WATER AND RELATED LAND RESOURCES

JAMES RIVER BASIN AND DESIGNATED MISSOURI RIVER SUB BASINS

SOUTH DAKOTA

U. S. DEPARTMENT OF AGRICULTURE

Economic Research Service
Forest Service
Soil Conservation Service

MAY, 1966

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and

DESIGNATED MISSOURI RIVER SUB-BASINS

SOUTH DAKOTA

A Report Based on a Cooperative Survey by

SOUTH DAKOTA WATER RESOURCES COMMISSION
OAHE CONSERVANCY SUB-DISTRICT
LOWER JAMES CONSERVANCY SUB-DISTRICT
and
THE UNITED STATES DEPARTMENT OF AGRICULTURE

May, 1966

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SUMMARY

The land area of the James River Basin and the Designated Missouri River Sub-Basins is located in east-central South Dakota. The Study Area consists of 20,081 square miles or 26 percent of the total land area in the State. About 42 percent of the State's farms and ranches is in this area, and these produce 37 percent of the total value of farm products sold in the State.

The average annual precipitation ranges from about 16 inches in the northwest to about 22 inches in the southeast. Frost-free periods vary from 120 to 150 days.

The average annual run-off from the James River Basin is 0.23 inch. The water yield is the lowest of all the major river basins in South Dakota.

Most of the area lies within three Land Resource Areas (LRA 53 - Dark Brown Glaciated Plains; LRA 55 - Black Glaciated Plains; and LRA 102 - Loess, Till, and Sandy Prairies). LRA 53 has 44 percent cropland, 54 percent grassland, and 2 percent other uses. LRA 55 has 62 percent cropland, 36 percent grassland, and 2 percent other uses. LRA 102 has 68 percent cropland, 28 percent grassland, and 4 percent other uses.

Dryland agriculture is the principal industry with annual sales of agricultural products totaling over 190 million dollars. Twenty-six percent of personal income is from agriculture, while the national average is less than 4 percent. Livestock and livestock products account for 165 million dollars or 87 percent of the total annual sales. By the year 2020, it is estimated that the number of farms and ranches will decrease from the present 23,000 to 9,800. As these changes occur in the rural community, it is anticipated that during the same period the total population will expand from 235,000 to 398,000.

In 1959, twenty percent of the farms had gross receipts of less than $2500. The average value of all farm products sold in 1960 was $10,800 per farm. It is estimated that by 2020 the average will be $55,200 or an increase of 412 percent. The increases in total cash receipts and the decreases in the number of farms indicate a better economic position for farmers in 2020.

The proposed Oahe Unit Irrigation Project is located in the area, but the economic impact of the project was not evaluated as a part of the USDA Study. This project was considered in place for project formulation and planning purposes. The Oahe Project has been evaluated by the Bureau of Reclamation as a part of the Missouri River Basin Development. The principal benefits from this project were based on the irrigation of 495,000 acres. Other benefits from the proposed project would accrue from fish and wildlife development, recreation, municipal water, flood control, and pollution abatement.

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The entire Study Area periodically has wind erosion problems. This is a serious problem on 400,000 acres. Water erosion of varying degrees is a problem on approximately two million acres of cropland.

About 269,000 acres are subject to flooding. Seventy-two percent of the floodplain lands is in tributary watersheds, and the remainder on the James River floodplain. Approximately one-third of the tributary floodplains is used as cropland. The most frequent flooding is from snowmelt run-off resulting in relatively minor agricultural damage.

Nearly every year some portion of the Study Area experiences moisture deficiencies during the growing season. There are over three million acres of suitable soils that could be irrigated if water were available. It is estimated there is adequate water within the Basin to irrigate approximately 147,000 acres. Shallow acquifers could provide water for 123,000 acres, and 24,000 acres could be irrigated from surface run-off.

There are about 314,000 acres of Class III and IV, cropland, that periodically have either surface or sub-surface drainage problems. Most of the surface drainage problems consist of small, wet areas within lands suitable for crop production.

Variable climatic conditions occasionally cause water shortages in reservoirs and dugouts used for stockwater. Because of this water shortage, the use of the land resource for grazing can be limited, even in years of average or above normal precipitation. It is estimated that demands for rural domestic water will more than double by 2020.

Of the 118 towns and villages in the Study Area, 112 obtain their water supply from wells. Ninety percent of these supplies do not meet national standards for quality because of high mineral content. About one-third of these towns and villages has experienced water shortages, and by 2020, approximately one-half will need additional water supplies.

Based on present population, over 60 percent of the area has inadequate water-based recreation facilities.

The greatest opportunity for solving wind and water erosion problems is the application of land treatment measures. The principal measures required are 1,400,000 acres of windstrip cropping, 2,000,000 acres of stubble mulch tillage, 41,000 miles of terracing, 2800 miles of field wind breaks, and 1,000,000 acres of contour farming. The application of these and other land treatment measures can improve the economy of the area.

Opportunity for project development is indicated in fifteen sub-basins which represent 18 percent of the Study Area. Five of these could be developed by local people under existing authorities. Four others have projects with favorable physical and economic potential, but must be deferred because of authority limitations or the need for other multi-purpose development. Six have projects of marginal economic feasibility.

Projects in nine of the fifteen sub-basins include flood prevention as a primary purpose. Three of these projects also have water-based recreation as a specific purpose and two include irrigation.

Six of the fifteen sub-basins have potential single-purpose agricultural water management projects. Five of these are irrigation projects, and one is a drainage project.

In the entire Study Area, opportunities exist for developing soil and water resources on other than a project basis. Sites for potential development of reservoirs, diversions, and other structural measures were noted that can be considered for development in the future by individuals, local groups, and State or Federal Agencies.

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GENERAL

AUTHORIZATION OF USDA STUDY

Section 6 of the Watershed Protection and Flood Prevention Act (P.L. 566, 83rd Cong., 68 Stat 666), as amended, contains this statement: "The Secretary is authorized in cooperation with other Federal Agencies and with States and local agencies to make investigations and surveys of the watersheds of rivers and other waterways as a basis for the development of coordinated programs. In areas where the programs of the Secretary of Agriculture may affect public or other lands under the jurisdiction of the Secretary of Interior, the Secretary of the Interior is authorized to cooperate with the Secretary of Agriculture in the planning and development of work or programs for such lands."

The South Dakota Water Resources Commission and the Oahe Conservancy Sub-District made a formal request for a Section 6 Study in May, 1961. Governor Gubbrud supported this request by presenting testimony before a Congressional delegation. USDA approval for the Study was based on a Plan of Work dated September 6, 1962. This Plan of Work was developed by the Department of Agriculture cooperating with the South Dakota Water Resources Commission and the Directors of the Oahe Conservancy Sub-District. These local entities of State government became sponsors. In 1965, the Lower James Conservancy Sub-District requested and was accepted as a third sponsor.

OBJECTIVE OF STUDY

The objective of the Study is to evaluate opportunities for developing water and land resources within the area for present and future use. Achievement of this objective requires an inventory of the utilization of water and land, identification of problems associated with water and land and delineation of other opportunities.

Accomplishment of this objective provides data the sponsoring organizations can use to develop understanding among the people of the problems and opportunities within the area. The report will assist in effective planning of possible land and water resource development by various agencies.

HISTORY OF AREA

Recorded history in this area begins in 1743. The Verendrye Brothers working for the Canadian Government explored along the Missouri River in that year. School children in 1912 found a lead plate near Fort Pierre that establishes this fact.

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Prior to this period, and until 1851 when certain Indian treaties were executed, Indians roamed this area in search of buffalo and other game. The Arikara Indians were the principal tribe in the area until the powerful Sioux Indians pushed them out.

Little is known about the activities of white men for the fifty-year period following the Verendrye Brothers' explorations. It is known that trappers, hunters, and missionaries spent some time in this area. In 1804, Lewis and Clark passed through South Dakota while exploring the Louisiana Purchase the United States secured from France in 1803.

After 1851, this area was opened for white settlement. Settlement was slow at first and consisted primarily of a few trading posts for trading with the Indians. In 1861, Congress created the Dakota Territory that included what is now known as North and South Dakota plus the area west to the Continental Divide. In 1863, the area was reduced to include only North and South Dakota. Part of Wyoming was added to the Dakota Territory for the period of 1864 to 1868. The territory was divided in 1889, and on November 2 of that year, South Dakota became a State.

The counties as we know them today were created by the Dakota Territorial Legislature between 1862 and 1883. Some counties organized immediately, but others took up to eleven years to become officially organized.

The first railroad came to Yankton in 1873, and by 1891 all counties had railroad service. The Homestead Act of 1861 had its effect on the rate land was settled, but the advance of the railroads had the greatest effect on the rate of settlement. By 1890, most of the land in the area had been claimed by settlers.

Some of the early settlers were vagabonds who stayed only long enough to prove their claims, borrow all they could on the land, and then move on. Fortunately, there were other settlers who stayed. They experienced hardships such as Indian massacres, drought, grasshoppers, prairie fires, and severe winters. Some prospered, but others lost their land by mortgage foreclosures and tax sales.

In the early part of the twentieth century, this area and the State developed rapidly despite periodic hardships common to a semi-arid area. A population peak for the State was recorded in the 1930 census. The economy, as today, had agriculture as its principal base. During the "Dirty 30's", many individuals and families migrated from the State. This migration was primarily because of the drouth, following boom prices paid for land in the 1920's. With a series of crop failures, farmers did not have the financial resources to tide them over.

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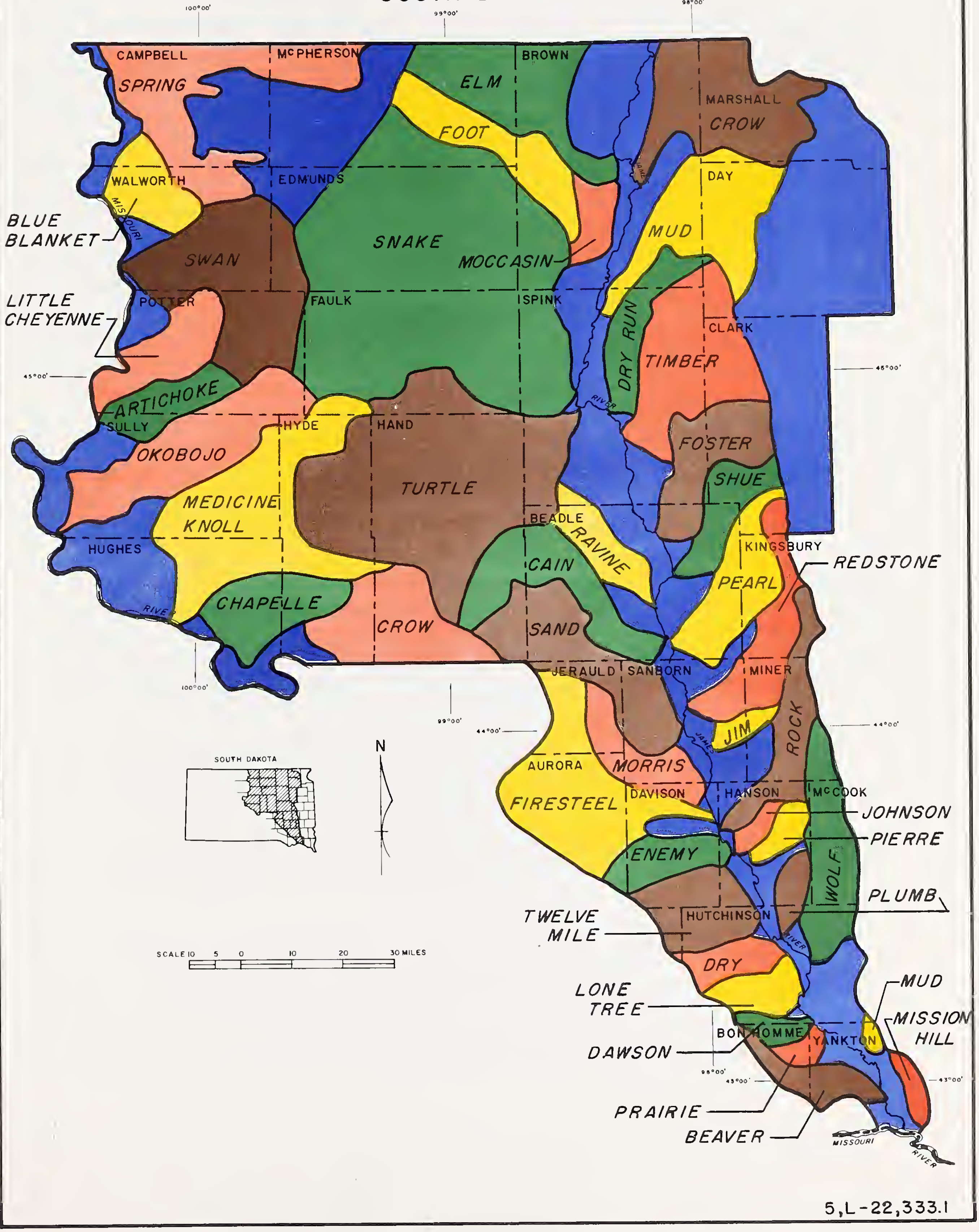
FIGURE I
PRINCIPAL SUB-BASINS JAMES RIVER BASIN AND DESIGNATED MISSOURI RIVER SUB-BASINS SOUTH DAKOTA



In the early 40's, the migration continued. First, many young men were called into the armed service, but secondly, this was also the period when many farmers were completing the transition from horse-drawn machinery to tractor power. As a result of these circumstances, there were fewer opportunities for young people to stay in agriculture.

After the population loss of the 30's and 40's, the farm population in the Study Area and the State has continued to decline. Substitution of power equipment for labor has permitted the average farmer to expand his operations. Total population in the Study Area has also decreased while the State has had an increase, primarily in the urban areas.

This area and South Dakota have had a brief history; however, in the two hundred years that the white man has known the area, there have been many dramatic and exciting events. Our Nation has had a rich heritage that was developed by the trapper, miner, homesteader, and immigrants who settled the West. South Dakota and the area discussed in this report have made a contribution to this rich heritage.

DESCRIPTION OF AREA

Location and Size

The Study Area has 20,081 square miles which is twenty-six percent of the total land area in the State of South Dakota. This area includes the drainage of the James River in South Dakota, plus the balance of the Oahe Conservancy Sub-District outside the James River Basin (Figure 2).

Climate

The Study Area is in a zone of semi-arid to sub-humid climate with extremes of summer heat and winter cold. Normal annual precipitation data is shown on Figure 3. Normal annual precipitation as used in this report is the average for a specific 30-year period. Precipitation extremes show a low of seven inches at Mobridge in 1936, and a high of twenty-eight inches at Tyndall in 1944. Tyndall is just outside of the Study Area.

Extreme temperature differentials are quite common throughout the area. Maximum temperatures over 110 degrees (F.) and minimum temperatures of minus 40 degrees (F.) have been recorded in most counties.

The average number of frost-free days in the area ranges from 120 to 150 days. The dates of the last spring freeze and the first autumn freeze are shown in Figure 4.

Wind conditions, in addition to temperature and precipitation, have considerable effect on this area. The prevailing wind direction during the growing season is generally from the south-southeast. Hot, dry winds are a regular occurrence during the summer. During the balance of the year, winds are generally from the north-northwest. Wind velocities for this area and the rest of South Dakota average eight to eleven miles an hour.

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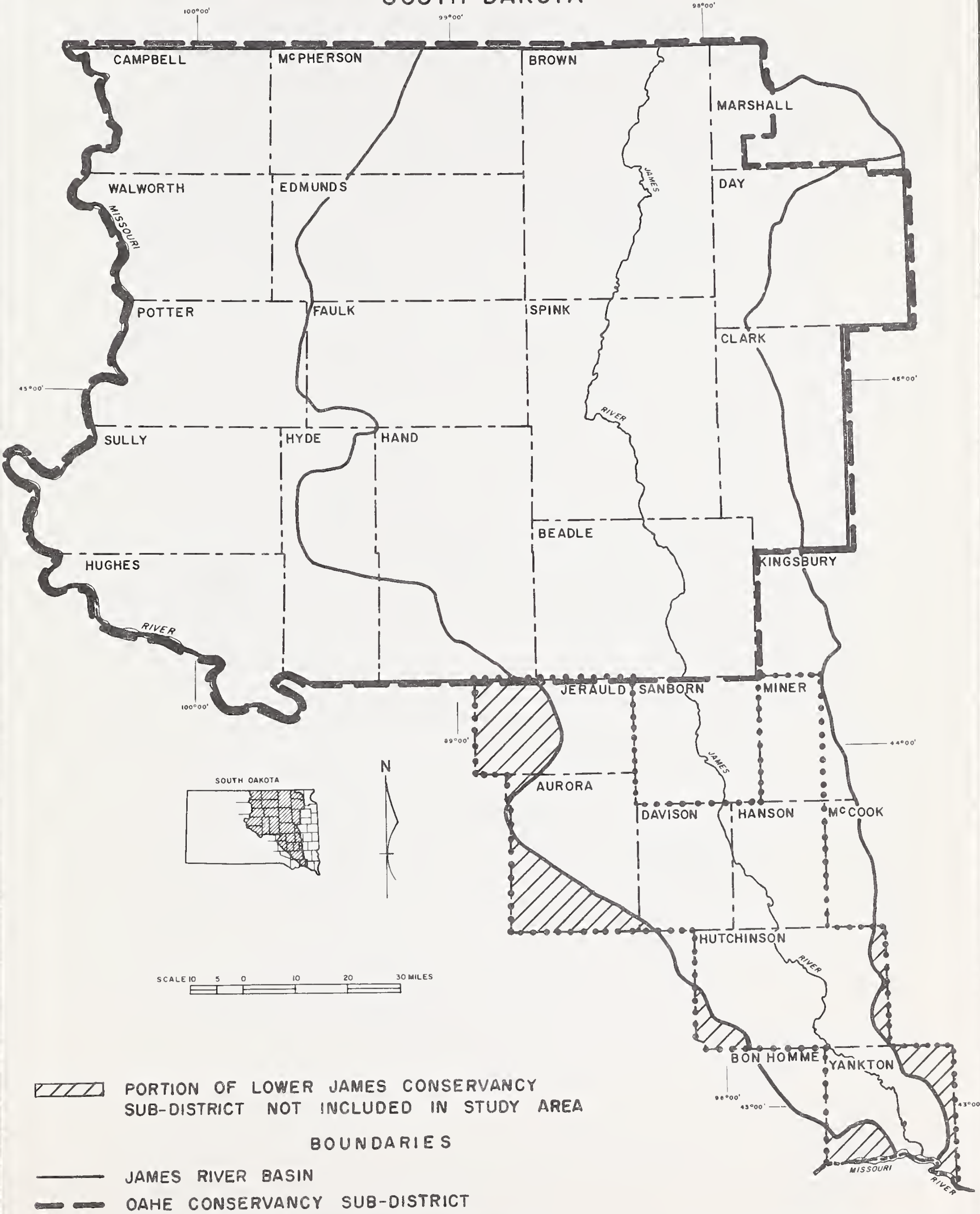
FIGURE 2

STUDY AREA AND SUB-DISTRICT BOUNDARIES JAMES RIVER BASIN AND DESIGNATED MISSOURI RIVER SUB-BASINS SOUTH DAKOTA



PORTION OF LOWER JAMES CONSERVANCY SUB-DISTRICT NOT INCLUDED IN STUDY AREA

BOUNDARIES

JAMES RIVER BASIN

OAHE CONSERVANCY SUB-DISTRICT

LOWER JAMES CONSERVANCY SUB-DISTRICT

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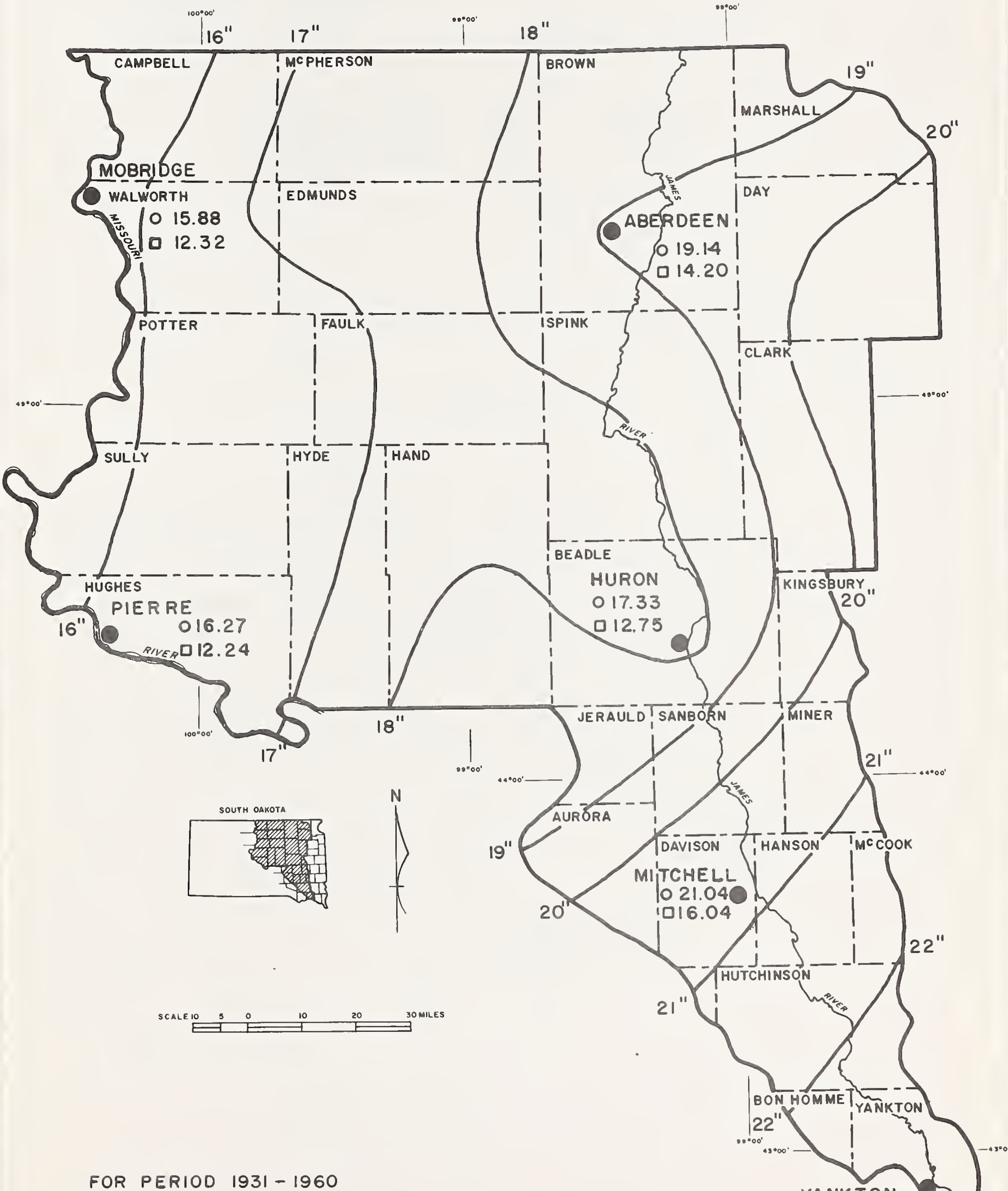
FIGURE 3

NORMAL ANNUAL PRECIPITATION STUDY AREA



FOR PERIOD 1931 - 1960

O ANNUAL

□ GROWING SEASON (APRIL-SEPT.)

