANNUAL DISCHARGE IN ACRE-FEET, OF THE MOREAU RIVER
AT PROMISE, SOUTH DAKOTA, DURING THE PERIOD 1929
TO 1938 INCLUSIVE ¹
(Drainage area 5,225 Sq. MI.)

<u>Year Ending</u> <u>September 30</u>	<u>Discharge in</u> <u>Acre-Feet</u>	<u>Run-off in Acre-Feet</u> <u>Per Square Mile</u>
1929	285,000	54
1930	90,900	17
1931	41,500	8
1932	203,000	39
1933	123,000	23
1934	14,500	3
1935	63,502	12
1936	37,284	7
1937	226,765	43
1938	51,697	10
Average	113,675	22

¹ Source: House Document 76-73-1, Report on Cannonball, Grand, and Moreau Rivers, N.D. & S.D., 1934 and from U. S. Geological Survey Records.

The above information shows that there is a wide variation in run-off and that there is no assured water supply available for irrigation or storage. These records show the average annual yield for the Moreau River at Promise is 22 acre-feet per square mile for the period of record. This figure is indicative but not conclusive for this area, because of variations in vegetative cover, soil types, topography, and precipitation. Independent estimates of run-off for each facility should be made before construction is contemplated.

In order to permit a determination of water supply available, gaging stations should be established at strategic points in this area and should operate concurrently. They would also enable the State Engineer to differentiate between dry draws and flowing streams.

III

WATER RIGHTS

The waters of South Dakota are public and subject to appropriation for beneficial use. Prior use establishes prior right. Water for irrigation purposes is appurtenant to the land. There are two main distinctions in the classes of water rights, water rights on non-navigable streams and water rights on dry draws. The distinction is defined thus: "The words 'dry draw' and 'water course', as used in this section, shall be construed to mean any ravine or water course not having a flow of at least twenty miner's inches of water during the greater part of the year.....One cubic foot of water per second is equivalent to fifty miner's inches."¹ Under the terms of the above definition it appears that the entire drainages of Rabbit and Thunder Butte Creeks come under the classification of dry draws.

The dry draw appropriation was intended to allow settlers and landowners to construct reservoirs for impounding storm water without having to go to the expense of making surveys and submitting applications in regular form to the State Engineer. The law merely requires a Location Certificate to be filed with the Register of Deeds in the County in which the appropriation is made, a copy to be posted at the place of diversion and another copy to be filed

1 State of S. Dak. - Regular Legislative Session of 1939 - Code Revision Report, Vol. VIII.

with the State Engineer. If these requirements are fulfilled and the works constructed within sixty days after posting the certificate, and the water put to beneficial use, the appropriator then has the right of such water in accordance with his location certificate. Then if the appropriator desires a certificate from the State Engineer to the effect that he has a water right under the laws of the state (state water right), he is required to petition the State Engineer for the same.

There are no dry draw rights and only one state water right for 2.4 cubic feet per second on Thunder Butte Creek. There are 40 dry draw fillings and nine state water rights for 45 cubic feet per second on Rabbit Creek.

IV

EXISTING WATER FACILITIES

Existing water facilities within the drainages of Rabbit and Thunder Butte Creeks consist of stock water ponds, farmstead and range wells, a few storage reservoirs, pumping plants, and numerous small flood irrigation facilities. (Map 2)

The largest reservoir is on a branch of Rabbit Creek near Sorum and has a capacity of about 200 acre-feet. It was built by the Works Progress Administration for recreational purposes and has no outlet works. There is little evidence of silt accumulation in the reservoir.

Two small pumping units were observed which pump water from the stream channels to irrigate small tracts for truck garden and supplemental feed. These units are small but have proven successful.

Flood irrigation has been practiced by several operators for many years. One typical unit observed has been in operation since 1918 with but two failures, one due to grasshoppers and one due to insufficient run-off. Normal years have provided at least one and frequently three floodings a year. This particular unit is used to flood about 120 acres of native hay meadow. Three Water Facilities Demonstration Projects for flood irrigation, water

spreading and subirrigation have been constructed recently in the area.

There is no information available on the duty of water for this area. It is not particularly important as there is no assured water supply.

ECONOMIC CONDITIONS IN THE AREA

The area is primarily an agricultural area with no industrial development other than a few small coal mines.

Although the first settlers came to the area about 1890, there was no large influx of settlers until the area was opened to homesteading about 1900. The first settlers were hunters and trappers and were gradually replaced by cattlemen who only produced such crops as were needed for home consumption. With the increase in homesteading, small ranch units were displaced. The larger cattle operators stayed in the area but were forced to raise more feed due to restricted range. Recent years of drought have caused the abandonment of many of the dry-land farming units and a serious decrease in the number of cattle.

Population, Transportation, Markets, and Public Facilities

The total population of the area is approximately 2,500. Practically all the population is rural with the exception of Dixon, the county seat of Perkins County with a population of about 500.

The nearest shipping point is at Lemmon on the Chicago, Milwaukee, St. Paul, and Pacific Railroad, about 40 miles north-east of the area. There are no hard surfaced roads in the area.

State Highway Number 8 traverses the area from east to west. Numerous county and township roads extend throughout the area but most of these are practically impassable in winter and early spring.

Lemmon is the principal shipping point for cattle produced in the area. Local demand is usually sufficient for hay, forage, and graden truck produced in the area.

A power plant at Bison serves the needs of the town. Rural power is supplied by private individual units. Several farm telephone lines serve the area.

Rural schools are scattered throughout the area with a consolidated high school at Bison. There are several churches scattered throughout the area.

General Fiscal Conditions

Data are available to show the amount of land subject to tax deed or in county ownership in Perkins County only, but it is believed that such information is representative of the entire area. As of May 1939, 16 per cent of the land in Perkins County is in county ownership and an additional 22 per cent is subject to tax deed.¹

The tax per acre levied against agricultural land in Perkins County in 1938 varied from 10.1 cents to 14.7 cents and averaged 12.2 cents per acre.

1 Source: Unpublished data, Division of Land Economics, Lincoln, Neb.

The lease rate for publicly-owned grazing land varies from five to eight cents per acre.

Available information on federal assistance to operators in the area was limited to the portion of the area lying in Perkins County. Seventy-four of the 178 operators in this part of the area have received loans or grants from the Farm Security Administration.¹ Approximately \$90,000 has been expended to November 1, 1939 by this agency in the form of grants of which about one-third has been expended during the last 12 months. About \$40,000 has been expended in the form of emergency loans and a similar amount for Standard Rehabilitation Loans. About one-fourth of the amount expended for standard loans has been repaid.

Land Ownership

Available information on land ownership is limited to Perkins County.² As of January 1, 1938 about 74 per cent of the land in the county was owned by private individuals, three per cent by corporations, 14 per cent by the State, eight per cent by the county and about one per cent by the Federal Government. Data as of June 15, 1939 indicate a reduction of about 14 per cent in the land under private ownership and increases of about 7 per cent in both county-owned and other publicly-owned lands.

The average operator in the area owns 14 per cent of the land in his unit, rents 70 per cent and uses without legal control 16 per cent.

1 Source: Farm Security Administration Records, Perkins County.
2 Source: Unpublished data, Division of Land Economics, Lincoln, Neb.

Present Land Use

Present land use has been mapped in place for that portion of the watershed lying in Perkins County. (Map 3) Four representative townships in Perkins County were further studied to determine the percentage of land under cultivation. This information, tabulated in Table 2 indicates that about 14 per cent of the land is under cultivation, about 8 per cent in the restoration program of the Agricultural Adjustment Administration and about 78 per cent in range land. A somewhat higher percentage of the land is under cultivation in Present Land Use Area I than is indicated above.

The cultivated land is used for the production of wheat or forage crops. Erosion is a minor problem except in localized areas. Moderate sheet and wind erosion occur in a small area on lower Rabbit Creek.

Table 2 indicates the present size of operating unit is about 790 acres in Area I, 1,060 acres in Area II and about 2,500 acres in Area III.

Average yields of wheat per acre as indicated by Federal Crop Insurance records for Perkins County show the high risk nature of crop production in this area. The wheat yields of only four operating units are listed as being above 8.6 bushels per acre. About 25 operating units are listed as having yields of 6.6 to 8.5 bushels per acre. The above yields are the highest given in this area. As the yield of six to seven bushels of wheat per acre is

considered necessary to repay the cost of production it can readily be seen that there is very little or no profit in cash wheat production in this area.

Table 2.—SIZE OF OPERATING UNIT AND USE OF LAND IN SELECTED TOWNSHIPS IN RABBIT CREEK AND THUNDER BUTTE CREEK DRAINAGES, MOREAU RIVER WATERSHED, SOUTH DAKOTA¹

Present Land Use Area	Description of Township	Average Size of Operating Unit - Acres	Average Cropland Acres	Average Res-toration Land Acres	Average Range Land Acres
I	18 14	786	284	85	417
II	17 11	1,061	400	93	568
III	16 16	2,426	147	161	2,118
	16 15	2,719	117	196	2,406
Average Acres		1,748	237	134	1,377
Per Cent		—	14	8	78

Two general types of farming exist in the area at present, combination cash grain-livestock, and livestock. The first type is generally found in Present Land Use Areas I and II, while the latter type is found mainly in Present Land Use Area III.

¹ Source: Perkins County AAA Records, 1938

VI

RECOMMENDED LAND USE AND DEVELOPMENT OF WATER FACILITIES

In considering the probable best use of the land in the area, two land-use areas have been delineated on Map 3 and suitable types of farming recommended for each area. In general, the area is best suited for the production of livestock and major reliance for farm income should be placed on cattle and sheep production.

In Recommended Land Use Area A, composed of Present Land Use Areas I and II, a combination livestock and cash grain type of farming may be followed with feed crops being produced on the best cropland. If additional good cropland is available wheat may be produced.

In Recommended Land Use Area B, composed of Present Land Use Area III, a livestock type of farming should be followed. Feed crops should be produced on the best cropland. Cropland not needed for feed production should be retired from cultivation and restored to grass.

It is believed that at least 150 animal units are necessary in this area to pay average farm overhead and operating expenses and to provide the average farm family with a minimum income adequate for family living. Assuming the carrying capacity of range land in this area to be 25 acres per animal unit for a ten-month period, it is necessary that operators in this area have

long-time control of at least six sections of grazing land. In addition, operators should control enough cropland to provide winter feed and adequate feed reserves. In Recommended Land-Use Area A where wheat may be produced, the acreage devoted to wheat production must be provided in addition to the above acreage requirements for livestock.

It is recommended that as much of the family food requirements as possible be produced on each of the operating units in the area.

The development of a lower risk more extensive type of agriculture rather than the present high risk more or less intensive type should be encouraged.

Although it is realized that these recommendations are of a very general nature, applicable to the average operator in the area, and subject to variation in individual cases, water facilities should not be developed on units which do not at least meet these minimum requirements without very careful consideration and justification.