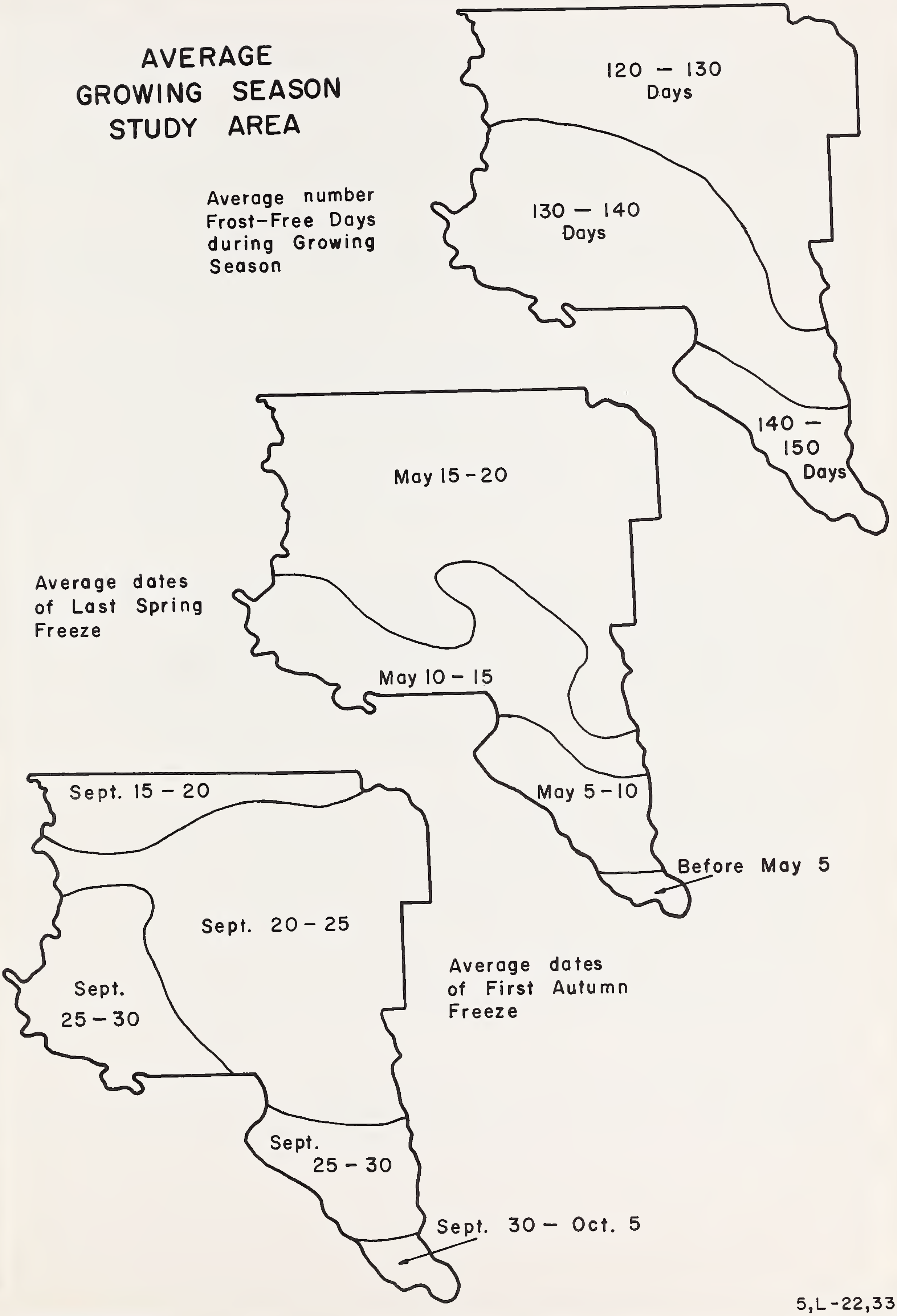
YANKTON

O 22.92

□ 17.87

5,L-22,333.9

FIGURE 4



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Geology

Surficial deposits consist principally of unconsolidated material of glacial and interglacial origin. During the Pleistocene epoch or "Ice" Age, four major ice advances crossed parts of eastern South Dakota. They deposited glacial drift of variable thickness on Pre-Cambrian quartzites and Cretaceous chalks and shales. Recent age alluvium is on the flood-plains of the main streams, but makes up a small percentage of the total surficial deposits in the Study Area.

Exposures of Cretaceous and Pre-Cambrian rock can be found locally along stream channels. A few isolated erosional remnants of Tertiary rock are exposed as hills and buttes. The most conspicuous of these exposures is the Wessington Hills.

Complete identification of all the major glacial deposits have not been made; however, it is known that all four major ice advances have had some effect on the area. The first ice sheet to enter South Dakota was the Nebraskan. It was followed by the Kansan, Illinoisan, and Wisconsin. Only Wisconsin Age drift is exposed in the Study Area. The Wisconsin Stage was one of general deglaciation and subsequent re-expansion of the ice sheet. It has been divided into four substages. These substages have been named Iowan, Tazewell, Cary, and Mankato, in the order of their advance.

Prior to the Illinoisan Ice Sheet, the major rivers of western South Dakota flowed into eastern South Dakota, and either flowed north to Hudson Bay or south to the Gulf of Mexico following the approximate course of the present day James River. The western margin of the Illinoisan Ice Sheet blocked these rivers, diverting them to the south and east, approximately along the margin of the blockading ice. The streams, plus the melt water from the edge of the glacier, entrenched itself in the underlying rock, forming the present course of the Missouri River.

The glacier ice entered the state from the northeast or north, and flowed generally southward and westward. Glacier erosion of the weak Cretaceous rocks is believed to have been great. Much of the width and depth of the James River lowland is believed to be the result of glacial action. As the glacier moved over preglacial topography, it filled valleys, planed off hills, cut new valleys, and piled up large ridges. The physical divisions of these glacial deposits are divisible into three groups. These groups are till, outwash, and glacial lake deposits. Till, the most abundant material, consists of an unsorted and unstratified mixture of material that ranges from clay to boulders. The till was produced by abrasion of the ice sheet against the land surface. It is deposited as ground or end moraine.

Outwash is composed of stratified sand, gravel, and silt reworked from the drift and deposited by melt water streams of an ice sheet. These deposits are a valuable source for groundwater supply.

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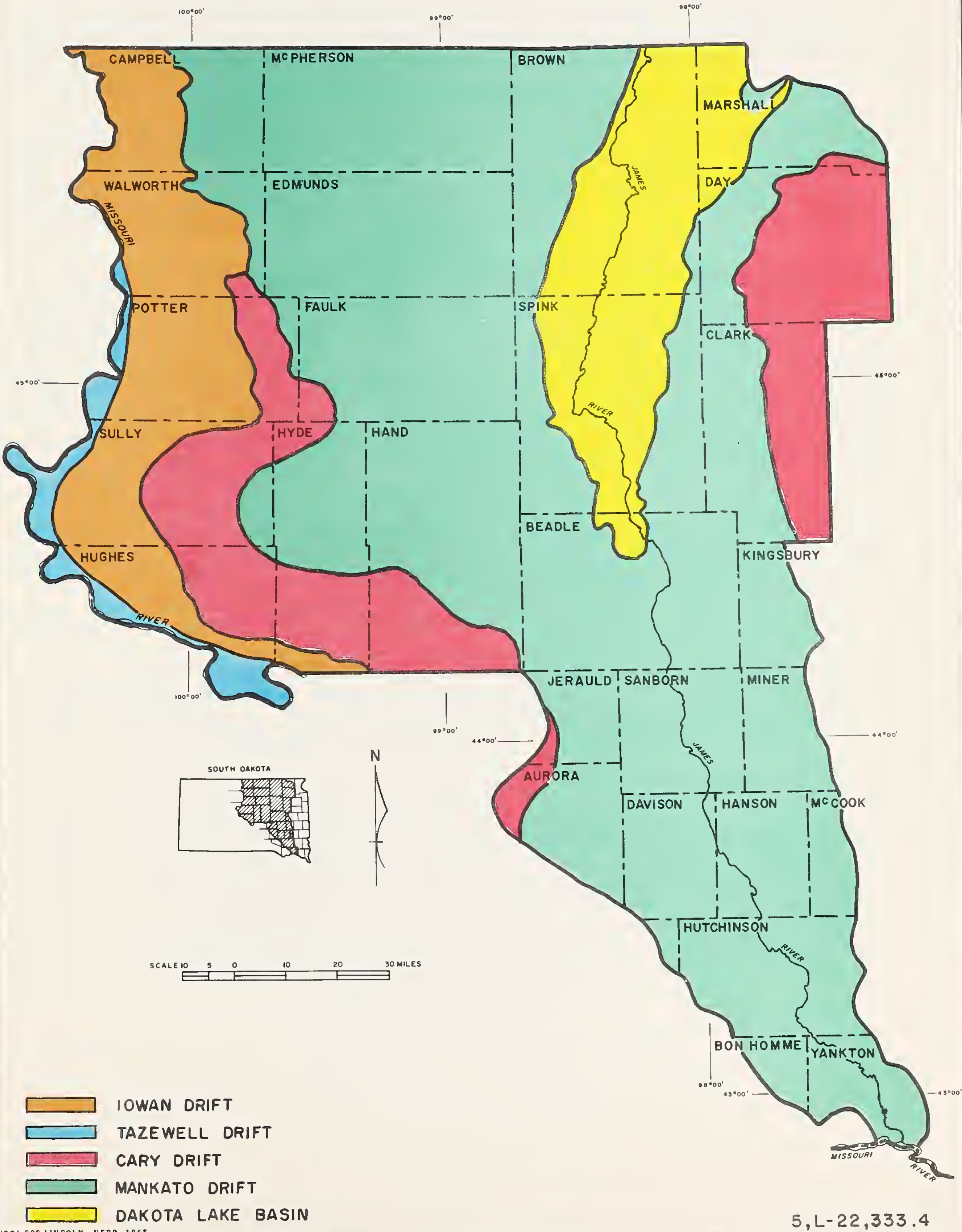
FIGURE 5

GLACIAL SURFACE DEPOSITS STUDY AREA



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Glacial lake deposits, the least abundant material, consist of parallel-bedded silt, sand, and clay. They were deposited by streams as they emptied into ponded water held behind temporary glacial dams. These deposits are found on the Lake Dakota Plain.

Interglacial deposits, called loess, mantle a large part of the western one-third of the Study Area. During interglacial periods, strong winds picked up fine sediments from outwash areas and deposited them in layers of variable thicknesses.

Physiography and Topography

There are two principal physiographic areas in the Study Area. The eastern physiographic area is called the Central Lowland, and the western area is called the Missouri Plateau.

In the Central Lowland area, there are four physical divisions. One division is the Coteau-Des-Prairies. This is on the east edge of the Study Area, and consists of a highland between the Minnesota-Red River lowlands and the James River lowlands. Its eastern and western slopes are steep at the northern end and taper off toward the south. Elevations range from 2000 feet above sea level on the north to about 1600 feet on the south. The top of the Coteau is dotted with lakes and sloughs. The streams on the west side of the Coteau flow generally in a southwesterly direction. These streams drop 300 to 400 feet from the top of the Coteau to the base of the Coteau in the northern part of the area.

A second division in this physiographic area is the James River Lowlands. This is a gently undulating plain lying considerably lower than the Coteau-Des-Prairies on the east and the Coteau-Des-Missouri on the west. The James River drains through the area from north to south with elevations ranging from about 1300 to 1400 feet above sea level.

The third division is called the Lake Dakota Plain. It is nearly level and consists of lacustrine sediments that were deposited when glacial Lake Dakota was ponded with water. The area is sandy at the north end, and has a silt clay loam or silty clay texture over the balance of the area.

The fourth area is the James River highlands. This area consists of three ridges at the lower end of the James River lowlands. These ridges are remnants of former stream divides. These ridges are called Turkey Ridge, Yankton Ridge, and James Ridge. The west flank of the Turkey Ridge is in the Study Area. The Yankton Ridge is the northern bluff of the Missouri River west of the outlet for the James River. The James Ridge is on the west side of the James River a few miles north of its outlet. Each ridge has a core of Niobrara chalk overlain by Pierre shale. Each ridge stands 100 to 200 feet above the surrounding terrain.

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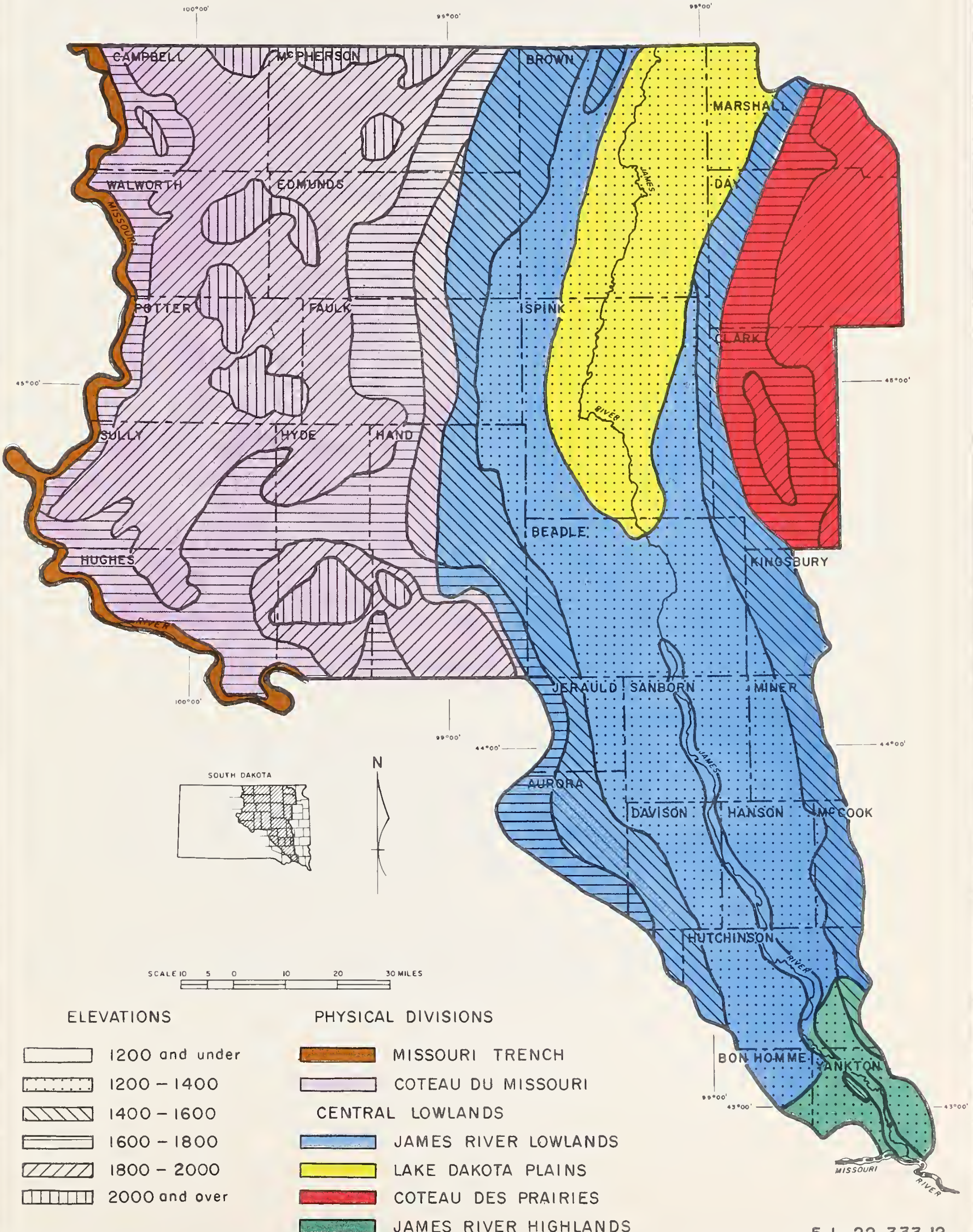
FIGURE 6
GEOLOGIC PHYSICAL DIVISIONS AND TOPOGRAPHY STUDY AREA



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The Missouri Plateau has two sub-areas in the Study Area called the Coteau-Des-Missouri and the Missouri River Trench. The Coteau-Des-Missouri lies east of the river. This highland area is covered with glacial deposits and underlain by Pierre shale that is an older formation. Several broad, shallow sags traverse the Coteau which mark the positions of pre-glacial stream valleys. The Coteau has a fairly definite escarpment on the eastern edge. This does not exist on the western edge, but the area is terminated by the deep Missouri trench. The high elevations are generally around 2000 feet above sea level across the entire Study Area where this division is located.

The Missouri Trench averages over a mile in width with valley floors 300 to 600 feet below the tops of the steep, bisected bluffs. The river flows south-southeast with a gradient of about one foot per mile.

Water

The average annual water yield from the James River Basin is the lowest of all the major river basins in South Dakota. A thirty-four year record from a stream gage on the James River near Scotland shows an average annual run-off of .23 inch. The greatest amount of run-off, occurring in water year 1962, was 1,425,000 acre-feet. This amounted to 1.24 inches of run-off. The lowest amount of run-off was 10,020 acre-feet, occurring in water year 1934. This amounts to about .009 inch of run-off. The drainage area above the gage is about 21,550 square miles, part of which is in North Dakota (Figure 8).

Practically all of the sub-basins, including the Missouri River Sub-Basins, have no run-off during the fall and winter months. In dry years, these sub-basins may have no run-off for the entire year. An example of this is the west branch of Snake Creek where a thirteen-year stream gage record shows three years of no run-off.

Run-off varies considerably over the area (Figure 7). Estimates range from no run-off to about 1.4 inches on an average annual basis.

Run-off for the streams generally takes place from March through July, with March, April, and June producing the greatest amounts. The high run-off in March and April is primarily from snowmelt, while the run-off in June is a result of rainfall. Maximum annual peaks and volumes are primarily from snowmelt. On an average annual basis, snowmelt accounts for about 50 percent of the run-off from the high-producing areas, and up to 75 percent for the low producing areas.

Low-producing run-off areas are characterized by the following: (1) Prairie pothole area; (2) Areas having numerous shallow depressions or lakes: and (3) Dakota lake plain area with flat land surfaces.