Field observations indicate that this area is adequately supplied with livestock and farmstead water. Any adjustment in land use or size of operating units may create a need for additional development. However, there is a need for the repair and improvement of farmstead wells, stock water ponds, and range wells.

The development of additional flowing wells for livestock, farmstead and garden uses, merits careful consideration.

The irrigation of family-sized garden tracts from either wells or stock water ponds is recommended. There are a few locations along lower Rabbit Creek and lower Thunder Butte Creek where pumping from perennial pools for garden irrigation is feasible. However, before undertaking such development, it will be necessary to investigate each individual requirement and determine the water supply. It is recommended that snow traps be utilized to catch drifting snows in order to increase moisture content of garden soils.

There is little opportunity for irrigation from impounding dams. Such storage, except in isolated cases, is not recommended because of the erratic water supply.

The opportunity for water spreading, flood irrigation and sub-irrigation exceeds the water supply and care should be exercised to prevent overdevelopment. Water rights should be secured on all proposed developments and care should be exercised to assure that the many existing rights on Rabbit Creek are not infringed upon.

Most of this development can be and should be made by the individual operator with his own equipment and labor with the technical assistance offered under the Water Facilities Program.

The Water Facilities Act requires: "The facilities to be included within such program shall be located where they will promote the proper utilization of lands and no such facilities shall be located where they will encourage the cultivation of lands which are submarginal and which should be devoted to other uses in the public interest".

VII

VALUE OF WATER FACILITIES

The development of water facilities will assist in the stabilization of operating units in the area. Such development will permit the irrigation of family sized gardens which will contribute greatly to the farm family food requirements. Water spreading, flood irrigation and sub-irrigation facilities will increase the production of supplemental feed and tend to assure the production of feed in dry years.

APPENDIX

MAPS

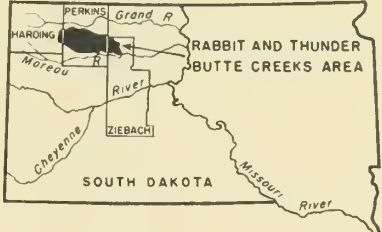
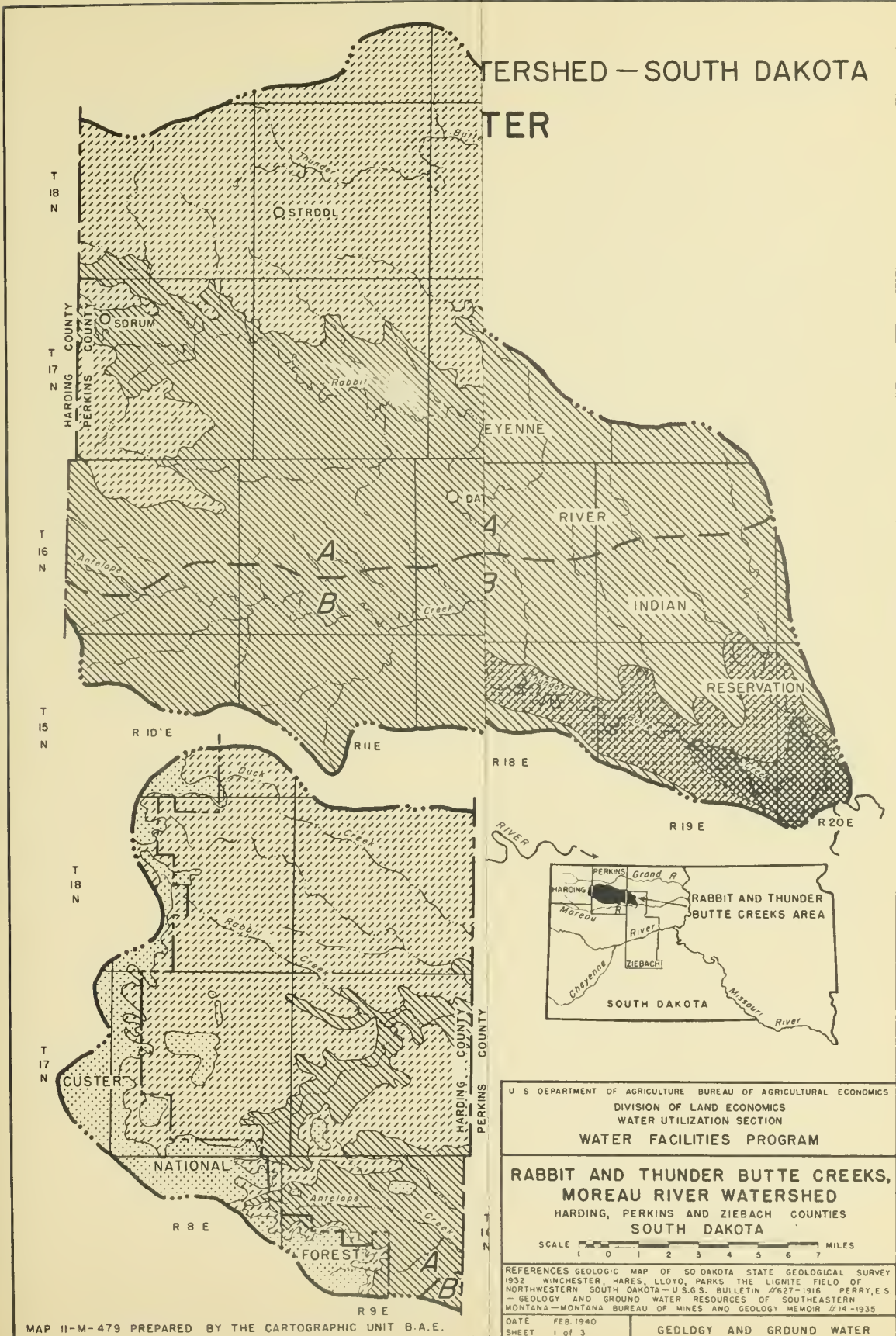
Contents