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FIGURE 7
AVERAGE ANNUAL RUN-OFF
STUDY AREA

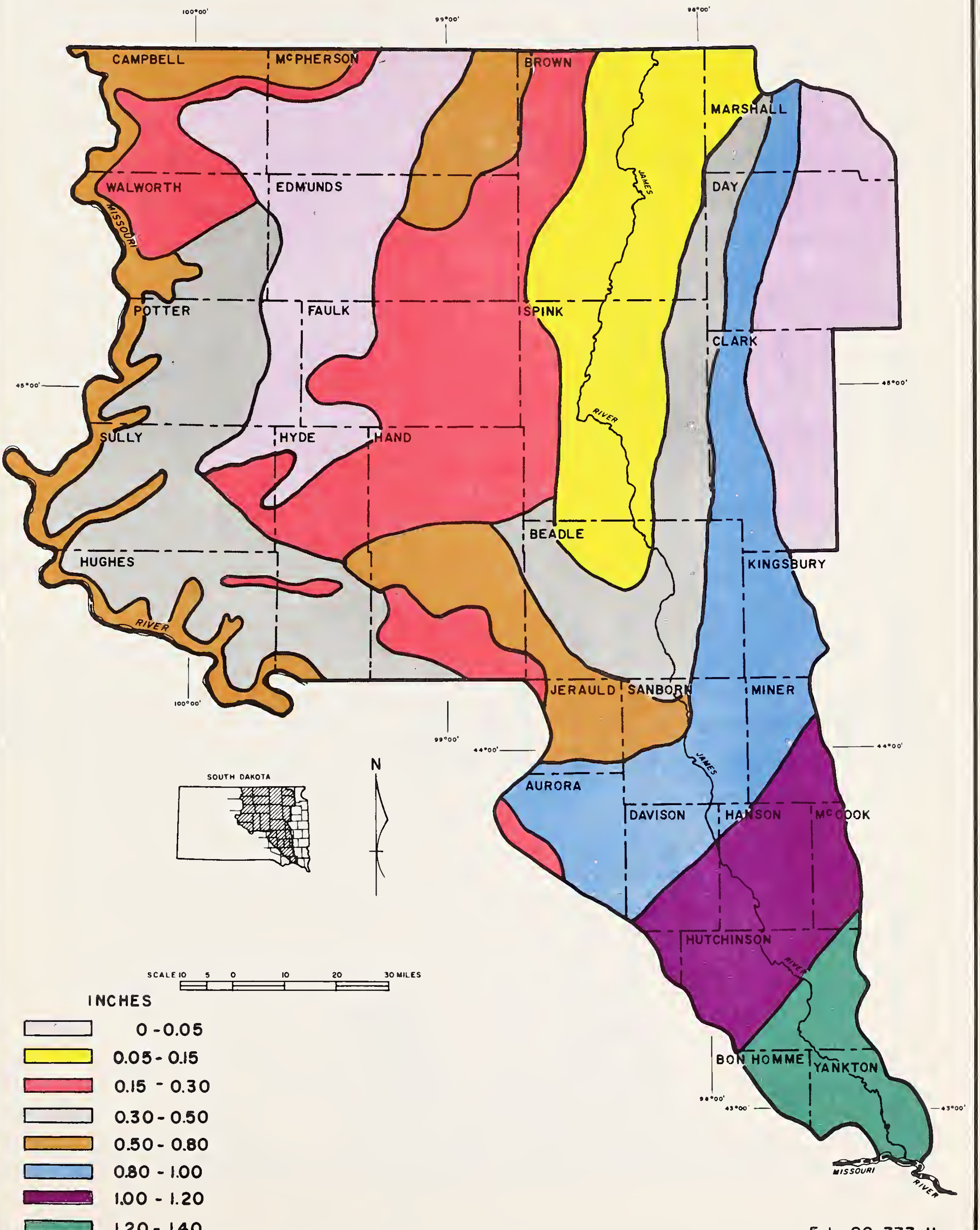

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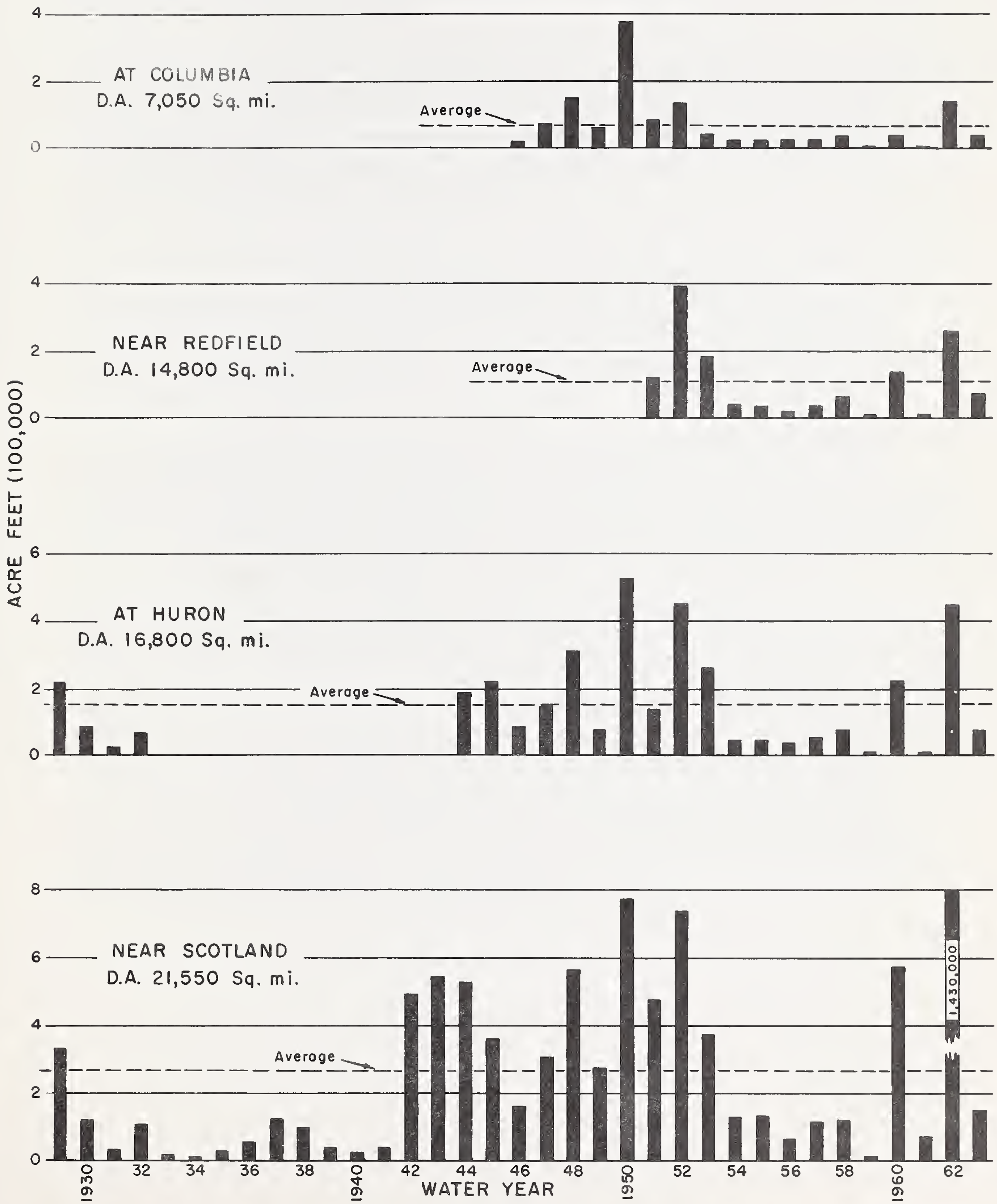
FIGURE 8

TOTAL ANNUAL RUNOFF
FOR
JAMES RIVER BASIN



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High-producing areas have steeper land slopes and stream gradients, well-defined drainage systems, and areas of higher precipitation.

Vegetative cover and soils, which affect run-off, are fairly uniform throughout the area. One exception is the area adjacent to the Missouri River where the cover is native grasses, and the soils are shallow over-laying shale parent material.

Groundwater is presently the principal source for domestic and municipal use. The quantity and quality of water from this source are being studied by State and Federal Agencies. Water is available from deep artesian formations and shallow acquifers. The extent of the shallow acquifers has been summarized on a map produced by the South Dakota Water Resources Commission dated August 1, 1965 (Figure 17).

Soils

The variation of climate, soil, and physiography within the James River Basin and Missouri Sub-Basins has resulted in distinctive patterns of agriculture and land use. Areas having similarities in climate, soil, and physiography usually have similarities in land use, cropping patterns, hazards and limitations, and treatment needs. These are referred to as land resource areas.

The larger portion of the Study Area is covered by three land resource areas. These are the Dark Brown Glaciated Plains (LRA 53), the Black Glaciated Plains (LRA 55), and the Loess, Till and Sandy Prairies (LRA 102). The Rolling Pierre Shale Plains (LRA 63) and the Rolling Soft Shale Plains (LRA 54) are resource areas of minor importance located adjacent to the Missouri River because of small acreages.

Land Resource Area 53 generally includes all of the Missouri River Sub-Basins except a narrow band adjacent to the Missouri River. The western portion of the land resource area is dominated by soils developing in the silty sediments of eolian and alluvial origin. The second largest parent material in this area consists of the loamy glacial till with smaller segments of soils developing in residuum of Pierre shale or in small lacustrine deposits which dot the area. The landscape of the western portion is generally smooth, except around the few drainageways which occur here. This is in contrast to the more undulating relief of the eastern portion of the land resource area. Soils here are dominantly on generally undulating to sloping surfaces, and closed basins and depressed areas are a typical part of the landscape. Drainage of the landscape quite often terminates into these basins.

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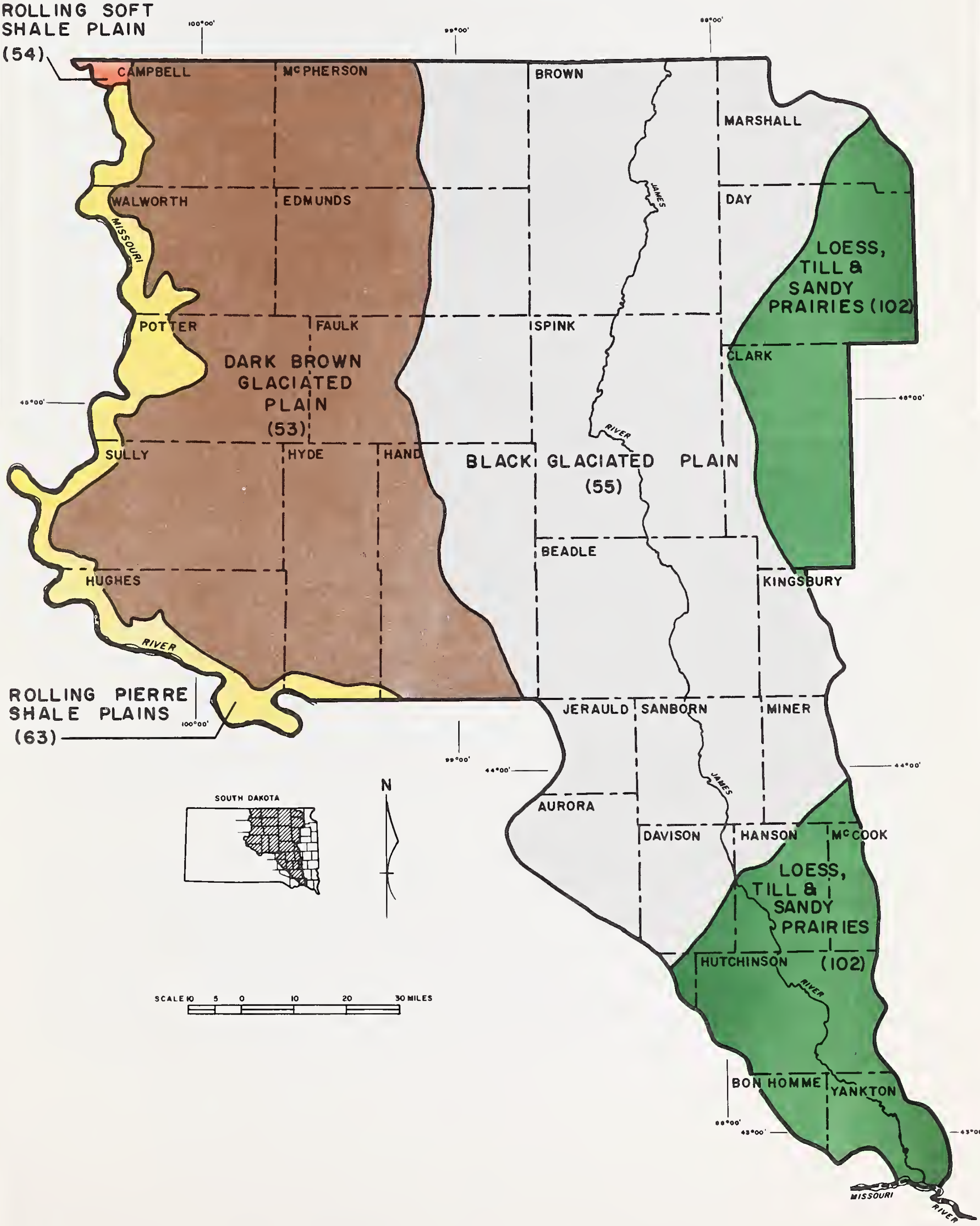
The principal soils of the resource area are Agar, Eakin, Oahe, Akaska, Williams, and Regosolic Zahl. Agar soils are developing into moderately thin to thick deposits of silty loessial materials. The Eakin soils typify soils which are developing in silty mantles that are of moderate depth to loamy till. Oahe soils are developing into moderately coarse sediments overlying sands and gravels, and the Akaska has a thin mantle of silty sediments overlying sands and gravels. The normal soil of the uplands is the Williams, which is of medium texture and noncalcareous on generally undulating to steeper sloping surfaces. The Regosolic Zahl soils occur in complex with the Williams on the steep slopes of the morainic areas and areas where drainageways have become entrenched. Other soils are the Promise, the Pierre, and the Lismas soils of the droughty and clayey residuum of the Pierre shale; the Raber, the Cavour, the Cresbard soils of the flats; and Tetonka, Shonkin and Hoven soils of depressional areas.

Land Resource Area 55 includes the nearly level, smooth, broad lowland that lies between Land Resource Area 53 and Land Resource Area 102. The area is situated mostly north and south, running almost the full length of the James River Basin in South Dakota. It has a width of approximately 50 to 60 miles. This resource area is significantly lower than the adjacent resource areas. The James River drains through the central portion of the resource area, and is some 30 to 100 feet lower in elevation than the surrounding uplands. The general relief of the area is that of a nearly level to very gently undulating plain, with small local variations. The tributary streams to the James are not well established, and are usually broad, shallow depressions which serve to drain the surrounding country. Much of the surface run-off drains into shallow depressions. Included within the boundaries is the Lake Dakota Plain, which is a nearly flat floor of an abandoned lake, which has lacustrine deposits. The local relief is very low and extends no more than a few feet.

The resource area is thought to be one or more old valleys which have been modified with glacial action and partially filled with glacial drift. The parent materials are quite similar to those of the adjacent resource areas except for the effect of a more nearly level topography on the characteristics of the parent material in which the soils are developing. The glacial tills are usually of a loam texture to light clay loam, and silty mantles over the till are not uncommon. The lacustrine silts and clays of the Lake Dakota Plain give rise to soils of similar characteristics. Soils forming in or partially in sand and gravels also occur within this resource area. The till area, having low relief, seemingly has an increased amount of soils having higher clay content than where the relief is more sloping. This is considered as being an effect of slope upon the parent materials. The drainage of the area is adequate, except for the shallow depressional areas or during seasons of above average rainfall.

FIGURE 9
LAND RESOURCE AREAS
STUDY AREA



SOURCE: ATLAS OF RIVER BASINS

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The zonal soil of the uplands is the Houdek, which occurs typically on the more sloping land, and is a deep, medium textured soil. Associated with the Houdek on the lower slopes are the Bonilla soils, which are derived in part from colluvial sediments. Cavour and Cresbard soils typify the solodized Solonetz of the uplands. Soils such as the Beotia and Aberdeen are developing in lacustrine silts and clays of the Lake Dakota Plain. The Hecla and Ulen typify the sandy loams which are developing in the nearly level to hummocky portion of the Lake Dakota Plain. Numerous other soils include the Parnell and Tetonka of the depressions, some imperfectly drained solodized Solonchaks, and other soils which are in lesser amounts but of significant consequence in the agriculture of the resource area.

Land Resource Area 102 lies on the eastern and southeastern edge of the Study Area. This area includes part of the headwaters of the Sioux and Vermillion River Basins and the lower reaches of the James River Basin. Parent materials of the land resource area include loam and light clay loam glacial till, as well as some sands and gravels which occur along glacial terraces and outwash areas. Much of the glacial till in the area is mantled by silty materials of alluvial origin. Usually these are of moderate depth, so that soils develop in both materials. Areas of eolian sediment occur locally. Locally, areas of lacustrine silty clays occur where glacial waters have ponded and deposited fine materials. Pierre shale underlies most of this portion of the Study Area and occasionally crops out. The drainage of these materials is mostly moderately well to well drained. However, in areas of lacustrine deposits or where clayey sediments have been deposited, the drainage is restricted. This is particularly true in the vicinity of intermittent and permanent lakes.

The northern portion of the resource area contains many perennial and intermittent lakes. This area is generally without conspicuous drainageways or valleys. Much of the drainage is interior, and run-off waters end up in the intermittent or permanent lakes. The dominant soils of the area are the Poinsett and Sinai, which are nearly level, well drained silt loams, silty clay loams, which have developed from silty drift or silty alluvium mantling the till. Also included are the moderately well drained Waubay soils, which occur on the silty drift, and Fordville soils, which overlie sands and gravels on terraces and outwash planes. Parnell and Tetonka soils occur in depressed areas and are imperfectly to poorly drained.

The southern portion of the resource area has considerably lower elevations, and is part of an old preglacial valley which has been partially filled with glacial drift. The soils of the southern portion are developing mostly in loamy glacial till, with soils such as Houdek and Bonilla comprising the moderately well drained, medium textured soils of the uplands. Soils such as Cavour, Cresbard, and several unnamed calcium carbonate Solonchaks occur on the flats and in depressions. Soils such as Parnell and Tetonka occur in the depressed areas, with the Regosolic Buse occurring on the steeper slopes.

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Land Resource Area 63 lies in a 2 to 25 mile bank adjacent to the Missouri River. The topography is undulating to steep, and is characterized by smooth, uniform slopes. Broken areas occur immediately adjacent to the Missouri River Valley wall. Slope gradients range from 1 to 9 percent on the lesser slopes to about 35 percent on the more broken and steeper portions. The drainage pattern is distinct, with well entrenched channels which are relatively straight and short.

Pierre shales contribute most of the parent materials in which soils of this area are developing. These are mostly clays, both in place and transported. Minor amounts of soil are developing in alluvial and wind-borne sediments, some pockets of till, and areas of outwash. The residuum of the shales readily melts down or slumps to form smooth, rounded, uniform slopes, and gives the area a worn or used appearance. The clay materials give rise to the shallow Samsil on the steep slopes, along with the Opal clays, which also occur on less steeply sloping areas. Promise soils are deep, and occur on older landscapes and low gradient toe slopes. Agar soils are on loess mantles, and may be in association with Eakin and Raber soils where till and loess occur.

Land Resource Area 54 lies in the extreme northwestern corner of Campbell County along the Missouri River Valley. About 9500 acres are in the Study Area, but are not described because of the small size.

Land Use

Fifty-six percent of the total Study Area is used for cropland. Pasture accounts for 42 percent, while forest and other uses represent 2 percent of the area. There are significant differences in land use between land resource areas. Cropland uses vary from 68 percent in LRA 102 to 21 percent in LRA 63.

The Study Area contains about 92,000 acres of forest land. About 60 percent of the forest area is native or natural forest which occurs in narrow strips in the moist localities along stream banks, on lake shores, and in draws and coulees. These are deciduous forests of the ash-elm type, with ash, elm, and cottonwood being the predominant species. The remaining 40 percent of the forest acreage is in shelterbelt plantings of over 120 feet in width and one acre in size. Not included in the forest and woodland area are many miles of single-row tree windbreak plantings.

The hazards and limitations of land use increase as the land capability class number increases. Class I land has few hazards or limitations, while Class VIII land has no value for cultivation or grazing, but is suitable for recreation, wildlife, and aesthetic use. Generally, land capability Classes I through IV are suited for cultivation and other uses, and Classes V through VIII are suited for range, forestry, and wildlife.

Land use and land capability classes are summarized in Table 1 and Figure 10.

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TABLE 1

SUMMARY OF LAND USE AND LAND CAPABILITY CLASSES
BY LAND RESOURCE AREAS
STUDY AREA

Land Resource Area	Capability Class	Cropland	Pasture	Forest	Other	Total
55	II	2,548,569	864,815	24,372	58,229	3,495,985
	III	782,482	391,119	10,629	10,379	1,194,609
	IV	349,622	378,239	4,671	5,507	738,039
	V	63,282	197,566	3,183	383	264,414
	VI	77,682	266,357	140	973	345,152
	VII	5,271	130,675	- -	583	136,529
	VIII	- -	- -	- -	6,921	6,921
LRA Total		3,826,908	2,228,771	42,995	82,975	6,181,649
53	II	582,217	275,513	3,635	6,367	867,732
	III	1,115,862	1,005,451	5,965	17,749	2,145,027
	IV	109,585	257,769	143	1,096	368,593
	V	17,937	163,803	189	- -	181,929
	VI	61,992	224,366	296	935	287,589
	VII	6,373	381,026	- -	2,804	390,203
	VIII	- -	- -	- -	8,091	8,091
LRA Total		1,893,966	2,307,928	10,228	37,042	4,249,164
102	I	409,259	62,510	2,862	11,371	486,002
	II	611,702	152,317	8,321	14,705	787,045
	III	163,408	77,920	1,551	3,248	246,127
	IV	118,334	92,612	1,438	612	212,996
	V	41,606	95,951	97	1,077	138,731
	VI	17,575	25,229	552	557	43,913
	VII	3,726	62,199	190	460	66,575
	VIII	- -	- -	- -	35,784	35,784
LRA Total		1,365,610	568,738	15,011	67,814	2,017,173
63 1/	II	34,482	39,617	566	472	75,137
	III	26,287	51,693	- -	221	78,201
	IV	20,596	32,028	10,363	133	63,120
	V	194	3,006	- -	- -	3,200
	VI	5,082	67,082	5,929	- -	78,093
	VII	222	98,970	- -	94	99,286
	VIII	- -	- -	6,795	89	6,884
LRA Total		86,863	292,396	23,653	1,009	403,921
STUDY TOTAL		7,173,347	5,397,833	91,887	188,840	12,851,907

Source: Conservation Needs Inventory, 1958.

1/ Includes about 9500 acres in LRA 54.

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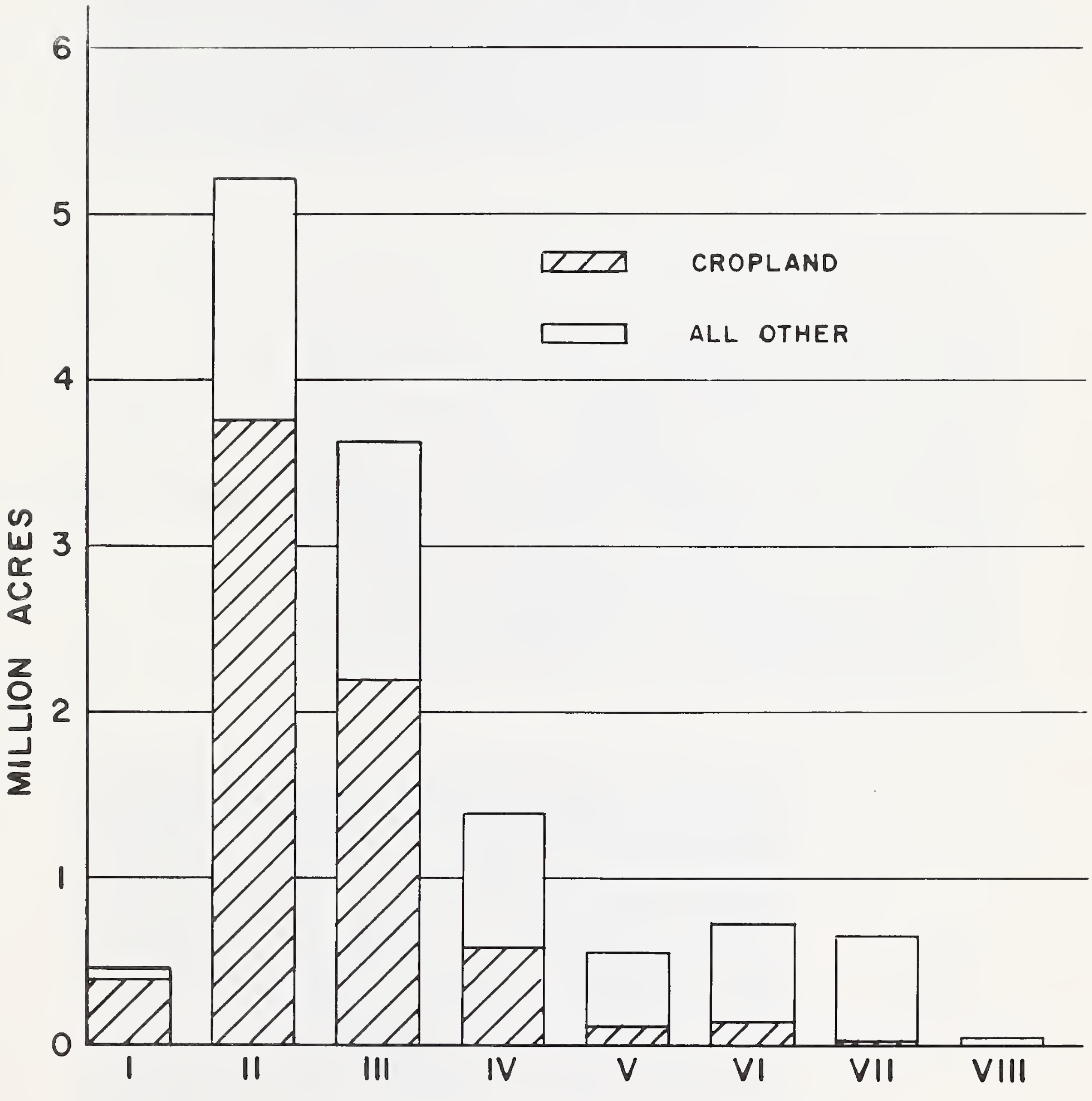
FIGURE 10

DISTRIBUTION OF CROPLAND BY LAND CAPABILITY CLASSES

LAND USE BY LAND CAPABILITY CLASSES



Source: Conservation Needs Inventory, 1958

5,L-22,333.16

LRA
53
Grass

LRA
55
Small Grain

LRA
102
Row Crops

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Economic Data[1]

Dryland agriculture is the principal industry in the Economic Study Area. Less than 10,000 acres are presently irrigated out of a total cropland acreage of over 7 million. In 1959, farm sales of agriculture products totaled about 190 million dollars. This represented about 37 percent of the total products sold in the entire State. Thirty-two percent of the total land in farms and 42 percent of the total commercial farms of the State are located in the area.

Livestock is the predominant enterprise in all land resource areas. Livestock or livestock products account for 165 million dollars, or about 87 percent of the total farm products sold annually.

Cattle sales acount for the major portion of livestock sales. Based on representative counties in each land resource area, cattle accounts for 58 percent of all livestock sales in LRA 53, 48 percent in LRA 55, and 41 percent in LRA 102. Hogs are the second largest source of livestock sales ranging from 33 percent in LRA 102 to 22 percent in LRA 53.

Ranching, which produces feeder stock, is the principal livestock enterprise in LRA 53. Livestock feeding is the predominant livestock enterprise in LRA 102. Most farms in LRA 55 produce feeder cattle, but also feed a considerable number for slaughter. Figure 11 shows the percent distribution of types of farms by LRA's.

Most crops in all the LRA's are produced for livestock feed. The principal crops are corn, oats, and tame hay. Spring wheat is the principal cash crop grown in both LRA 55 and LRA 53. In the northern part of LRA 55, some flax and barley are produced as cash crops. In LRA 102, the principal crop is corn which comprises over 50 percent of the crops grown. About one-third of the corn is used for silage, and the balance is harvested as grain. Soybeans in the southern half and flax in the northern half of LRA 102 are the other two principal cash crops.

There are 23,282 farms of which 89 percent is classified as commercial farms by the U. S. Census of Agriculture. LRA 53 has the largest farms with an average size of 1160 acres. The average size farm in LRA 55 is 640 acres, and in LRA 102 is 380 acres.

The largest percentage of farms in both LRA 55 and LRA 102 is in the 260-acre to 500-acre category. This size of unit represents 36 and 46 percent, respectively, for the two LRA's. Forty percent of the farms in LRA 53 is in the 500-acre to 1000-acre category. Figure 12 shows the percent distribution of farm sizes by LRA's.

1/ Full counties were used for Economic Study Area (See Figure 20). Data was summarized using three major LRA's (53, 55, and 102). Economic Study Area in LRA's 54 and 63 were grouped with LRA 53.

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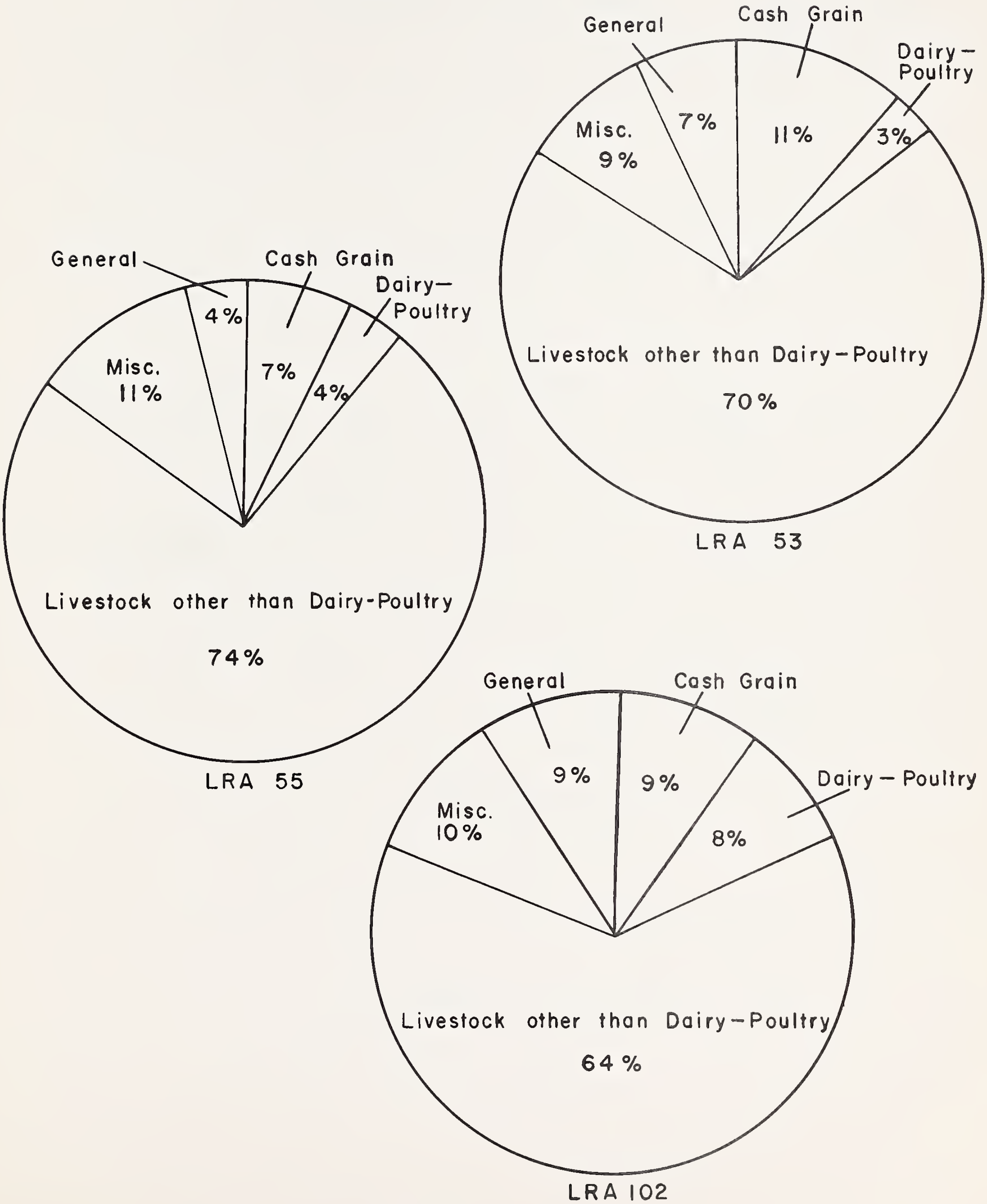
FIGURE 11

PERCENTAGE DISTRIBUTION OF FARMS BY TYPE AND BY LAND RESOURCE AREAS ECONOMIC STUDY AREA



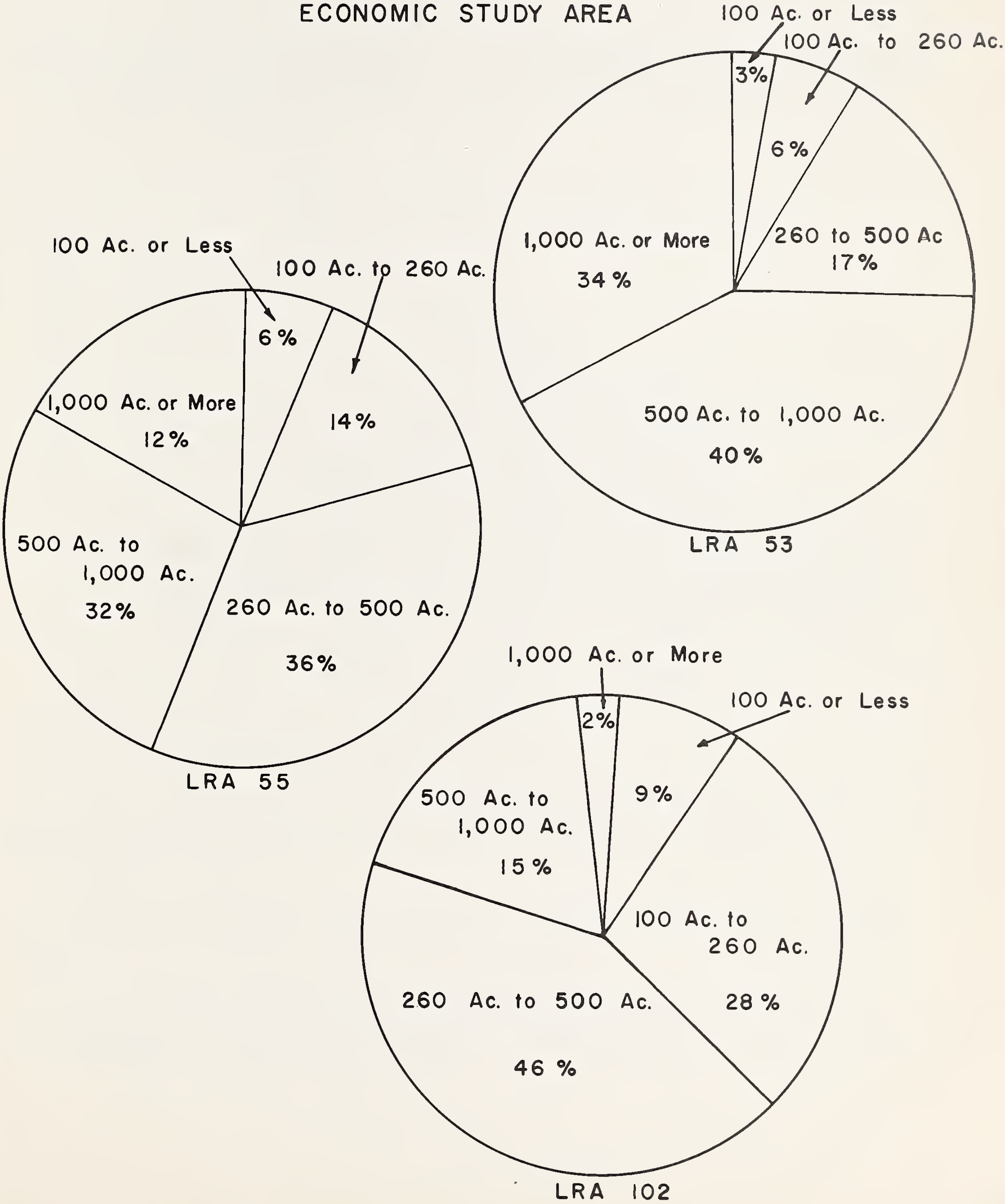
Source: U. S. Census of Agriculture, 1959 5, L-22,333.17

USDA-SCS-LINCOLN, NEBR. 1965

FIGURE 12

PERCENTAGE DISTRIBUTION OF FARMS BY FARM SIZE AND BY LAND RESOURCE AREAS

ECONOMIC STUDY AREA



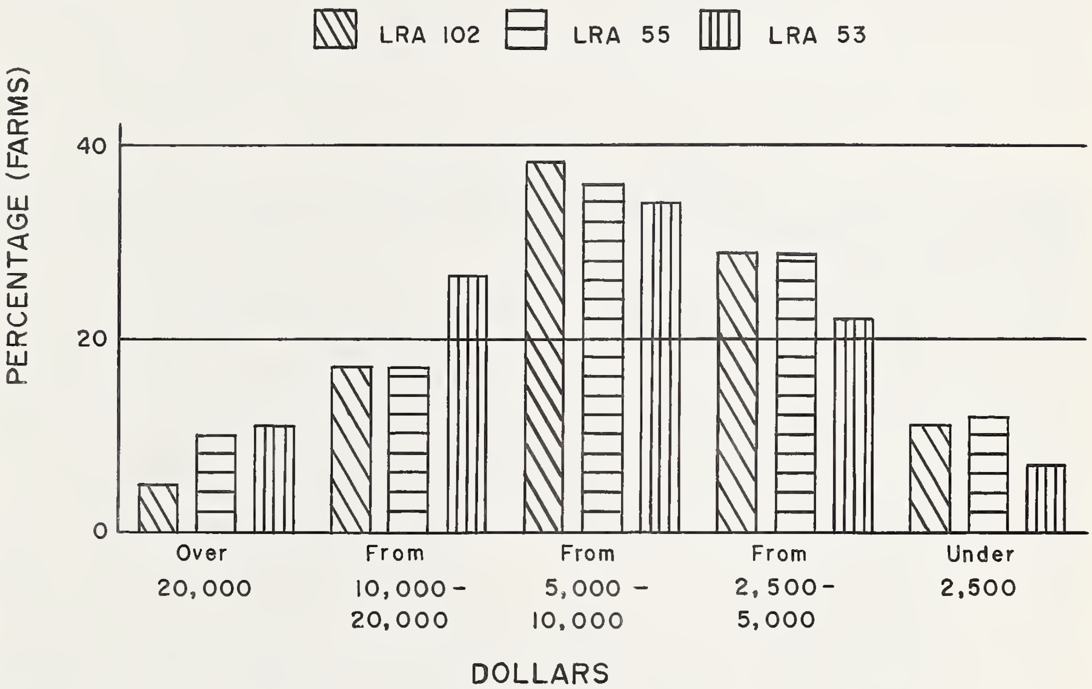
Source: U. S. Census of Agriculture, 1959

5, L-22, 333.18

Another way of measuring farm size is by value of products sold. Less than 2 percent of the commercial farms have sales over $40,000 annually, and 10 percent have sales under $2500. Figure 13 shows the percentage distribution of commercial farms by value of products sold by LRA's.

FIGURE 13

PERCENTAGE DISTRIBUTION OF COMMERCIAL FARMS BY VALUE OF FARM PRODUCTS SOLD AND BY LAND RESOURCE AREAS



Source: U. S. Census of Agriculture, 1959 5,L-22,333.15

Farm values vary less between LRA's than do size and number of farms. The average value per farm in LRA 55 is $34,200 compared to $34,800 in LRA 102 and $44,100 in LRA 53.

Most farms are operated by part owners. The large farms found in LRA 53 have fewer full owners as operators, but also have fewer tenant-operated farms.

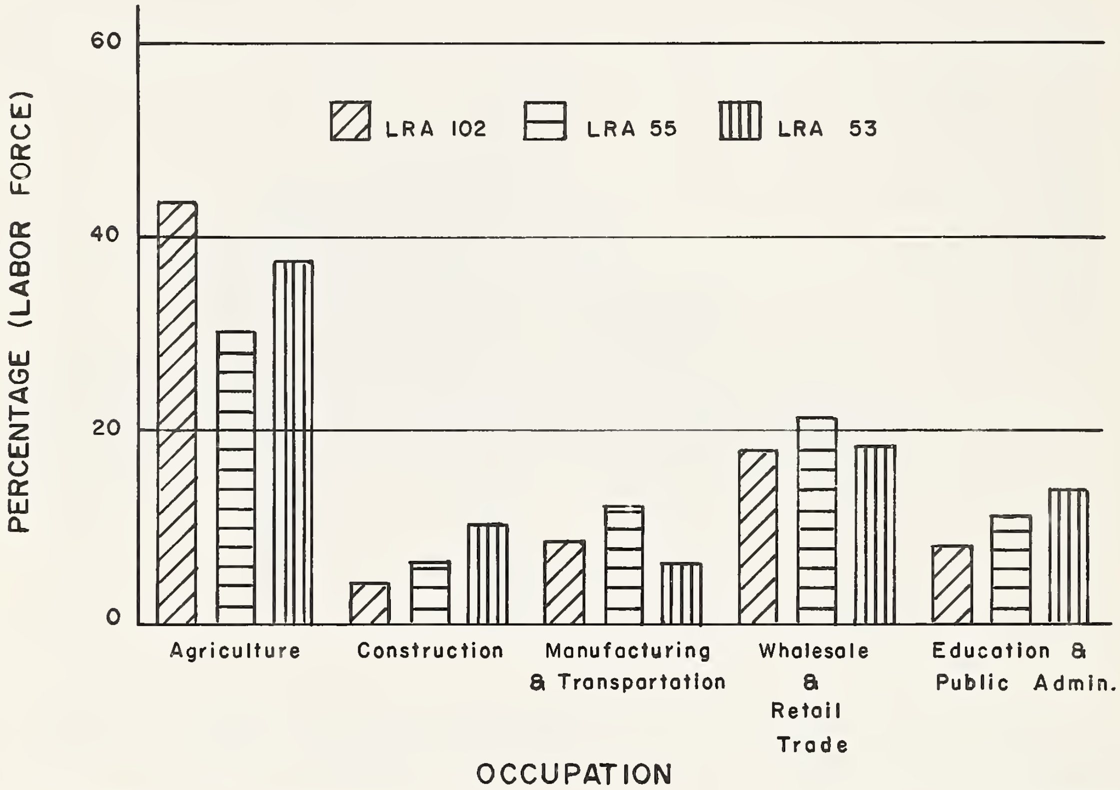
About 31 percent of the farms are operated by full owners, 44 percent by part owners, and 25 percent by tenants. Farms operated by managers make up less than 1 percent of the total.

The total population in the Economic Study Area in 1960 was 235,500. Urban residents accounted for about 33 percent; farm residents, 36 percent; and rural non-farm residents, 31 percent.

In 1960, agriculture employed about 35 percent of the total labor force of 83,300. Wholesale and retail trade provided employment for about 19 percent of the labor force. The majority of the employees are for agriculture-oriented businesses.

Figure 14 shows the percentage distribution of the labor force by occupation for each land resource area.

FIGURE 14
PERCENTAGE DISTRIBUTION OF LABOR FORCE BY OCCUPATION AND BY LAND RESOURCE AREAS



Source: U.S. Census of Population, 1960

5,L-22,333.19

Forests do not make a significant contribution to the local economy. Timber cut for lumber, other wood products, and for fuel is negligible. Timber that is cut is used chiefly for home consumption, and seldom are any of the forest products placed for sale. The forest and timber lands are valuable for reducing wind erosion, stream bank stabilization, wildlife habitat, recreation, and aesthetic values.

WIND AND WATER EROSION

Over 400,000 acres of sandy soils have serious wind erosion problems. In the 30's, these areas were very troublesome and generally were the proving grounds for early Soil and Water Conservation District programs. Counties with sizeable acreages of sandy soils are Beadle, Brown, Campbell, Edmunds, Marshall, Sanborn, and Spink Counties. In addition, there are many other soils that are vulnerable to wind erosion if left without cover during the winter.

Wind Erosion Problem During 1930's

- SCS Photo SD-20

Every county has some soils vulnerable to water erosion if not given adequate protection. Sheet erosion is the principal hazard on Class II, III, and IV lands with moderate to steep slopes. There are about 1,850,000 acres of cropland in these land capability classes.

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Typical Water Erosion on Class III and IV Cropland

- SCS Photo SD-415

Severe gully erosion occurs on rangeland in the breaks of the Missouri River. Minor to moderate size gullies occur in cropland throughout the Study Area.

Channel erosion is not a serious problem on the major tributaries. Occasionally, certain channel reaches have some streambank erosion on the outside edge of meandered streams. Channel aggradation, rather than degradation, occurs on most of the major tributaries. Floodplain scour is generally minor.

The average annual gross water erosion rate varies from .0006 to .0035 acre-feet/acre/year (Figure 15). These rates are based primarily on topography, land use, soils, and precipitation. Figure 15 shows two areas having the same rate, even though there are different combinations of factors in the respective areas. The delivery rate of sediment to a stream or lake varies by the size of the drainage area. For areas less than a square mile, the delivery rates range from 40 to 100 percent of the gross, while in drainage areas of 100 to 1,000 square miles, the delivery rates range from 12 percent to as low as 4 percent. Except for isolated areas, sedimentation is not a significant problem on floodplains. Sediment accumulation in streams, lakes, and reservoirs is a problem.

Sediment Deposited in Lake Mitchell, Mitchell, S. D.