Map 1 - Geology and Ground Water

Map 2 - Facilities

Map 3 - Present and Recommended Land Use Areas

WATERSHED — SOUTH DAKOTA CREEK



U S DEPARTMENT OF AGRICULTURE BUREAU OF AGRICULTURAL ECONOMICS
 DIVISION OF LAND ECONOMICS
 WATER UTILIZATION SECTION
WATER FACILITIES PROGRAM

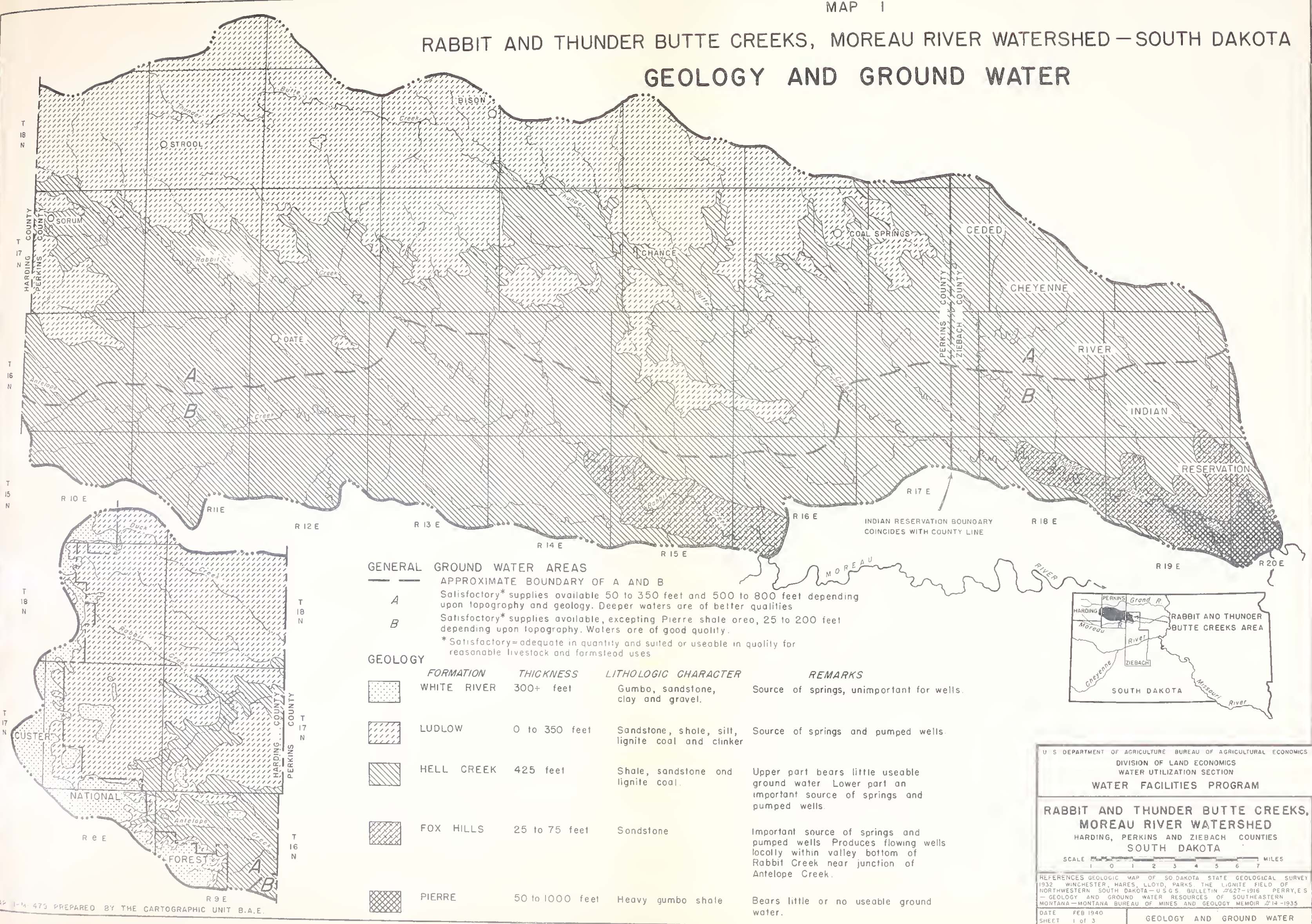
RABBIT AND THUNDER BUTTE CREEKS, MOREAU RIVER WATERSHED HARDING, PERKINS AND ZIEBACH COUNTIES SOUTH DAKOTA

SCALE 1 0 1 2 3 4 5 6 7 MILES

REFERENCES GEOLOGIC MAP OF SOUTH DAKOTA STATE GEOLOGICAL SURVEY
 1932 WINCHESTER, HARES, LLOYD, PARKS THE LIGNITE FIELD OF
 NORTHWESTERN SOUTH DAKOTA—U.S.G.S. BULLETIN #7627—1916 PERRY, E.S.
 — GEOLOGY AND GROUND WATER RESOURCES OF SOUTHEASTERN
 MONTANA—MONTANA BUREAU OF MINES AND GEOLOGY MEMOIR #14—1935