- SCS Photo SD-L-99

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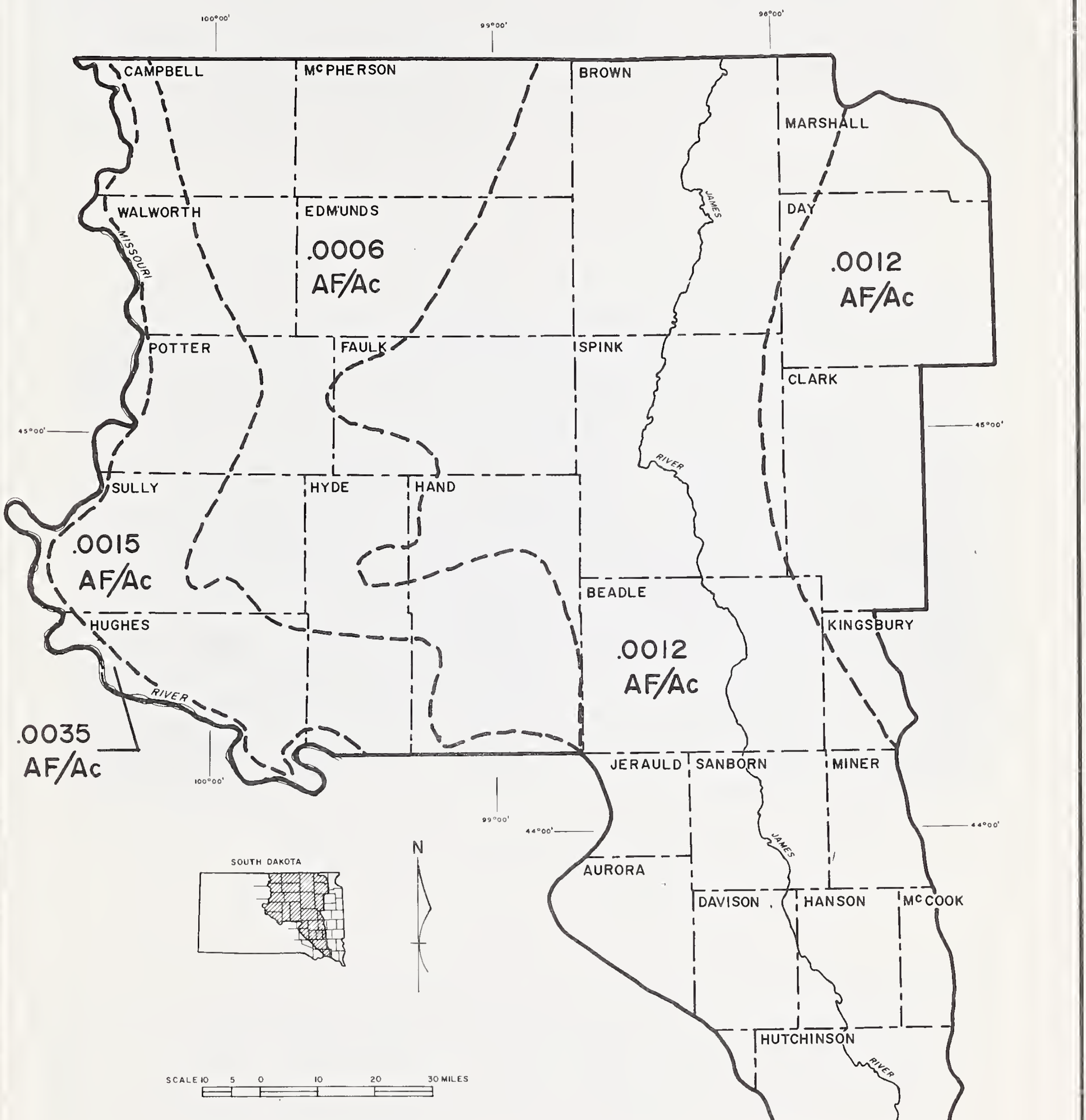
U. S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

FIGURE 15
GENERALIZED ANNUAL GROSS WATER EROSION RATE STUDY AREA



FLOODWATER DAMAGE

A reconnaissance of the area indicates there are about 193,000 acres in the sub-basins subject to periodic flooding. The present land use on these floodplains is 66,000 acres cropland, 121,000 acres grassland, and about 6,000 acres in other uses. Data available from the Corps of Engineers' studies indicates there are about 76,000 acres on the mainstem of the James River in South Dakota subject to flooding. Land use on the James floodplain is about 57,000 acres of cropland, 17,500 acres of grassland, and about 1,500 acres of other uses.

Flooding on Sand Creek Watershed

- SCS Photo SD-6151-9

Flooding is a result of spring and summer run-off. Stream-flow records indicate spring floods are larger than summer floods, both in peak discharge and in volume; however, this may not be true for small areas where land slopes are moderate to steep. Some spring flooding occurs on the average of about every two to five years, with major flooding occurring about every ten years.

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Agricultural damages from snowmelt run-off are minor, except for areas where water stays on the land for long periods of time, causing a delay in seeding crops or destroying grass. The primary damages resulting from spring floods are to roads, bridges, fences, and urban property.

Summer floods, caused by high intensity thunderstorms and generally isolated, cover a relatively small area. The frequency of significant flooding from summer storms is about every five to ten years. The principal damages from summer floods are to growing crops.

Most of the significant urban damages occur in Aberdeen and Parkston; however, several other towns have some urban property subject to flooding. Some farmsteads are subject to floods, but generally farmsteads have been located out of the floodplains. Flood damage to utilities and other properties are generally minor.

AGRICULTURAL WATER MANAGEMENT NEEDS

Irrigation

At some period during the growing season, nearly every area lacks sufficient soil moisture for maximum crop production. Table 2 shows data on average moisture conditions for nine locations.

TABLE 2

AVERAGE SOIL MOISTURE CONDITIONS

(In Inches for Selected Locations)

Station	Date: Mar. 4	Apr. 1	May 6	June 10	July 15	Aug. 19	Sept. 23	Oct. 28
Britton	2.1	2.5	3.0	2.7	2.0	1.6	1.8	1.9
Eureka	1.9	2.3	2.7	2.8	2.0	1.5	1.6	1.9
Faulkton	2.1	2.7	3.1	2.8	1.9	1.4	1.6	1.9
Highmore	1.9	2.5	2.9	2.8	1.8	1.4	1.3	1.7
Huron	2.0	2.6	2.9	2.5	1.7	1.5	1.5	1.8
Mitchell	2.3	2.9	3.2	2.7	2.0	1.7	2.0	2.1
Pierre	1.6	2.3	2.6	2.5	1.6	1.3	1.2	1.5
Redfield	2.1	2.6	2.9	2.5	1.9	1.4	1.5	2.0
Vermillion*	2.4	2.8	3.0	2.8	1.8	1.7	2.1	2.2

* Closest available station to Yankton.

NOTE: Figures underlined represent drouth conditions.

Source: Agricultural Economics Pamphlet 99, SDSU, Feb., 1959.

Drouth is defined as any period during which the soil moisture in the crop root zone contains less than 50 percent of its available field capacity. The moisture which the soil can hold in the crop root zone was assumed to be four inches. The figures are averages for a period of record.

Table 2 indicates average moisture conditions, but does not indicate variability of conditions by years. Severe drouths occur in some years causing a complete crop failure. Other years, moisture deficiencies will reduce crop yields.

There are over three million acres of soils in the Study Area that could sustain irrigation, but the quantity and quality of surface and groundwaters limit the acreage that can be developed.

It is estimated that the 80 percent chance water yield[1/] is sufficient to develop irrigation on an additional 22,200 acres. Water yields are estimated for the principal sub-basins in Table 3.

Other studies indicate there are almost a million acres underlain with shallow acquifers that have a potential for irrigation water development. It is assumed that eight surface acres are required to provide adequate recharge to irrigate one acre. On this basis, development of ground water acquifers for irrigation could sustain an additional 115,800 acres. Generally, water quality in these ground water acquifers is satisfactory for irrigation, but some acquifers are being polluted with poor quality water. This poor quality water is coming from abandoned or poorly maintained artesian wells. This situation is effecting two valuable resources - - the value of the shallow acquifer is being reduced, and the artesian basin is being depleted.

1/ Percent probability that the given event will be equalled or exceeded in any given year.

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TABLE 3

ESTIMATED WATER YIELDS
FOR
MISSOURI AND JAMES RIVER SUB-BASINS

Sub-Basins	Drainage Area Contrib. Sq.Mi.	Run-Off Curve No.[1/]	Average Annual Run-Off Inches	Estimated Annual Water Yield: 80% Chance Run-Off Inches	80% Chance Run-Off Ac.Ft.	50% Chance Run-Off Inches	50% Chance Run-Off Ac.Ft.
Missouri River							
Spring Creek	370	74	.728	.207	4084	.495	9767
Hiddenwood	100	75	.430	.051	272	.198	1055
Swan Lake	242	74	.450	.10	1290	.30	3870
Artichoke	125	75	.500	.114	760	.33	2200
Okobojo	240	74	.500	.114	1460	.33	4220
Medicine Knoll	597	73	.430	.051	1620	.198	6300
Chapelle	235	73	.450	.10	1250	.30	3760
James River							
Elm River	906	77	.612	.135	6522	.422	20389
Foote & Moccasin	404	77	.171	.019	440	.097	2245
Crow Creek	327	72	.100	0	0	0	0
Mud Creek	597	78	.185	.024	764	.118	3757
Snake	1131	76	.233	.022	1327	.086	5187
Turtle	963	75	.364	.034	1746	.135	6933
Dry Run	205	81	.15	.027	295	.077	842
Timber	578	78	.54	.098	3020	.278	8569
Foster	221	77	.65	.119	1402	.335	3948
Shue	179	79	.90	.165	1575	.463	4420
Ravine	97	73	.39	.070	362	.200	1035
Pearl	283	80	1.05	.174	2626	.473	7138
Redstone	286	77	1.01	.168	2562	.455	6940
Cain	215	76	.79	.131	1502	.356	4082
Sand	374	72	.60	.100	1994	.270	5385
Morris	119	69	.75	.148	939	.382	2424
Firesteel	504	76	1.04	.206	5537	.530	14245
Enemy	163	74	1.08	.214	1860	.550	4781
Twelve Mile	268	75	1.16	.230	3287	.592	8461
Dry Creek	120	76	1.32	.262	1677	.672	4300
Lone Tree	106	75	1.27	.252	1427	.647	3657
Jim Creek	52	75	1.11	.220	610	.565	1566
Plano	32	74	1.13	.224	382	.575	981
Rock	285	76	1.16	.230	3495	.592	8998
Johnson	50	74	1.20	.238	634	.611	1629
Pierre	58	73	1.13	.224	693	.575	1778
Plumb	62	74	1.23	.244	807	.627	2073
Wolf	297	76	1.25	.248	3928	.637	10089
Dawson	80	75	1.39	.275	1173	.708	3020
Prairie	52	75	1.44	.286	793	.734	2035
Beaver	136	74	1.30	.258	1871	.662	4801

1/ A curve number based on antecedent moisture, vegetative cover conditions, and soil type and condition.

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Drainage

Approximately 1,640,000 acres have problems with wetness. Of this amount, about 650,000 acres are in Land Capability Classes III and IV, and, because of inadequate drainage, yields are reduced during years of above normal precipitation. Poor surface drainage is a problem on about 450,000 acres, of which 230,000 acres are used for cropland. Water table effects 200,000 acres. Eighty-four thousand acres of this total are used for cropland. Drainage of much of this land is not economically justified because of excessive cuts, poor outlets, and the infrequency in which the wetness problem occurs.

Cropland With Inadequate Drainage

- USDA Photo Sd-3971-1

Agricultural Domestic Water[1/]

The agricultural economy is based on livestock production. Stockwater reservoirs and dugouts are the principal facilities used for summer water supplies. Snowmelt run-off is the primary source of surface water for these facilities. Extreme climatic conditions occasionally result in inadequate water supplies during the grazing season. Some years, there is little or no run-off for the entire year. This, together with high evaporation losses, results in a water shortage even in years in which there is adequate moisture for grass production.

It is estimated that in the next 60 years, rural domestic water requirements will more than double. Estimated present and future needs are shown in Table 4.

1/ Does not include towns and villages under 2500 population.

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TABLE 4

ESTIMATED ANNUAL AGRICULTURAL DOMESTIC WATER REQUIREMENT
STUDY AREA

	1960			1980			2020		
County	Household Ac.Ft.	Livestock Ac.Ft.	Total Ac.Ft.	Household Ac.Ft.	Live-Stock Ac.Ft.	Total Ac.Ft.	Household Ac.Ft.	Livestock Ac.Ft.	Total Ac.Ft.
Aurora 1/	83	511	594	92	807	899	104	1325	1429
Beadle	239	1230	1469	265	1960	2225	300	3220	3520
Bon Homme 1/	34	94	128	37	150	187	42	246	288
Brown	315	1296	1611	350	2028	2378	395	3329	3724
Campbell	83	511	594	92	826	918	104	1359	1463
Clark	172	809	981	191	1281	1472	216	2104	2320
Davison	135	585	720	150	930	1080	170	1528	1698
Day	221	691	912	245	1106	1351	277	1817	2094
Douglas 1/	22	71	93	25	119	144	28	196	224
Edmunds	128	759	887	143	1237	1380	161	2035	2196
Faulk	99	698	797	110	1104	1214	125	1813	1938
Hand	158	2754	2912	175	2187	2362	198	3593	3791
Hanson	125	512	637	139	815	954	156	1340	1496
Hughes	71	976	1047	29	779	808	89	1280	1369
Hutchinson 1/	211	1053	1264	235	1689	1924	265	2776	3041
Hyde	58	780	838	64	1232	1296	73	2024	2097
Jerauld 1/	41	293	334	46	462	508	52	759	811
Kingsbury 1/	121	972	1093	135	536	671	152	880	1032
Marshall 1/	122	530	652	135	849	984	153	1396	1549
McCook 1/	92	272	364	102	434	536	116	714	830
McPherson	123	838	961	137	1358	1495	155	2235	2390
Miner 1/	64	303	367	71	384	455	81	631	712
Potter	81	579	660	90	920	1010	102	1512	1614
Sanborn	111	732	843	123	1160	1283	139	1905	2044
Spink	253	1014	1267	281	1603	1884	318	2632	2950
Sully	64	704	768	71	1108	1179	80	1818	1898
Walworth	79	544	623	88	878	966	99	1444	1543
Yankton 1/	136	380	516	151	604	755	171	992	1163
Total	3441	20491	23932 2/	3772	28546	32318 3/	4321	46903	51224 4/

1/Partial County 2/21% Surface Water 3/18% Surface Water 4/13% Surface Water

NON-AGRICULTURAL WATER MANAGEMENT NEEDS

Municipal Water

There are 118 towns and villages in the Study Area. All, except seven, use wells for their water supply. Four of the larger towns (Aberdeen, Huron, Mitchell, and Mobridge) obtain their water from rivers or lakes. Wessington Springs and part of Ree Heights water supply is from springs.

The Public Water Supply Data (July, 1961), prepared by the South Dakota Department of Health, indicates there are sixteen towns using wells in the Study Area where water quality meets or approaches national standards. Towns using surface supplies have treatment plants that provide water meeting Public Health Service standards.

It is estimated that a third of the towns and villages using wells have water shortages. Based on present facilities, it is estimated that over half of these towns and villages will have water shortages by 2020. Generally, the source of water for towns using surface water supplies is presently adequate. In the future, they may have to enlarge their storage capacities or seek new sources.

Recreation, Fish and Wildlife

The study of recreation, fish and wildlife developments was limited to water-based activities. It was determined that project development would have limited effect on most game species. Existing recreation areas were considered adequate if facilities were available for fishing, swimming, camping, and boating. Using this criteria, it is estimated that 40 percent of the area has adequate facilities for the present population. Five percent of the area has good facilities, but too small to adequately serve the present population. About 25 percent of the area has water areas with inadequate facilities. Thirty percent of the area has neither adequate water areas nor recreation facilities (Figure 16).

The South Dakota Department of Game, Fish, and Parks has taken the leadership in developing recreation areas listed in Table 5.

Only seven of the 85 meandered lakes have basic facilities deemed adequate to meet the needs for all types of water-based recreation. These lakes are concentrated in Clark, Day, and Marshall Counties.

Stubble Mulch Tillage Reduces Wind Erosion
and Conserves Moisture

- SCS Photo Sd-7695-3

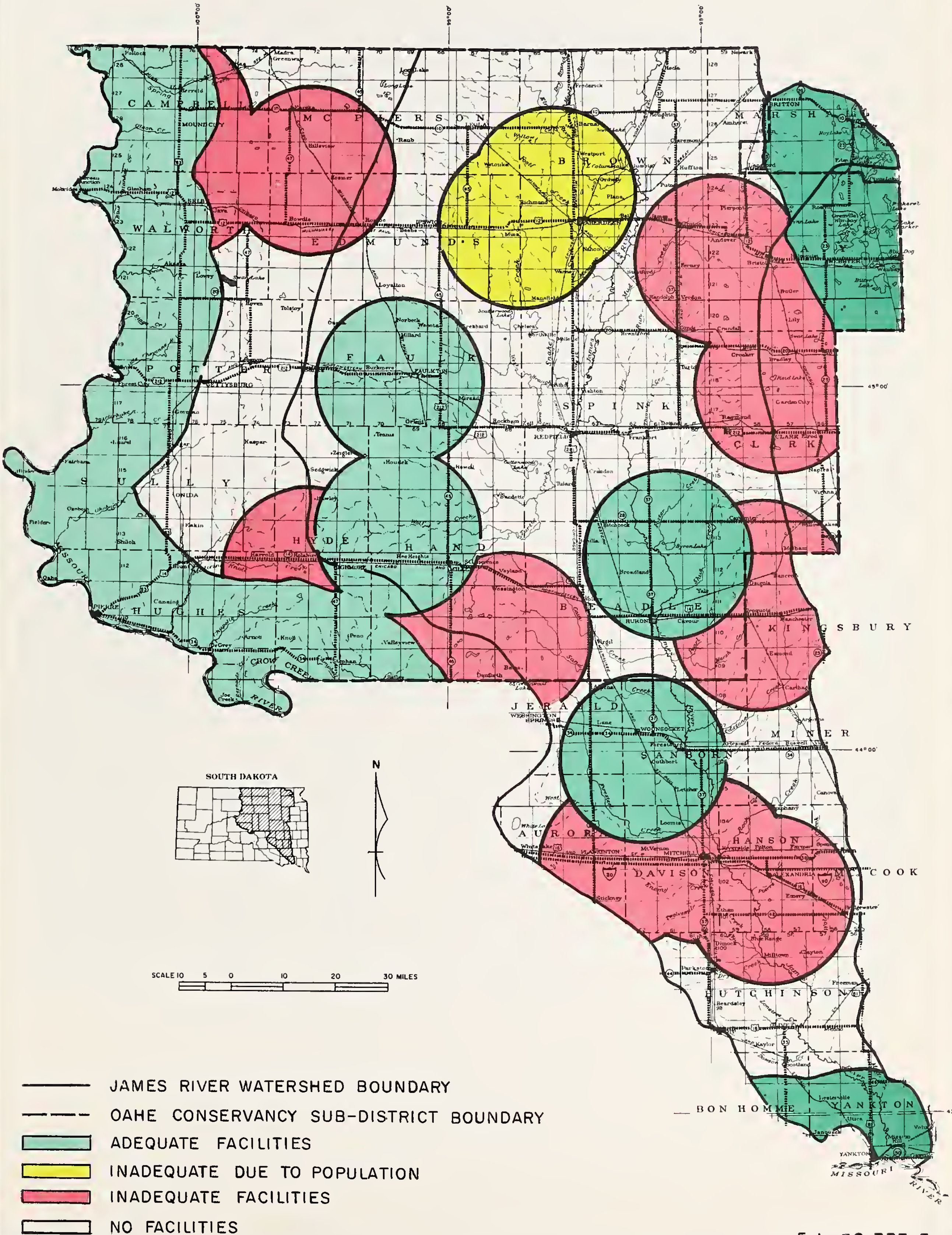
Contour Strip Cropping
is an Important Water Erosion Control Measure

- SCS Photo Sd-9737-3

Wind Strip Cropping and Field Windbreaks
Have Stabilized Sandy Soils in Brown County

- SCS Photo Sd-600

FIGURE 16
PRESENT WATER-BASED RECREATION FACILITIES STUDY AREA



USDA-SCS-LINCOLN, NEBR. 1965

5,L-22,333.5

TABLE 5

EXISTING RECREATIONAL FACILITIES
STUDY AREA

Area	Water Area Acres	Rec. Land Acres	Facilities Available: Swim	Boat	Picnic	Camp	Fish	Other	Pop. 15-Mi. Use Radius	1963 Use
State Parks										
Fishers Grove	James R.	120	x		x	x	x	Golf Crs.	6,980	60,295
Ft. Sisseton	0	10			x	x		Historic	5,966	32,170
Lk. Hiddenwood	32	160	x	x	x	x	x		2,745	35,123
Roy Lake	666	632	x	x	x	x	x	Cabins	5,950	63,400
State Rec. Areas										
Lake Byron	1447	15	x	x	x	x	x		18,355	23,895
Clear Lake	865	3	x	x	x		x		7,750	12,250
Lk. Faulkton	100	320	x	x	x		x		3,445	23,045
Lk. Louise	135	320	x	x	x	x	x		4,660	52,000
Lk. Osceola	13	40			x	x	x		5,920	1,825
Pickerel Lake	1052	60		x	x	x	x		7,220	25,250
Richmond Lake	500	480	x	x	x	x	x	Gr. Camp	27,420	53,000
Twin Lakes	300	15	x	x	x		x		5,490	12,050
Cooperative Parks										
Lake Agnew	21	40			x	x			6,475	1,750
Amsden Dam	214	13		x	x	x	x		4,105	20,725
Bailey Lake	208	32		x	x	x			5,600	9,475
Bowdle-Hosmer	80	4		x	x	x			6,065	710
Lk. Campbell	60	4			x	x	x		3,485	1,185
Lk. Carthage		(Under Construction)								
Lk. Chapelle	45	56			x	x			1,780	8,250
Doland	0	10			x	x		Ball Park	2,330	5,480
Fish Lake	200	60			x	x			5,015	14,500
Lake Hanson	62	30	x	x	x	x	x		20,320	20,235
Herreid	0	2			x	x			3,535	3,900
Lk. Iroquois	20	160			x	x	x		5,720	3,650
Lk. Mitchell	0	70			x	x			18,360	11,050
Lk. Molstad	104	16			x	x	x		6,440	3,485
Parmley(Mina)	500	856		x	x	x	x	Ball Park	27,785	51,875
Lk. Pierpont	80	160	x	x	x	x	x	Rodeo Grn.	5,500	19,750
Pollock	2300	22	x	x	x	x	x		1,985	1,200
Rose Hill	35	20	x		x	x	x		4,140	20,050

PROPOSED WORKS OF IMPROVEMENT

SOIL CONSERVATION SERVICE

Under Public Law 566, the Watershed Protection and Flood Prevention Act, the Soil Conservation Service assists local organizations plan and develop small watersheds. Local people submitted watershed applications for the Upper and Lower Crow Creek Watersheds in June, 1957. Planning was authorized in January, 1958, and proceeded intermittently for several years. Because of unsatisfactory outlet conditions, certain structural measures were required that exceeded the criteria set forth in the present legislation. Planning was suspended in December, 1962. If improvements are made on the James River channel, or if certain amendments are made to the present law, planning could be resumed.