DATE FEB. 1940
 SHEET 1 of 3
 GEOLOGY AND GROUND WATER

RABBIT AND THUNDER BUTTE CREEKS, MOREAU RIVER WATERSHED — SOUTH DAKOTA GEOLOGY AND GROUND WATER



GENERAL GROUND WATER AREAS

- APPROXIMATE BOUNDARY OF A AND B
- A** Satisfactory* supplies available 50 to 350 feet and 500 to 800 feet depending upon topography and geology. Deeper waters are of better qualities
- B** Satisfactory* supplies available, excepting Pierre shale area, 25 to 200 feet depending upon topography. Waters are of good quality.
- * Satisfactory=adequate in quantity and suited or useable in quality for reasonable livestock and farmstead uses

GEOLOGY

FORMATION	THICKNESS	LITHOLOGIC CHARACTER	REMARKS
WHITE RIVER	300+ feet	Gumbo, sandstone, clay and gravel.	Source of springs, unimportant for wells.
LUDLOW	0 to 350 feet	Sandstone, shale, silt, lignite coal and clinker	Source of springs and pumped wells.
HELL CREEK	425 feet	Shale, sandstone and lignite coal.	Upper part bears little useable ground water. Lower part an important source of springs and pumped wells.
FOX HILLS	25 to 75 feet	Sandstone	Important source of springs and pumped wells. Produces flowing wells locally within valley bottom of Rabbit Creek near junction of Antelope Creek.
PIERRE	50 to 1000 feet	Heavy gumbo shale	Bears little or no useable ground water.

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DIVISION OF LAND ECONOMICS
WATER UTILIZATION SECTION

WATER FACILITIES PROGRAM

**RABBIT AND THUNDER BUTTE CREEKS,
MOREAU RIVER WATERSHED**
HARDING, PERKINS AND ZIEBACH COUNTIES
SOUTH DAKOTA

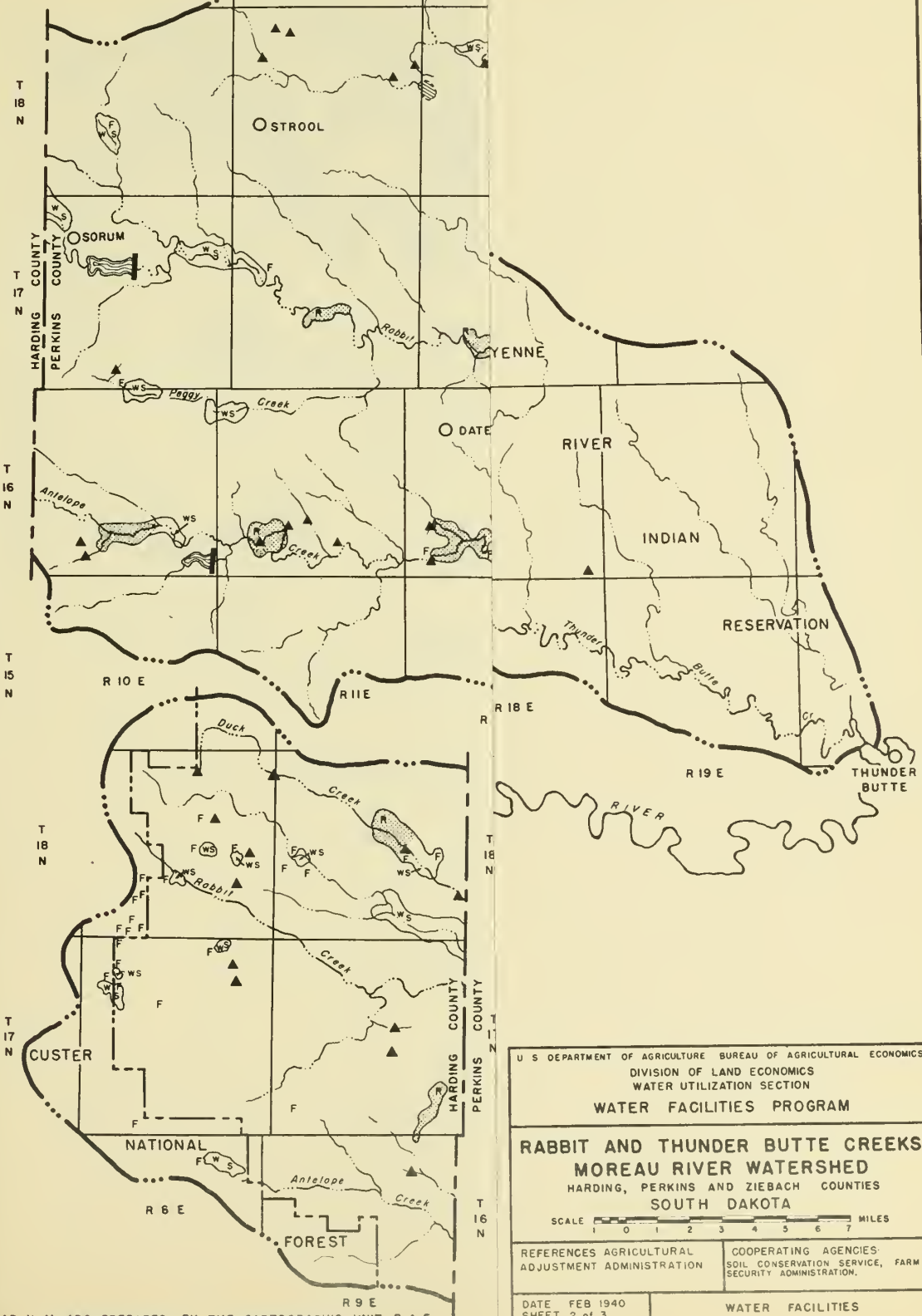
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REFERENCES: GEOLOGIC MAP OF SOUTH DAKOTA STATE GEOLOGICAL SURVEY 1932 WINCHESTER, HARES, LLOYD, PARKS THE LIGNITE FIELD OF NORTHWESTERN SOUTH DAKOTA—U.S.G.S. BULLETIN #2627-1916 PERRY, E.S. — GEOLOGY AND GROUND WATER RESOURCES OF SOUTHEASTERN MONTANA—MONTANA BUREAU OF MINES AND GEOLOGY MEMOIR #14-1935

DATE FEB 1940
SHEET 1 of 3

GEOLOGY AND GROUND WATER

WATERSHED — SOUTH DAKOTA



MAP II-M-480 PREPARED BY THE CARTOGRAPHIC UNIT B.A.E.

U S DEPARTMENT OF AGRICULTURE BUREAU OF AGRICULTURAL ECONOMICS
 DIVISION OF LAND ECONOMICS
 WATER UTILIZATION SECTION
WATER FACILITIES PROGRAM

**RABBIT AND THUNDER BUTTE CREEKS,
 MOREAU RIVER WATERSHED**
 HARDING, PERKINS AND ZIEBACH COUNTIES
 SOUTH DAKOTA

SCALE 1 0 1 2 3 4 5 6 7 MILES

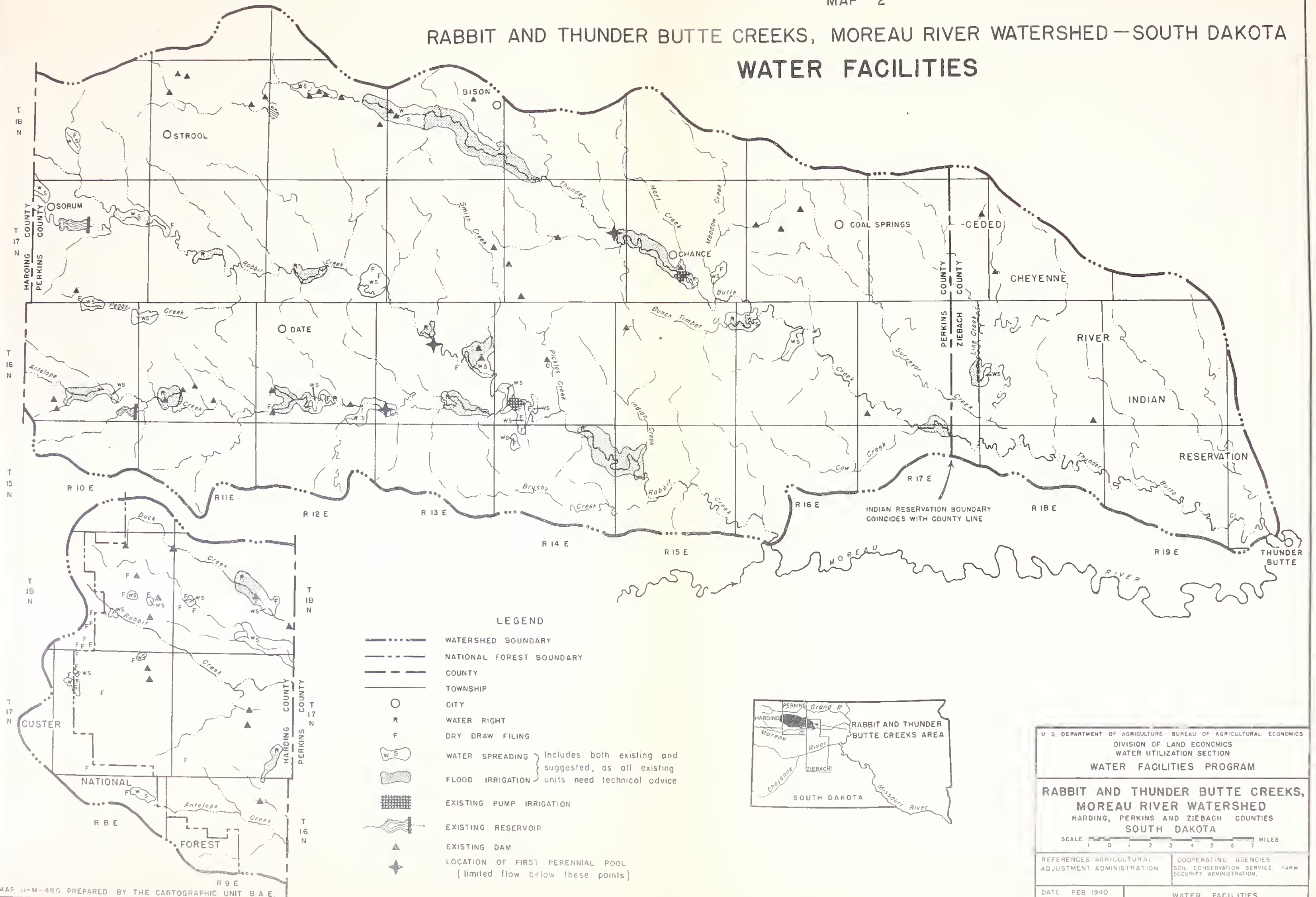
REFERENCES AGRICULTURAL
 ADJUSTMENT ADMINISTRATION

COOPERATING AGENCIES:
 SOIL CONSERVATION SERVICE, FARM
 SECURITY ADMINISTRATION.