Applications have been submitted for Spring Creek Watershed in Campbell and McPherson Counties.

BUREAU OF RECLAMATION

The Oahe Unit in South Dakota is part of the Missouri River Basin Project authorized by the Congress of the United States through the passage of the Flood Control Act of 1944. In May, 1965, the Missouri-Oahe Projects Office completed a report on the Oahe Unit covering 495,000 acres. This outlines a plan for diversion of water from the Oahe Reservoir in the Missouri River above Pierre. Proposed supply works consist of the Oahe pumping plant, a system of 340 miles of main canals, three regulating reservoirs, the James River pumping plant, a diversion dam, and channel improvements on the James River. The plan includes 2041 miles of canals and laterals, and about 9,953 miles of open and closed drains.

In addition to irrigation, the Oahe Unit provides opportunities for fish and wildlife development, recreation, and municipal water supplies. Benefits will also result from flood control and stream pollution abatement.

The irrigated areas are located in Spink, Brown, Day, Marshall, Sully, and Potter Counties. An initial stage for the project is described in a supplemental report on the Oahe Unit, dated June, 1965. This report outlines a 190,000-acre project primarily in Spink and Brown Counties.

The bureau is evaluating a pump irrigation project in Campbell County. Another study has been initiated in the Mitchell area to evaluate the potential to develop municipal water supplies and other water resource developments.

CORPS OF ENGINEERS

Studies on the James River were initiated in the late 20's, and since that time several flood control studies have been made. An unpublished report prepared in 1947 contained a plan for flood control on the James River. The plan proposed a dam above Jamestown on the James River, a dam at Westport on the Elm River, channel improvement from Columbia to the mouth, and drainage of 125,000 acres in Brown and Marshall Counties. The Westport Dam, drainage in Brown and Marshall Counties, and channel improvements in Brown and Spink Counties were determined to be physically and economically feasible. Local interests opposed the plan, so no project action was taken at that time.

In 1950, a special study was made of flood problems at Aberdeen. Channel improvements and levees were proposed along the Elm River, but local interests were unwilling to provide the needed cooperation to construct the project.

A new evaluation of flood problems on the James River was completed in 1963. A preliminary report of the findings in this study was presented to the Directors of the Oahe Conservancy Sub-District at the March, 1963, meeting. The Directors requested the Corps of Engineers not to publish the South Dakota portion of the report until after the USDA and the Bureau studies were completed in 1965. The Corps agreed to follow this suggestion.

The Corps of Engineers has nearly completed its work on the Oahe Dam and Reservoir which form much of the western border for the Oahe Conservancy Sub-District. Several recreation areas are being developed adjacent to the Oahe Reservoir.

LAND AND WATER RESOURCE OPPORTUNITIES

LAND TREATMENT

Application of land treatment measures is a basic requirement for the conservation, utilization, and development of our land and water resources to control wind and water erosion problems.

There are about 163,000 acres of cropland in Land Capability Class VI that should be converted to other uses. Because of location and tract size, it is estimated it would be practical to convert about 80 percent of this acreage.

Reduction of wind erosion damage can be accomplished by application of wind strip cropping, field windbreaks, and stubble mulch tillage. The 1959 Conservation Needs Inventory indicates there is a need to apply wind strip cropping on about 1,400,000 acres. About two million acres of cropland need stubble mulch tillage. The need for field windbreaks is about 2800 miles.

Trees have great potential as a land treatment measure for cropland. Additional windbreaks and shelter belts should be established to prevent wind erosion, and for protection of homes, livestock, and wildlife.

Forest and woodland areas that are grazed heavily by domestic livestock are problem areas. Controlling the grazing will allow these problem areas to recover naturally. Underplanting with desirable species will improve the forest stand, and give opportunity for some economical return to the land owner.

Water erosion problems on cropland can be reduced by applying about 41,000 miles of terraces, 800,000 acres of contouring, 87,000 acres of grassed waterways, and 500 grade stabilization structures. These practices will also substantially reduce sediment damages.

The remaining land treatment measures required on cropland for each county are shown in Table 6. Land used for pasture and hay does not add materially to the wind and water erosion problems; however, land treatment measures are required to maintain production and to achieve proper use. The remaining practices needed for pasture and range are listed by counties in Table 7.

TABLE 6

REMAINING CONSERVATION NEEDS ON CROPLAND (DRYLAND)

County	Total Acres	Terraces Level & Gradient (Mi.)	Strip Cropping Contour (Ac.)	Contour Farm (Ac.)	Strip Cropping Wind (Ac.)	Tree Planting (Ac.)	Grassed Water-ways (Ac.)	Diver-sions (Mi.)	Drainage Imp. (Ac.)	Rotating Hay and Pasture (Ac.)	Stubble Mulch (Ac.)	Crop Res. Use (Ac.)	Grade Stab. Struct. (No.)	Wildlife Habitat Devel. Area (Ac)
Aurora	148,044	1,589	6,375	0	53,434	600	1,860	0	4,615	34,648	36,803	112,593	0	463
Beadle	464,032	1,018	13,650	12,400	31,980	1,230	4,195	28	36,900	34,785	30,330	415,594	11	1,778
Bon Homme	26,202	342	1,587	668	1,573	129	368	2	417	3,590	798	25,128	8	204
Brown	724,801	4,440	78,061	31,274	235,928	7,530	19,309	41.6	12,685	210,179	299,821	424,980	22	15,795
Campbell	270,806	1,009	69,322	0	62,995	1,185	1,464	0	0	42,640	207,090	57,134	145	0
Clark	281,402	3,062	48,721	20,095	23,407	3,000	6,419	24.6	4,687	74,398	107,874	173,528	7	11,192
Davison	191,458	537	2,179	1,822	1,299	520	965	5	3,462	39,079	18,511	162,122	18	1,782
Day	366,107	3,744	39,554	20,628	10,305	2,260	10,850	28.5	5,355	70,813	42,419	313,688	10	8,974
Douglas	19,837	109	2,265	333	638	73	189	1	462	3,939	480	19,326	3	124
Edmunds	413,243	1,884	37,723	0	50,544	1,900	1,357	13	13,011	165,737	78,253	116,084	27	1,667
Faulk	271,198	1,428	56,196	0	75,138	600	788	23	9,152	104,052	91,167	50,684	10	210
Hand	415,464	1,144	107,103	0	75,096	1,110	6,273	47	13,072	79,358	136,225	260,330	37	413
Hanson	201,476	232	678	1,356	0	1,440	281	5	2,625	12,469	0	201,476	4	312
Hughes	168,111	1,142	21,948	6,340	29,400	1,000	1,094	5	0	9,115	101,470	26,150	11	509
Hutchinson	320,279	1,104	6,575	4,124	0	924	2,609	33	11,911	42,248	0	318,587	40	1,502
Hyde	120,887	1,433	14,562	0	40,342	1,171	1,528	14	1,492	16,853	44,342	76,904	0	583
Jerauld	77,072	866	16,315	2,383	7,053	650	969	16	871	11,460	19,087	57,730	6	444
Kingsbury	150,245	2,062	8,271	8,022	8,146	560	1,470	2	4,025	34,879	4,043	147,371	11	1,173
Marshall	120,304	392	4,242	4,242	43,266	1,473	900	2	2,239	46,647	19,280	93,600	0	1,210
McCook	87,789	788	9,574	5,088	1,561	381	742	0	1,256	10,708	3,826	81,499	10	250
McPherson	277,977	1,226	33,942	2,760	27,136	2,167	904	23	2,243	236,279	70,767	75,256	5	637
Miner	82,840	251	4,556	3,383	1,802	388	595	5	2,349	17,986	8,636	69,836	12	1,183
Potter	313,172	3,291	62,630	0	20,089	1,900	753	1	200	66,243	18,497	57,868	26	190
Sanborn	217,742	714	2,070	3,465	37,200	3,640	1,404	7.5	4,360	42,270	63,050	157,670	19	5,247
Spink	665,930	971	19,488	33,584	451,351	6,235	4,253	5	9,898	124,154	145,745	520,185	5	11,795
Sully	298,432	1,414	60,140	23,380	70,605	1,500	2,250	6.5	2,800	14,200	277,700	51,200	18	2,200
Walworth	256,966	4,002	63,735	0	40,955	1,407	1,389	29	1,036	66,882	199,479	41,906	21	664
Yankton	96,925	732	13,021	2,484	42	803	2,226	6	1,393	13,334	0	97,340	31	487
Basin Totals	7,038,741	40,926	804,483	187,831	1,401,285	45,776 1/	87,404	37.5	152,516 2/	1,529,944	2,025,693	4,205,766	517	70,988 3/

Source: Conservation Needs Inventory, 1958.

1/ Cropland Conversion Required to Protect Adjacent Land and to Provide Wildlife Habitat.
2/ Considered economically feasible.
3/ Establishing Plants on Other Than Wetlands for Wildlife Food and Cover.

TABLE 7

REMAINING CONSERVATION NEEDS ON PASTURE AND RANGE

County	Total Acres	Total Acres Needing Treatment (Ac.)	Total Seeding Needs (Ac.)	Deferred Grazing (Ac.)	Rotation Grazing (Ac.)	Proper Range Use (Ac.)	Pond Construction (No.)	Spring Development (No.)	Wells (No.)	Water Spreading (Ac.)	Contour Furrowing (Ac.)	Diversions (Mi.)	Fish Pond Treatment (No.)	Wetland Development (Ac.)
Aurora	106,024	65,000	5,661	9,569	10,529	27,159	158	10	71	975	2,600	11	65	13,000
Beadle	289,000	164,000	10,130	- -	49,900	94,400	3,073	30	80	350	19,000	15	60	3,000
Bon Homme	42,860	4,400	1,093	895	1,321	2,512	26	- -	- -	27	487	- -	6	143
Brown	276,899	173,059	20,504	764	66,611	58,282	616	36	426	1,731	16,887	56	23	15,927
Campbell	170,646	152,627	53,673	500	- -	3,000	1,200	20	30	2,500	1,500	2	25	200
Clark	180,433	130,790	1,127	1,786	2,270	126,890	1,015	18	75	330	3,020	36	10	2,616
Davison	69,220	59,000	- -	5,718	20,654	41,915	208	18	- -	4,840	1,076	- -	87	2,200
Day	159,446	148,446	26,007	117,011	7,347	112,922	526	36	38	742	32,079	36	- -	2,000
Douglas	9,561	6,672	696	1,045	1,650	4,739	47	- -	1	44	187	2	1	- -
Edmunds	301,429	237,653	9,333	30,788	2,678	56,674	1,397	20	20	5,898	- -	12	25	5,000
Faulk	356,053	184,063	1,500	18,000	5,000	150,000	822	5	30	800	13,329	20	- -	2,000
Hand	491,459	- -	89,202	- -	- -	- -	1,720	24	110	300	5,000	38	275	6,000
Hanson	61,986	46,500	6,286	5,180	14,773	43,619	294	3	20	100	2,336	20	106	- -
Hughes	275,257	179,000	36,306	28,031	8,000	121,715	834	19	90	1,470	37,500	1	- -	- -
Hutchinson	109,778	81,828	1,290	25,800	2,580	43,172	546	4	48	502	4,243	33	42	430
Hyde	412,594	- -	25,030	58,275	9,000	24,379	141	13	9	2,820	500	10	228	- -
Jerauld	77,010	38,250	6,169	5,131	18,535	12,183	343	14	51	2,294	2,550	44	26	- -
Kingsbury	23,450	- -	3,634	4,313	5,917	11,351	250	7	16	106	5,552	4	55	- -
Marshall	122,252	85,576	8,319	9,379	9,321	54,395	165	6	51	428	8,558	24	19	1,246
McCook	28,468	25,597	2,545	2,780	2,165	17,718	102	6	6	23	1,450	1	10	1,371
McPherson	408,241	358,241	27,107	30,000	- -	246,367	1,774	- -	75	5,000	- -	12	180	- -
Miner	35,530	32,470	1,700	3,434	11,900	19,040	286	3	13	109	4,180	3	13	850
Potter	221,219	199,097	19,082	29,000	750	105,702	700	6	30	6,900	9,680	3	400	500
Sanborn	128,000	77,000	22,814	2,437	2,000	26,074	503	30	330	100	2,380	- -	29	1,000
Spink	256,555	214,555	51,242	113,308	14,625	188,114	712	- -	20	- -	1,471	9	- -	- -
Sully	320,049	242,902	4,488	21,885	8,000	226,902	1,029	22	35	463	289	8	216	3,000
Walworth	146,357	131,721	- -	- -	147	- -	350	20	30	3,930	8,000	147	60	600
Yankton	29,434	24,152	1,846	440	- -	17,437	546	1	5	- -	18,430	189	42	220
Basin Totals	5,109,210	3,062,599	436,784	525,469	275,673	1,836,661	19,383	371	1,710	42,782	202,286	736	2,003	61,303 1/

Source: Conservation Needs Inventory, 1958.

1/ Creating or improving a wetland habitat by dyking, ditching, planting, or by other means.

E

FLOOD PREVENTION

Floodwater retarding structures and channel improvements are the principal structural measures required to reduce floodwater damages. Evaluations indicate there are physical and economic potentials for project development in sub-basins that would benefit approximately 75,000 acres. Part of these projects could be developed under present USDA authorities, primarily the Watershed Protection and Flood Prevention Act. Other projects will require new or amended authorities before they can be considered for development.

AGRICULTURAL WATER MANAGEMENT

There are opportunities to increase irrigation with water supplies that can be developed in the area. Most of these opportunities will be developed by individual farmers with irrigable soils lying over ground water acquifers (Figure 17). It is estimated that an additional 115,800 acres could be developed from this source.

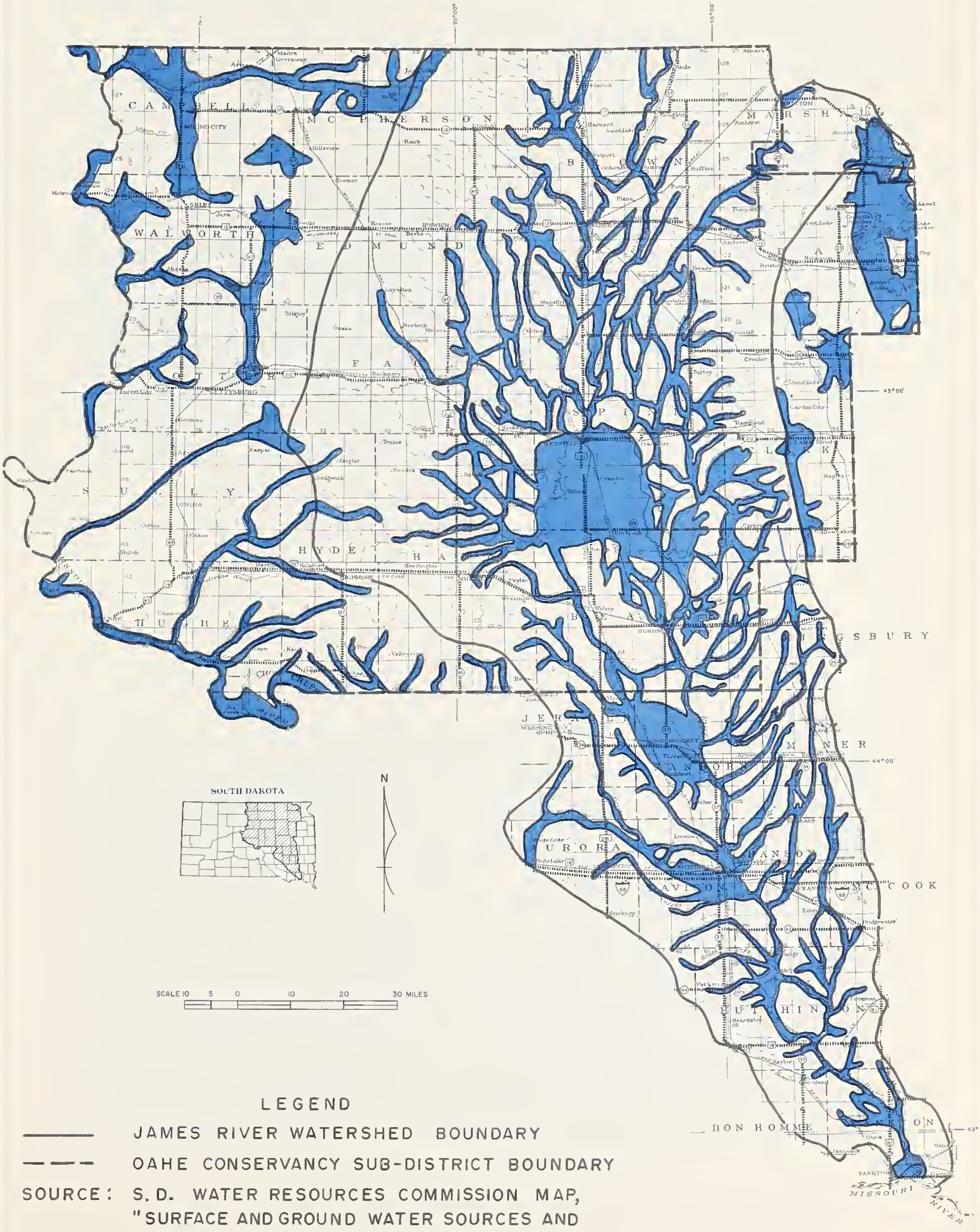
Evaluations indicate that the sub-basins produce sufficient surface water to irrigate an additional 22,200 acres. Because of physical and economic limitations, it appears there is an opportunity to irrigate only 4,200 acres. Economic feasibility for these single-purpose irrigation projects is marginal; therefore, it will be necessary to make additional studies to evaluate the effect of flood prevention on mainstem floodplains.

Agricultural production could be increased on 650,000 acres having Land Capability Classes III and IV soils by on-farm surface and sub-surface drainage. It is estimated that farmers and ranchers could profitably drain 50 percent of this area. Deep cuts and poor outlets make it impractical for individual farmers and ranchers to drain the balance. Project drainage could benefit this area, but investigations indicated that improvements are physically and economically justified on only 6700 acres in one sub-basin.

Additional water to satisfy future domestic needs can be obtained by several means. Developing wells or reservoirs for community use is one alternate. A second alternate is to reduce evaporation and seepage losses by using sealed catchment basins or filament on water surfaces. The artesian basin can be conserved by regulating flow loss from abandoned or poorly maintained wells.

U. S. DEPARTMENT OF AGRICULTURE | SOIL CONSERVATION SERVICE

FIGURE 17
SHALLOW AQUIFERS STUDY AREA



LEGEND

——— JAMES RIVER WATERSHED BOUNDARY

— — — OAHE CONSERVANCY SUB-DISTRICT BOUNDARY

SOURCE: S.D. WATER RESOURCES COMMISSION MAP, "SURFACE AND GROUND WATER SOURCES AND IRRIGATION DEVELOPMENT"

USDA-SCS-LINCOLN, NEBR. 1965

5,L-22,333.13

Floodwater Retarding Structures
Protect Cropland and Other Properties on Watershed Floodplains

- SCS Photo Sd-9669-6

Channel Improvements are Often required
in Flood-Prevention Projects

- SCS Photo Sd-9152-7

Irrigation can be Developed in the Study Area
Using Surface and Ground Water

- SCS Photo Sd-3983-6

NON-AGRICULTURAL WATER MANAGEMENT

This Study considered only surface water supplies for municipal water. No opportunities were found to incorporate municipal water development as a part of multi-purpose project. Sites were located that can be considered for development by the cities of Aberdeen, Miller, Britton, and Mitchell.

Representatives of the South Dakota Department of Health have stated that only towns of 1500 or greater population can afford to develop surface water supplies. There are physical opportunities for developing surface water supplies for some of the smaller towns, but because of economic limitations, it is unlikely that these opportunities will be developed.

A research saline water treatment plant is being tested at Webster. Indications are that this system or a similar system may provide a solution for the water quality problem experienced by many towns.

Water-based recreation was included as a specific purpose in three of the fifteen sub-basins having potential for development. In six other sub-basins, recreation can be an incidental purpose.

Reservoir sites were located in other sub-basins. Some of these could have recreation potential. The data available for these sites may be useful for local groups and agencies planning recreation and other developments.