DATE FEB 1940
 SHEET 2 of 3

WATER FACILITIES

RABBIT AND THUNDER BUTTE CREEKS, MOREAU RIVER WATERSHED — SOUTH DAKOTA WATER FACILITIES



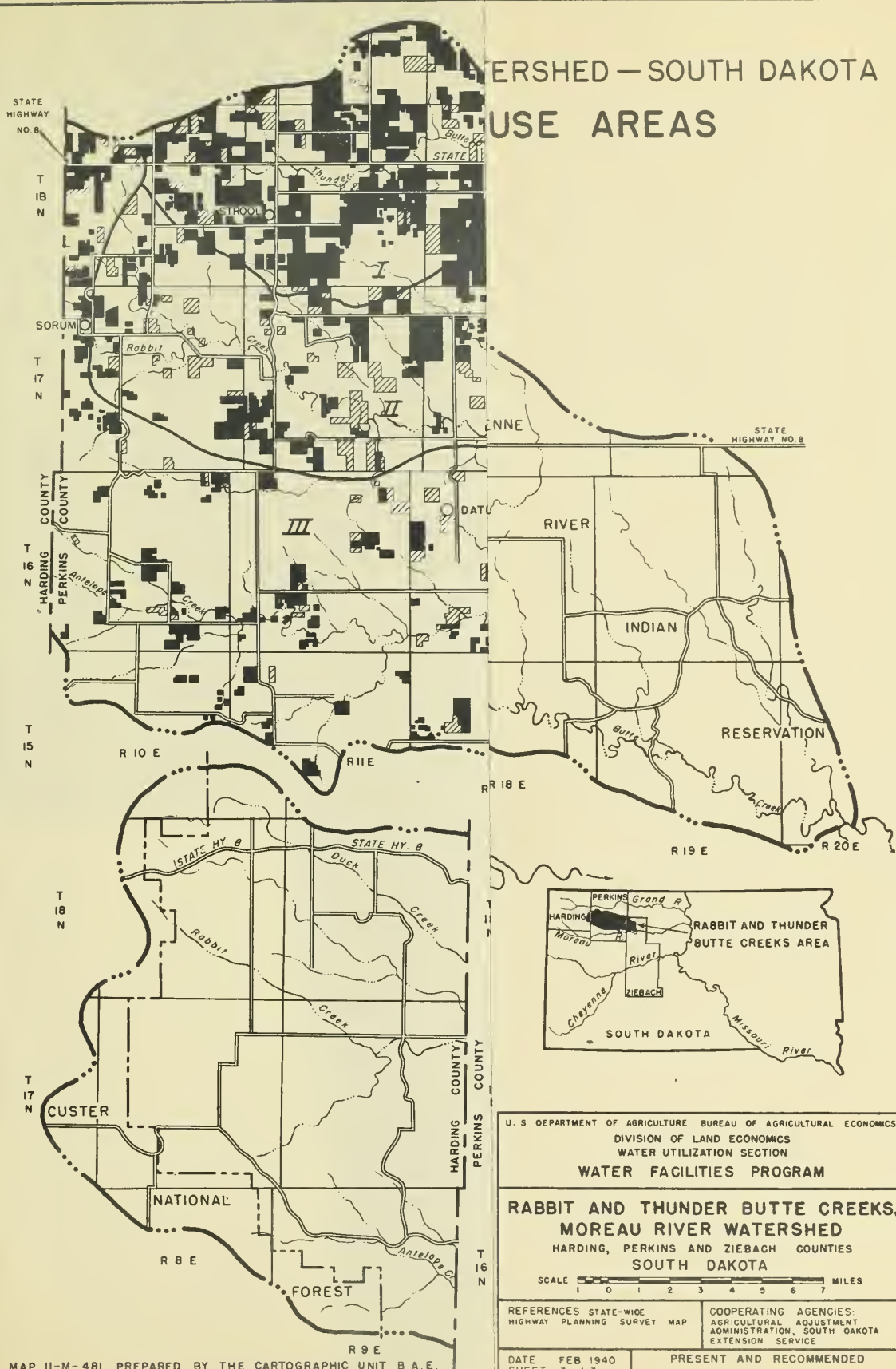
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WATER UTILIZATION SECTION
WATER FACILITIES PROGRAM

**RABBIT AND THUNDER BUTTE CREEKS,
MOREAU RIVER WATERSHED**
HARDING, PERKINS AND ZIEBACH COUNTIES
SOUTH DAKOTA

SCALE 0 1 2 3 4 5 6 7 MILES

REFERENCES AGRICULTURAL ADJUSTMENT ADMINISTRATION	COOPERATING AGENCIES SOIL CONSERVATION SERVICE, FARM SECURITY ADMINISTRATION.
DATE FEB 1940 SHEET 2 of 3	WATER FACILITIES

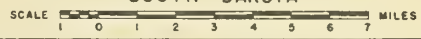
WATERSHED — SOUTH DAKOTA LAND USE AREAS



MAP II-M-481 PREPARED BY THE CARTOGRAPHIC UNIT B.A.E.