Watershed Projects Provide Opportunities
to Develop Water-Based Recreation

- SCS Photo Sd-9560-1

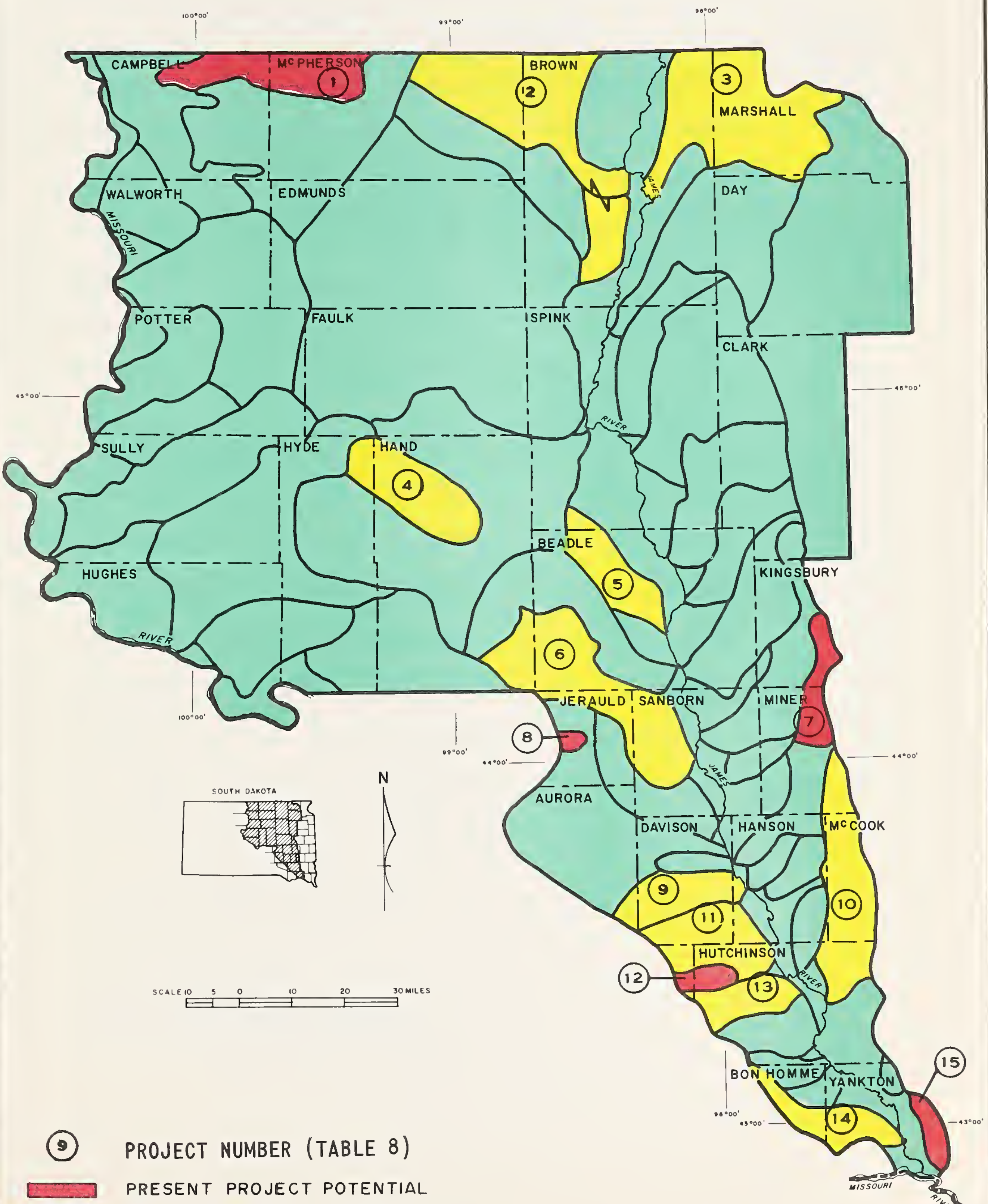
Figure 18 shows the sub-basins with potential for development. A summary of small watershed project potential is listed in Table 8.

U. S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

FIGURE 18

PROJECT POTENTIAL STUDY AREA



(9) PROJECT NUMBER (TABLE 8)

PRESENT PROJECT POTENTIAL

FUTURE PROJECT POTENTIAL

OTHER RESOURCE POTENTIAL

USDA-SCS-LINCOLN, NEBR. 1965

5,L-22,333.6

TABLE 8

SUMMARY OF PROJECT POTENTIAL BY SUB-BASIN

Proj. No.1/	Potential Projects	Purpose 2/	Feasi-bility	Present USDA Programs	Priority	Summary Report Page
1	Upper Spring Creek	FA	Feasible	Yes	Present	69
2	Elm River	F	Feasible	Yes	Future	51
3	Crow Creek	F	Feasible	Yes	Future	53
4	Shaefer Creek	A	Marginal	Yes	Future	56
5	Ravine Creek	A	Feasible	Yes	Future	58
6	Sand Creek	FN	Feasible	No	Future	60
7	Upper Rock Creek	FN	Feasible	Yes	Present	62
8	Wessington Springs Tributary	FN	Feasible	Yes	Present	63
9	Enemy Creek	FA	Marginal	Yes	Future	64
10	Wolf Creek	A	Marginal	Yes	Future	66
11	Twelve-Mile Creek	A	Marginal	Yes	Future	65
12	Pony Creek	F	Feasible	Yes	Present	66
13	Dry Creek	A	Marginal	Yes	Future	66
14	Beaver Creek	A	Marginal	Yes	Future	66
15	Mission Hill	F	Feasible	Yes	Present	67

Source: River Basin Staff

1/ See Figure 18

2/ F - Flood Prevention
A - Agriculture Water Management
N - Non-Agriculture Water Management

SUMMARY REPORTS FOR SUB-BASINS

Each of the forty-three major sub-basins in the Study Area were studied separately. The intensity of study varied; however, generally more data was developed for the sub-basins written up separately in the following summaries. The sub-basin summaries were grouped where the evaluations indicated marginal or no project potential. Sub-basin summaries for the James River Basin are listed in the narrative starting with the upper sub-basins and progressing downstream. These summaries are followed by those for the Missouri River Sub-Basins.

ELM RIVER

Description

The Elm River enters the James River from the west just below the community of Columbia. It drains parts of Brown and McPherson Counties in South Dakota, and Dickey and LaMoure Counties in North Dakota. The total drainage has about 1264 square miles. About 60 percent of the drainage lies in North Dakota.

It is estimated that 906 square miles of the total drainage area contribute water during average run-off years. The contributing drainage above the stream gage at Westport (established 1946) is estimated to be 870 square miles.

The Elm River Sub-Basin comprises four watersheds which are Elm River, Maple River, Dry Branch, and Willow Creek. The entire Willow Creek drainage lies in South Dakota, while the others have their headwaters in North Dakota. The sub-basin is in the Black Glaciated Plains Resource Area. It has four general soil areas. The upland glacial tills have Zahl, Williams, Houdek, and Bonilla silt loams. Soil types in the poorly drained depressional soils include Tetonka, Hoven, Cavour, Cresbard, and Miranda. A small acreage has sandy and gravelly sub-stratum with the Eckman and Fordville series. On the floodplains, LaDelle, Lamoure, and Maple soils are found.

This is a diversified farming area, but livestock is the principal enterprise in the steeper uplands. The land use inventory shows 52 percent cropland, 47 percent grassland, and one percent other uses.

There are three storage reservoirs in the sub-basin. The newest reservoir was completed in 1963, seven miles west of Ellendale, North Dakota, in the upper reaches of the Elm River Watershed. It was developed for multipurpose use including recreation, fish, wildlife, and municipal water. The reservoirs in South Dakota on Willow Creek and Elm River were developed primarily to supply municipal water for Aberdeen. Elm Lake has limited recreation use, and improvements are being added around the Willow Creek reservoir to develop its recreation potential. No floodwater storage is provided in any of these structures.

A watershed application was submitted in 1957 for the West Branch of the Maple River in North Dakota. There are 86,400 acres in this watershed. The application requested assistance with flood problems and agricultural water management needs. It is expected that planning authorization will be requested for this watershed in the next year or two. When the application was developed for the West Fork of the Maple River, there was interest in submitting an application for the balance of the Maple River. This interest may develop again if a severe flood occurs.

Problems and Needs

Peak flows can flood about 11,500 acres in the lower reaches of the Elm River floodplain. On an average annual basis, about 1200 acres of cropland area flooded. Larger floods overflow into the Moccasin Creek Watershed. This floods additional agricultural lands and causes severe damage to urban property in Aberdeen. Flood flows from the Elm River are responsible for considerable flooding on the James River floodplains in Brown County. A study of gage records indicates that peak flows from the Elm River are generally greater than the flood flows from the James River out of North Dakota. Peak flows are also more frequent from the Elm River. It is estimated that the Elm River floods or contributes to the flooding of about 18,000 acres on the James River floodplain in Brown and Spink Counties. Additional flooding of agricultural areas occur in North Dakota on the Maple River floodplain, but these areas were not inventoried as a part of this Study.

At present, Aberdeen has an adequate municipal and industrial water supply in the Elm River and Willow Creek reservoirs. In the future, added storage may be required if Missouri River water is not available from the Oahe Irrigation Project for a summer supply. Water-based recreation facilities are not adequate for the present population in the Aberdeen area. Further recreation development in the Elm River Sub-Basin would be desirable. If the water is not required for municipal water or recreation, limited irrigation could be considered. About a thousand acres of irrigable land lies along the lower reaches of the Elm River.

Opportunities

If justified projects for flood prevention and other purposes could be developed on the Maple River in North Dakota, there is a potential for feasible projects that would provide flood prevention to the agricultural properties on the Elm and James Rivers. Benefits would also accrue to the Moccasin Creek area and to the city of Aberdeen.

CROW CREEK

Description

Crow Creek enters the James River from the east just below Tacoma Park in Brown County, South Dakota. Upper Crow Creek Watershed lies in Marshall County, and covers an area of 236,000 acres. Lower Crow Creek Watershed drains part of Brown County, and covers an area of 160,000 acres. The total drainage area is approximately 619 square miles.

The headwaters of Crow Creek have potholes and numerous small lakes in an area known as the Sisseton Hills. From the Sisseton Hills area, Crow Creek flows generally in a westerly direction, dropping sharply to a relatively flat lake plain area. At the Brown-Marshall County line, Crow Creek flows through Renzienhausen Slough. It then turns and flows in a south-westerly direction through a series of sloughs. The overall shape of the Crow Creek sub-basin is generally fan-shaped. Elevations range from 1120 feet near the outlet to 1880 feet above mean sea level in the northeast part of the sub-basin.

Crow Creek Sub-Basin is in the Black Glaciated Plains Resource Area. The eastern one-fourth is an area of glacial moraine that caps Pierre shale. Slopes range from gentle to steep, and are irregular and choppy. Stones and gravel are common on and in the soil. The principal soils are Barnes, Buse, Krausburg, Harmony, Aberdeen, Bearden, Maple, and Ulen.

West of the Sisseton Hills, lake deposits exist as stratified clays, silts, and sands. This area is extremely flat. Soils are predominately sandy loam, except for local patches of light clay that lie in poorly-drained depressions. Dune sand of recent age is also found in the northern section of the sub-basin. The principal soils are Hecla, Tanberg, Ulen, Thurman, Bearden, and Maple.

Most farms are diversified; however, the principal source of income is livestock with some flax and wheat grown for cash income. The land use is 63 percent cropland, 31 percent pasture, and 6 percent other. The main crops grown are corn, oats, wheat, flax, and tame hay.

Four drainage districts, Crow Creek, Dayton-Crow Creek, Newport-Weston, and Spain, constructed channels through the bottomlands between 1916 and 1920.

Hickman Dam was built by WPA around 1940, and provides the only recreation reservoir in the sub-basin.

The South Dakota Department of Game, Fish, and Parks owns approximately 4500 acres of public shooting area in the sub-basin. About 2000 acres of these lands are wet areas along Crow Creek.

Problems and Needs

The major problem in the Crow Creek Sub-Basin is damage from snowmelt run-off. Up to 45,000 acres have been flooded. About 15,000 acres have flooded in the Upper Crow Creek watershed, and up to 30,000 acres in the Lower Crow Creek watershed. When floodwaters overflow the creek banks, a large amount of water is trapped in depressions. This causes delayed seeding, and after some floods, the land cannot be farmed during the entire year. Following the 1952 flood, 8000 acres could not be farmed in the Upper Crow Creek watershed. Most of the floodwaters causing damage in the Lower Crow Creek watershed originate in the upper watershed.

Sheet erosion is minor throughout the sub-basin, but there is some channel and gully erosion in the area with steep slopes. Wind erosion is a moderate to severe problem on a substantial portion of the flat lands. High water tables are a problem adjacent to the drainageways in the lower half of the sub-basin. Approximately 30 percent of the Lower Crow Creek watershed has a water table at 10 feet or less.

Two towns, Britton and Langford, have a need for additional municipal water.

Opportunities

Local people submitted applications for planning assistance for Upper and Lower Crow Creek watersheds under the Watershed Protection and Flood Prevention Act, P. L. 566, in June, 1957. Planning was initiated on these two watersheds in 1958. During the planning stage, about twenty floodwater retarding structure sites were investigated. These were all located in the Upper Crow Creek watershed in the area of the Sisseton Hills. Alternates were studied for carrying water across the flatlands in the Lower Crow Creek watershed.

Planning was suspended in 1962 when it was apparent that the existing outlet to the James River was not adequate. If future projects improve the James River near the outlet of Crow Creek, it appears that a feasible project can be developed for these two watersheds.

FOOT, MOCCASIN, SNAKE, MUD, TIMBER, FOSTER, AND DRY RUN CREEKS

Description

Foot Creek joins Moccasin Creek on the south edge of Aberdeen. Moccasin Creek enters the James River northwest of Stratford. These creeks drain portions of McPherson and Brown Counties.

Snake Creek Sub-Basin drains parts of Faulk, Edmunds, Brown, and Spink Counties. It drains south and east, entering the James River approximately three miles south of Ashton. The upper boundary of Snake Creek drainage forms a part of the western boundary of the James River Basin.

Mud, Timber, and Dry Run drain parts of Day, Brown, Clark, and Spink Counties, and enter the James River in Spink County. Mud Creek enters the James River northwest of Brentford, Dry Run near Fishers Grove State Park, and Timber Creek south of Frankfort.

Foster Creek enters the James River from the east in Beadle County. This sub-basin is the main drainage for Lake Byron located approximately 17 miles northeast of Huron. It drains parts of Clark, Spink, and Beadle Counties.

Mud Creek on the north, Dry Run, Timber Creek, and Foster Creek on the south are adjacent sub-basins. Their upper boundaries form a part of the eastern boundary of the James River Basin.

These sub-basins have an area of about 4000 square miles. Snake Creek is the largest sub-basin in the James River Basin with approximately 2000 square miles.

With the exception of Foster Creek, the lower portions of the other sub-basins are in the Lake Dakota Plain. The middle and upper portions are in the James River Lowland. The entire drainage area of Foster Creek lies in the James River lowlands.

All of the sub-basins are in the Black Glaciated Plains Resource Area. The soils of the Lake Dakota Plain are Beotia-Aberdeen soil association. These soils are nearly level, well to imperfectly drained, dark grayish brown, silt loams, and silty clay loams. The James River Lowlands soils are of the Houdek-Bonilla soil association. These soils are undulating to nearly level, well to moderately drained, dark grayish brown, slightly acid loams.

Diversified farming is carried out over most of the sub-basins. There are areas that have cash grain farming as the predominant type of farming. The land use of these sub-basins range from 55 to 81 percent cropland, 14 to 45 percent grassland, and 1 to 7 percent other. The principal crops grown are spring wheat, corn, oats, and flax, along with small amounts of barley and rye.

Legal drainage ditches have been constructed in the Timber Creek floodplain and in an area adjacent to Mud Creek. Three man-made lakes, Pierpont, Amsden, and Pigors are in the upper reaches of Mud Creek. Lake Faulkton and Lake Parmley are on Snake Creek drainage, and Lake Richmond is on Foot Creek. A small private irrigation storage dam is located on the lower reaches of Timber Creek. Lake Byron in Foster Creek drainage and Scatterwood Lake on a Snake Creek tributary are natural lakes.

Problems and Needs

Flooding occurs to some degree in all of these sub-basins. The principal source of flooding is snowmelt run-off. Most of the 32,000 acres that are subject to flooding in these sub-basins are in grassland. This acreage represents just over one percent of the total drainage area. Timber Creek has the largest contiguous floodplain with about 6900 acres, but it is less than 4 percent of the total sub-basin drainage. An area in Mud Creek near Ferney has frequently flooded from rainfall.

Opportunities

Flood prevention, drainage, and irrigation were evaluated in these sub-basins, and it was determined there was no project potential. Mud Creek and Timber Creek have a number of reservoir sites that have potential for additional recreation development.

TURTLE CREEK

Description

Turtle Creek Sub-Basin comprises a drainage area of about 1,495 square miles. It enters the James River from the west near the town of Redfield, and drains parts of Hyde, Hand, Beadle, Spink, and Faulk Counties. The principal tributaries to Turtle Creek are Wolf Creek and Medicine Creek. In general, the topography is flat to undulating except for some low hills located in the headwaters at the extreme southwest edge of the sub-basin. Elevations range from a low of 1300 feet at its mouth to 2100 feet in the headwaters.

Turtle Creek drains the southern part of the sub-basin. The drainage is generally well defined, and only a small area is classified as non-contributing. Wolf Creek has a drainage area of about 699 square miles. It drains the central and western part of the sub-basin. Of the total drainage area, 198 square miles are considered as non-contributing. This includes the area above Lake Mitchell, and other areas where numerous potholes and shallow depressions exist. Lost, Shaefer, and North Wolf Creeks are tributaries to Wolf Creek.

Medicine Creek has a drainage area of 252 square miles, and drains the northern part of the sub-basin. Cottonwood Lake is located on Medicine Creek, and has a drainage area of 203 square miles. During normal years, Cottonwood Lake retains all run-off from Medicine Creek and does not contribute to the flows in Turtle Creek.

Turtle Creek Sub-Basin is located in the Black Glaciated Plains and the Dark Brown Glaciated Plains Resource Areas. The soil for the upper part of the sub-basin is developed on gently rolling glacial till parent material. In the lower part, about 10 percent of the area has soils developed from sandy glacial outwash and silts from the Lake Dakota sediments. Williams, Houdek, and Zahl soils are developed on the more rolling topography. Bonilla and Hand soils usually occur in sizeable areas, and are located on nearly level topography. Other deep soils located in the level areas, developed from alluvium and outwash, are LaDelle, Gann, Oahe, Fordville, and Wessington. These soils are particularly important when considering irrigation potential.

A sandy outwash area is located in the vicinity of Cottonwood Lake in Spink County. The major soils in this area are Hecla, Hamar, Hecla-Till substratum, Maddock, and Wessington. This area also has a good potential for irrigation.

Land use for the area is 28 percent cropland, 70 percent pasture, and 2 percent other. Principal crops grown are corn, oats, and tame hay used for a feed base for livestock production, and wheat used as a cash crop.

Man-made lakes include Lake Louise, a recreational lake with good facilities for camping, fishing, and swimming. It is located on Wolf Creek about nine miles north of Ree Heights. Jones Lake is located on Turtle Creek about three miles south of St. Lawrence, and is primarily used for fishing. Redfield Lake, located on Lower Turtle Creek on the edge of Redfield, has limited use as a recreation area.

Twin Lake is a natural lake with water supplied from Turtle Creek by a diversion and channel. It is located in the lower part of the sub-basin about two miles northwest of Tulare. It is a popular fishing and hunting area.

Cottonwood Lake has many homes and cabins built along the shoreline. Some residents live there year-long. Public access is provided. It is located nine miles to the south and west of Redfield.

Problems and Needs

There are 16,800 acres of floodplain lands that are subject to flooding in this watershed. This includes 3600 acres of cropland and 13,200 acres of grassland. Flooding is primarily from snowmelt resulting in minor crop and pasture damage.

The town of Miller has a need for an additional water supply.

In this sub-basin, there are some areas of irrigable soils located adjacent and near the proposed Oahe Irrigation Canal. These areas are not a part of the present Oahe Irrigation Project. There are also sizeable areas of irrigable soils located in the lower reaches of Wolf Creek drainage. Evaluations indicate that the run-off from the Wolf Creek tributaries is not sufficient to irrigate a project size development.

Opportunities

Single-purpose flood prevention projects do not appear to be feasible for any watershed in this sub-basin. A single-purpose agriculture water management project for irrigation on Shaefer Creek watershed appears to be feasible providing additional water can be supplied from the proposed Oahe Irrigation Project. A structure site with adequate storage to irrigate approximately 1600 acres is available.

RAVINE CREEK

Description

Ravine Creek Sub-Basin comprises a total drainage area of about 174 square miles, of which 97 square miles are estimated as contributing. All of the contributing area is located in Beadle County, and enters the James River from the west at the city of Huron. The topography of the watershed is flat, and the non-contributing area consists of numerous shallow depressions. Elevations range from a high of 1300 feet to a low of 1250 feet.

The sub-basin is located in the Black Glaciated Plains Resource Area. The upland soils are medium-textured glacial till on level to undulating topography. These glacial till soils are Houdek, Bonilla, and Buse. About one-tenth of the area is mantled with sandy outwash ranging in depth from 2 to 15 feet. The sandy soils are predominantly Hecla, Maddock, Hamar, Embden, and Hecla till substratum. Tetonka, Cavour, Miranda, and Exline soils are developed in the areas with restricted drainage.

Land Use is 64 percent cropland, 28 percent grass, and 8 percent other. Principal crops grown are corn, oats, and tame hay used as a feed base for livestock production, and wheat used as a cash crop.

The only existing work of improvement is Ravine Lake located at the mouth of Ravine Creek in the city of Huron. Heavy use is made of a portion of the lake for swimming by residents of Huron.

Problems and Needs

The principal problem area in the sub-basin contains about 33,900 acres, of which 6700 acres have a drainage problem. This includes 2500 acres of cropland and 4200 acres of grassland.

Opportunities

A single-purpose agriculture water management project for drainage appears to be feasible. The principal benefits derived from a drainage project will be on cropland. These benefits will result from increased yields on the wet areas, and more efficient farm operation on 14,500 acres of cropland associated with the wet areas. Additional benefits will accrue on grassland.

SHUE, PEARL, REDSTONE, AND CAIN CREEKS

Description

Shue, Pearl, and Redstone Creeks drain to the James River from the east. Shue and Pearl Creeks enter the James River in Beadle County, Shue Creek northeast of Huron, Pearl Creek southeast of Huron. Redstone enters the James River north of Forestburg in Sanborn County. The upper portion of these sub-basins are adjacent areas forming a portion of the eastern boundary of the James River Basin. Cain Creek Sub-Basin drains to the James River from the west, entering the James River in Beadle County. The upper portion of Cain Creek forms a part of the western boundary of the James River Basin. These sub-basins are long and narrow, and comprise an area of about 1000 square miles.