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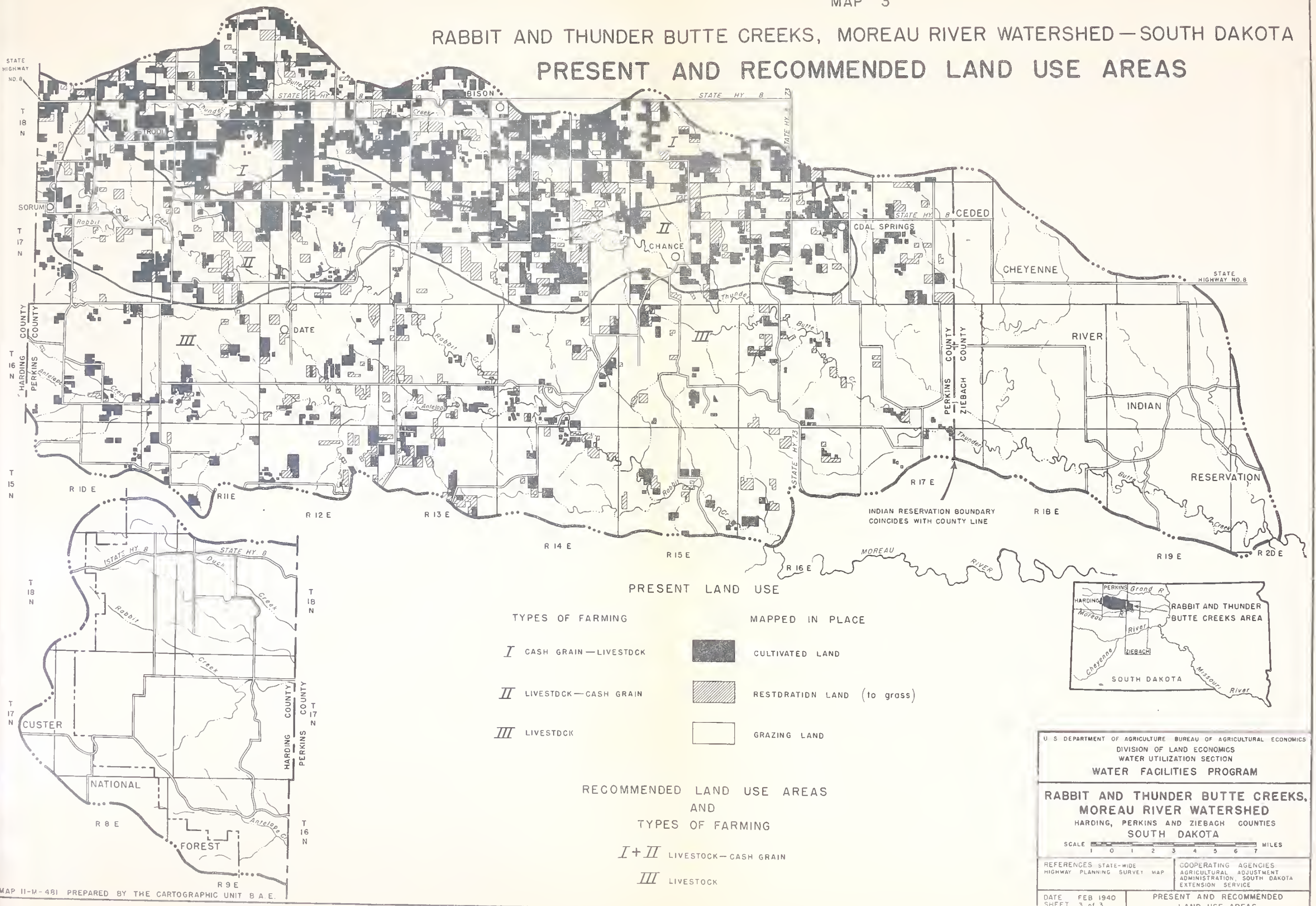
RABBIT AND THUNDER BUTTE CREEKS, MOREAU RIVER WATERSHED HARDING, PERKINS AND ZIEBACH COUNTIES SOUTH DAKOTA



REFERENCES STATE-WIDE HIGHWAY PLANNING SURVEY MAP	COOPERATING AGENCIES: AGRICULTURAL ADJUSTMENT ADMINISTRATION, SOUTH DAKOTA EXTENSION SERVICE
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DATE FEB 1940 SHEET 3 of 3	PRESENT AND RECOMMENDED LAND USE AREAS
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RABBIT AND THUNDER BUTTE CREEKS, MOREAU RIVER WATERSHED — SOUTH DAKOTA PRESENT AND RECOMMENDED LAND USE AREAS

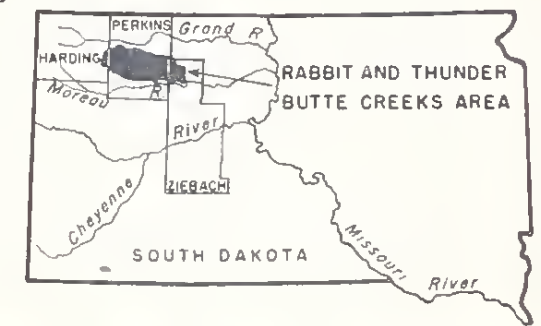


PRESENT LAND USE

- | | |
|----------------------------------|-----------------------------|
| TYPES OF FARMING | MAPPED IN PLACE |
| <i>I</i> CASH GRAIN — LIVESTOCK | CULTIVATED LAND |
| <i>II</i> LIVESTOCK — CASH GRAIN | RESTORATION LAND (to grass) |
| <i>III</i> LIVESTOCK | GRAZING LAND |

RECOMMENDED LAND USE AREAS AND TYPES OF FARMING

- I + II* LIVESTOCK — CASH GRAIN
- III* LIVESTOCK



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**RABBIT AND THUNDER BUTTE CREEKS,
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SOUTH DAKOTA

SCALE 1 0 1 2 3 4 5 6 7 MILES

REFERENCES STATE-WIDE HIGHWAY PLANNING SURVEY MAP
COOPERATING AGENCIES: AGRICULTURAL ADJUSTMENT ADMINISTRATION, SOUTH DAKOTA EXTENSION SERVICE

DATE FEB 1940 SHEET 3 of 3
PRESENT AND RECOMMENDED LAND USE AREAS