These sub-basins are in the Black Glaciated Plains Resource Area. The soils are of the Houdek-Bonilla soil association. These soils are undulating to nearly level, well to moderately well drained, dark grayish brown, slightly acid loams. The land use for these sub-basins is about 60 percent cropland, 33 percent grassland, and 7 percent other. Principal crops grown are spring wheat, corn, oats, and tame hay, with some barley, rye, and flax.

A new recreation dam near Carthage on Redstone Creek was completed by the South Dakota Game, Fish and Parks Department in early 1965.

Problems and Needs

Flooding occurs to some extent in all of these sub-basins. About 16,000 acres are subject to flooding, but most of the areas flooded are in grass. Floodplains represent less than 2-1/2 percent of the total drainage area. Snowmelt causes flooding on the average of once every three years, and rainfall once every 10 years. Sediment and erosion damage is insignificant in these sub-basins.

There appears to be potential for some irrigation in the lower portions of these sub-basins. The areas of irrigable soils are scattered tracts adjacent to the main channels.

No need exists for additional municipal water; however, additional recreation facilities would be desirable in this area.

Opportunities

It appears there is no potential for project-type flood prevention programs in these sub-basins. There is a physical possibility of raising the water level in Lake Cavour by diverting water from the west fork of Pearl Creek. Additional water could be diverted from Pearl Creek into a large slough north of Iroquois.

SAND CREEK

Description

Sand Creek Sub-Basin comprises a drainage area of about 462 square miles, and enters the James River from the west near the town of Forestburg. This sub-basin includes an overflow area to the south and adjacent to the lower portion of Sand Creek. The drainage heads in the Wessington Hills on the west, and drains parts of Hand, Beadle, Jerauld, and Sanborn Counties. Except for some low hills along the western edge, the area is generally flat containing small scattered shallow depressions and sloughs. Drainages are fairly well defined with low stream gradients.

The sub-basin lies within the Black Glaciated Plains Resource Area. In the foothills located in Hand County, the shallow and moderately stony soils are Zahl, Williams, Buse, and Raber. The footslope soils consist of Lane, Houdek, Exline, Harriet, and LaDelle. Soil in the middle portion of the sub-basin developed from friable glacial till. The upland soils are Buse, Houdek, and Bonilla, and the soils in the poorly drained depressional areas are Cavour, Cresbard, Miranda, Hoven, and Tetonka. The soils on the better drained alluvium bottom lands are LaDelle and Lamoure. Soils associated with high water table are Exline complex which is saline.

Parts of the lower portion of the watershed east of Alpena and Woonsocket have sandy outwash materials of variable depths over glacial till. These soils include Hecla, Hamar, Maddock, Fordville, and Renshaw. In the poorly drained areas, the soils are Exline, Maple, Cavour, and Miranda.

Land use is 54 percent cropland, 39 percent pasture, and 7 percent other. Principal crops grown are corn, oats, and tame hay used as a feed base for livestock production.

Existing works of improvement include Rose Hill Lake, a small recreational lake with limited facilities located in Hand County, and about 25 miles of legal surface drains located in Sanborn County. These drains, installed about 40 years ago, have not been maintained and are of limited value.

Problems and Needs

The most significant problem in Sand Creek Sub-Basin is the overflow area in the vicinity of Woonsocket where approximately 15,000 acres are subject to flooding. The primary source of floodwaters originate from Sand Creek. The frequency of flooding occurs on the average of about once every five years. The area flooded is primarily grassland, with the principal damage due to ponding of water for long periods of time. Urban damages also occur to the town of Woonsocket.

There is a need for good water-based recreation facilities in the area.

Opportunities

There is an opportunity for a multi-purpose project for flood prevention and recreation in this sub-basin. Flood prevention benefits will accrue from grassland improvement and reduction of urban damages in Woonsocket. Minor off-site benefits will accrue on the James River floodplain. With amended legislation, a multi-purpose project appears to be feasible in this sub-basin.

JIM, JOHNSON, PIERRE, AND MORRIS CREEKS

Description

These sub-basins are located in Sanborn, Hanson, Davison, and Aurora Counties. All of the above sub-basins except Morris Creek drain to the James River from the east. Morris Creek enters the James River from the west just northeast of the city of Mitchell. These are some of the smallest sub-basins in the James River Basin, with drainage areas varying from approximately 100 to 220 square miles.

Johnson and Pierre Creeks are located in the Loess, Till, and Sandy Prairie Resource Area while the others are located in the Black Glaciated Plains Resource Area. The soils in Morris and Jim Creek sub-basins are on the southern edge of Houdek-Bonilla soil association. These soils are generally undulating to nearly level, well to moderately well drained, dark grayish brown, slightly acid loams. The principal soils in Pierre and Johnson Creeks are Houdek, Bonilla, Vienna, Cresbard, and Buse. These soils are nearly level to gently undulating, well to imperfectly drained, very dark grayish brown, slightly acid to neutral loams.

Land use in these sub-basins is about 60 percent cropland, 35 percent grassland, and 5 percent other. The principal crops grown are corn, oats, and tame hay. Diversified farming is the principal type of farming.

Twin lakes in Morris Creek Sub-Basin have good facilities. Several legal drainage systems outlet into Morris Creek.

Problems and Needs

Nearly all of the 3800 acres that flood are grassland. The floodplains represent about one percent of the total drainage area.

Water-based recreation facilities are needed.

Opportunities

Project-type flood prevention cannot be justified in these sub-basins. Morris Creek Sub-Basin has a reservoir site near the outlet in which the stored water could be used either for recreation or as a municipal water supply for Mitchell.

ROCK CREEK

Description

Rock Creek Sub-Basin has a total drainage area of about 292 square miles. It drains parts of Kingsbury, Miner, and Hanson Counties, and enters the James River from the east about one mile north of the city of Mitchell. This drainage is about 52 miles in length, and has an average width of about six miles. It heads near the town of DeSmet, flows directly south to the Hanson-Miner County line, then in a southwest direction until it enters the James River. The topography is generally flat to undulating. The main tributary is entrenched and is well drained. Elevations range from about 1750 feet near DeSmet to 1250 feet at its mouth.

The sub-basin is located in the Black Glaciated Plains Resource Area. The major upland soils are Bonilla, Houdek, Buse, and Vienna. Soils developed in the poorly drained areas are Cresbard, Cavour, and Miranda. Tetonka soils occupy the enclosed depressions.

Some of the soils at the lower end of Rock Creek and the adjacent James River bottom lands are suitable for irrigation.

Land use is 67 percent cropland, 27 percent pasture, and 6 percent other. Principal crops grown are corn, oats, and tame hay used as a feed base for livestock production.

Problems and Needs

An area of about 2600 acres of floodplain located near the town of Argonne is subject to flooding from run-off from both snowmelt and rainfall. Flooding occurs on the average of about once every two to five years. The average annual acres flooded are about 500 acres. The land use on the floodplain is 58 percent cropland and 43 percent pasture.

Opportunities

A multi-purpose project including flood prevention and recreation appears to be feasible under P. L. 566 in Upper Rock Creek. There is an opportunity to store municipal water for the city of Mitchell near the mouth of Rock Creek. A tributary of Rock Creek can be diverted into a chain of small lakes located in southwestern Miner County. With more water, one or more of these lakes could be improved as a recreation area.

FIRESTEEL CREEK

Description

Firesteel Sub-Basin has a total drainage area of about 583 square miles, of which 540 square miles are considered as contributing for years of normal run-off. It drains parts of Jerauld, Aurora, and Davison Counties, and enters the James River from the west just upstream from the city of Mitchell. The drainage heads in the Wessington Hills, and generally flows in an eastern and southeastern direction.

Elevation ranges from a high of about 2000 feet in the headwaters near Wessington Springs to a low of 1200 feet at its mouth. Except for the Wessington Hills area along the west boundary, the topography of the watershed is generally flat to undulating. The watershed is located in the Black Glaciated Plains Resource Area. The soils associated with the upper portion of the sub-basin including the foot slopes of the Wessington Hills are Lane, LaDelle, and Jerauld. The Lane and LaDelle soils are generally suitable for irrigation. Firesteel floodplain soils are composed of Lamoure and Exline. The southwest portion of the drainage is nearly level to gently sloping. The soils on the nearly level areas are Cresbard, Cavour, Miranda, and Beadle, with Houdek and Buse occurring on the more sloping areas.

Land use is 50 percent cropland, 44 percent grassland, and 6 percent other uses. Principal crops grown are corn, oats, and tame hay used as a feed base for livestock production.

Works of improvement installed consist of Lake Mitchell which is the source of water supply for the city of Mitchell. This lake is also a popular recreation area for residents of the area. Other lakes are Wilmarth, Fish, and Stoddard.

Problems and Needs

About 9500 acres are subject to flooding in this sub-basin, of which 12 percent is cropland and 88 percent is grassland.

A small tributary to Firesteel Creek having a drainage area of 4.5 square miles has about 600 acres subject to flooding. This tributary heads in the Wessington Hills, flows directly east, passing to the south just outside of the city limits of Wessington Springs. The area subject to flooding includes 400 acres of cropland and 200 acres of grassland. There are 160 acres of cropland flooded on an average annual basis. Crop and pasture damages amount to about 83 percent of the total damages.

There is a need for additional water-based recreation in this area. It is anticipated that the city of Mitchell will need additional water in the future. At present, the available storage in Lake Mitchell is being depleted by siltation.

Opportunities

A multi-purpose flood prevention and recreation project appears to be feasible for the small tributary near Wessington Springs. Physical sites are available above Lake Mitchell to store additional municipal and industrial water and to trap sediment.

ENEMY CREEK

Description

Enemy Creek Sub-Basin has an area of about 196 square miles, and drains parts of Aurora, Davison, and Hanson Counties. This drainage enters the James River from the west about eight miles southeast of the city of Mitchell. The watershed is about 30 miles long with an average width of about 6 miles. The topography is flat to undulating, and its drainages are well defined. Elevations range from a high of 1600 feet at the headwaters to 1200 feet at its mouth.

The sub-basin is located in the Black Glaciated Plains Resource Area. The upland soils consist of Beadle, Cresbard, Cavour, and Miranda. Those associated with sloping topography are Buse and Houdek. Floodplain soils consist primarily of Fordville and Renshaw.

Land use is 62 percent cropland 32 percent grassland, and 6 percent other. The main crops grown are corn, oats, and tame hay used as a feed base for livestock production.

Problems and Needs

Total floodplain land subject to flooding is about 3000 acres. Land use on the floodplain is 17 percent cropland and 83 percent grassland. Estimated average annual acres flooded include 800 acres grassland and 160 acres cropland.

A structure site located at the mouth of the drainage has sufficient storage capacity to irrigate about 1300 acres.

Opportunities

A single-purpose flood prevention project is marginal; one reason is a high percent of the benefits are from land enhancement. It is estimated that 27 percent of the grassland subject to flooding would be converted to cropland if flooding were controlled. Enhancement benefits are 60 percent of the total benefits. An irrigation project may be feasible near the outlet if further evaluations show a reduction of flood damages on the James River floodplains.

TWELVE MILE CREEK

Twelve Mile Sub-Basin has a drainage area of about 279 square miles. It drains parts of Davidson, Douglas, Hutchinson, and Hanson Counties, and enters the James River from the west about nine miles east of the town of Parkston. The tributaries of South Fork and Pony Creek enter Twelve Mile Creek near its mouth. The sub-basin is diamond shaped with a length of 28 miles, and an average width of about 9 miles. The general topography is flat to undulating. Drainages are well-defined, becoming entrenched in the lower reaches.

The sub-basin lies within the Loess, Till, and Sandy Prairie Resource Area. Bonilla, Houdek, and Buse are the major upland soils, while Cresbard and Tetonka occupy the nearly level and depressional areas. The alluvial soils on the stream bottoms and those of the James River floodplain at the junction with the tributaries have irrigation potential.

The land use includes 69 percent cropland, 25 percent pasture, and 6 percent other. Principal crops grown are corn, oats, and tame hay used as a feed base for livestock production.

Lake Dimock and Ethan Lake provide some water-based recreation for this area.

Problems and Needs

About 3200 acres of floodplain land are subject to flooding, of which 25 percent is cropland and 75 percent is grassland. Flood damages to the agriculture floodplain land are minor.

Pony Creek watershed is located in Twelve Mile Creek Sub-Basin. Pony Creek passes directly through the town of Parkston. Channel capacities for the reach through town are small, primarily due to the constriction of bridges and culverts. About every three to five years, property owners living adjacent to the creek receive damages, resulting from flood flows from both snowmelt and rainfall run-off. Property subject to damage includes 28 private homes, 18 other private buildings, city park, school athletic field, Legion Hall, City Hall, and two business establishments. During the flood of 1962, the National Guard was called out to assist in the emergency.

Pony Creek drainage area above Parkston is about 16 square miles. The topography is flat, and the main channel above the town of Parkston is shallow, and in some places is just a broad swale. After it passes through Parkston, the channel becomes entrenched to the point of entry into Twelve Mile Creek.

Physical sites are available for reservoirs near the outlet of Twelve Mile Creek. Soils adaptable for irrigation are found in the vicinity of the reservoir sites.

Opportunities

A single-purpose flood prevention project for the protection of urban property in Parkston appears to be feasible. Field investigations discovered no suitable sites for floodwater retarding structure sites above Parkston. Field surveys indicate it is possible to divert flood flows around the west and north edge of Parkston through a floodway. An irrigation project may be feasible near the outlet of Twelve Mile Creek if further evaluations show a reduction of flood damages on the James River floodplain.

DRY, PLUMB, WOLF, BEAVER, MUD, LONE TREE, PRAIRIE, AND DAWSON CREEKS

Description

These sub-basins are located in the lower part of the James River Basin. Wolf and Plumb Creeks drain south, entering the James River from the east. They drain parts of Miner, McCook, and Hutchinson Counties. Dry, Lone Tree, Dawson, Prairie, and Beaver Creeks drain a portion of Hutchinson, Bon Homme, and Yankton Counties. They enter the James River from the west. Mud Creek in Yankton County enters from the east.

All of the sub-basins are in the Loess, Till, and Sandy Prairie Resource Area. The major upland soils are Bonilla, Houdek, and Buse. Vienna, Cresbard, and Tetonka occupy the nearly level and depressional areas.

The land use includes 72 percent cropland, 23 percent pasture, and 5 percent other. Principal crops grown are corn, oats, and tame hay used as a feed base for livestock production.

Problems and Needs

About 9200 acres of floodplain lands are subject to flooding. The land use on these floodplains is 20 percent cropland and 80 percent grassland.

Investigations were conducted on Beaver, Dry, and Wolf Sub-Basins for potential irrigation projects. It was estimated that there were about 500 acres of potential irrigable land on Beaver Creek, 600 acres on Dry Creek, and 1000 acres on Wolf Creek.

Flood damages on the agriculture floodplain land are minor.

Opportunities

Flood prevention projects do not appear to be feasible. There is marginal potential for irrigation projects in Beaver, Dry, and Wolf Sub-Basins. These may be feasible if additional evaluations show a reduction of flood damages on the James River floodplain.

MISSION HILL

Description

The drainage area for Mission Hill Sub-Basin is about 11 square miles located in Yankton County. The outlet at the present time is one-fourth mile downstream of where the James River enters the Missouri River. This area is included as a part of this report because a proposed diversion would bring a portion of the area into the James River Basin.

The watershed is about nine miles long, and averages a little over a mile in width. Elevations range from 1370 feet at the headwaters to 1150 feet at the outlet.

The sub-basin is located in the Loess, Till, and Sandy Prairie Resource Area. The upland soils consist mainly of Bonilla, Houdek, Vienna, with Buse occurring in the steeper slopes. Floodplain soils are principally Volin, Haynie, Wann-Leshara, and Blenco.

Approximately 75 percent of the land in the sub-basin is used for crops, 21 percent for grass, and 4 percent for other. The principal crops grown are corn, oats, tame hay, and soybeans. Most farms are dryland; however, there is some irrigation on the floodplain.

Farmers living on the floodplain have constructed a ditch to alleviate their flood problems, but because of inadequate outlets, this has not proven satisfactory in years of above-average run-off.

Problems and Needs

The principal problem in this sub-basin is flooding of highly productive cropland. Approximately 600 acres of cropland and 120 acres of slough area are subject to flooding. Approximately six to eight homes in Mission Hill have flooded in the past. People in Mission Hill have indicated that the slough areas have had stagnant water many years, causing a severe mosquito problem and undesirable conditions adjacent to the town.

Opportunities

A single-purpose flood prevention project appears to be feasible. A diversion channel will alleviate the flood damages, and improve the area adjacent to Mission Hill.

MISSOURI RIVER SUB-BASINS

Description

The Missouri River Sub-Basins include the area west of the James River Basin and east of the Missouri River. All of the sub-basins drain generally in a westerly direction directly to the Missouri River. Some of the principal sub-basins are Medicine Knoll, Okobojo, Chapelle, Artichoke, and Swan. Other sub-basins are Little Cheyenne, Blue Blanket, and Crow.

The Land Resource Area is the Dark Brown Glaciated Plains. Soil associations of this area are Agar-Williams, Williams-Zahl, and Raber-Eakin. They are well drained grayish brown loams, clay loams, and silt loams occurring on undulating or sloping land. These soils are developed from loess and/or glacial till.

Land use in these areas range from 35 to 66 percent cropland, 29 to 63 percent grassland, and 2 to 7 percent other. The principal crop grown is wheat, with smaller amounts of corn, oats, barley, rye, flax, and tame hay.

There are a number of small man-made and natural lakes throughout the area. A few have limited recreation facilities and improvements.

Problems and Needs

Flooding in the Missouri River Sub-Basins is principally from snowmelt run-off. The agricultural damage is minor because the land use on the floodplains is almost all grass.

Gully erosion has occurred in the breaks adjacent to the Missouri River. Some sediment is being deposited in the Missouri River reservoirs from the area adjacent to the shorelines.

Municipal water needs within the Missouri River Tributaries are supplied mostly by ground water. In some areas, a shortage of livestock water is a problem during years of low run-off.

The Oahe and Big Bend Reservoirs form the western boundary for these Missouri River Sub-Basins. These reservoirs will provide recreation for a large part of the area. There is a need for water-based recreation in the Eureka, Hosmer, and Bowdle area.

A sizeable acquifer has been identified in the Bowdle-Hoven area. No effort has been made to develop the acquifer even though there are some irrigable soils.

Opportunities

There are numerous physical sites for structures within the Missouri River Sub-Basins. These sites were not surveyed because from the reconnaissance it appeared that structural costs would exceed benefits for flood and erosion control. Some of the sites could be developed for community livestock water supplies or recreation if desired by local people.

SPRING CREEK

Description

This sub-basin has a drainage area of about 755 square miles, of which 482 square miles are considered as contributing. It drains parts of Emmons and McIntosh Counties, North Dakota, and Campbell and McPherson Counties, South Dakota. Spring Creek flows from east to west, and enters the Missouri River about five miles south of the North Dakota-South Dakota state line. All of the non-contributing area is characterized by large depressions. During years with extreme run-off, the Hiddenwood drainage south of Spring Creek may contribute floodwaters. Because of the infrequent occurrence, the Hiddenwood area was not included in the Spring Creek evaluation.

The contributing area is about 50 miles in length with an average width of ten miles. The upper portion of the sub-basin has three separate drainages coming together near the town of Artas. Between Artas and Herreid, the sub-basin is long and narrow with no major side tributaries. Below Herreid, side tributaries enter Spring Creek from both sides. The topography is classified as undulating to rolling.

The sub-basin is located in the Dark Brown Glaciated Plains Resource Area. In the upper portion of the sub-basin, the sandy and gravelly outwash soils along the stream terraces are composed of Oahe, Renshaw, Akaska, and Maddock. The upland soils, developed from glacial till, are Williams, Zahl, and Raber. The lower reaches of the stream are bordered by loess mantled till of which Eakin and Agar are the major soils. At the outlet, the stream has exposed the underlying shale of Pierre, Promise, and Lismis soils.

The land use is 54 percent cropland, 40 percent grassland, and 6 percent other. Principal crops grown are corn, oats, and tame hay used as a feed base for livestock production, and wheat produced for a cash crop.

Existing works of improvement in the sub-basin include Lake Pocasse, a recreational facility, and a levee along Spring Creek for the protection of Herreid. Both of these facilities were built by the Corps of Engineers.

Problems and Needs

Spring Creek floodplain has about 10,000 acres subject to flooding which include 70 percent grassland and 30 percent cropland. The Sioux Railroad extending from Pollock to beyond Artas generally follows the course of Spring Creek for a distance of about 28 miles, and sustains a significant amount of floodwater damage. Structural sites and soils are suitable to develop a 1000-acre irrigation project.

Opportunities

A single-purpose flood prevention project is not feasible; however, a multi-purpose flood prevention and irrigation project appears to be feasible. In addition to the principal benefits, incidental recreational benefits would be realized.

Applications have been submitted for Public Law 566 projects in this sub-basin.

SIOUX RIVER AND VERMILLION RIVER BASIN AREAS

Description

A portion of the headwaters of the Sioux River Basin is located along the eastern border of the Oahe Conservancy Sub-District. It includes the eastern half of Day and Clark Counties. This area has extensive potholes and natural lakes with no defined drainages. The Vermillion River Basin segment is a small area in the southeast corner of Clark County. This is an area of land-locked small lakes and depressions without a defined drainage pattern. It is in the upper end of the Vermillion River Basin.

These areas are in the Loess, Till, and Sandy Prairies Resource Area. The soils are of the Poinsett-Sinai soil association. They are undulating, nearly level, well drained, slightly acid silt loams, silty clay loams, and silty clays.

The land use is 55 percent cropland, 43 percent grassland, and 2 percent other. The principal small grain crops grown are flax, oats, and wheat. Other crops grown are corn and tame hay. Diversified farming is carried out throughout the area.

A number of the natural lakes in this area provide recreation opportunities for fishing, hunting, boating, swimming, and camping.

Problems and Needs

There are no significant flood problems. Fluctuating water levels and sedimentation in the lakes are the principal problems of the area.

Opportunities

The major opportunity with USDA programs is to assist with the application of land treatment measures that will help reduce the accumulation of sediment in the lakes.

RESERVOIR SITES

Data was developed for over 100 reservoir sites which were considered for multiple or single-purpose development for flood prevention, irrigation, municipal water, recreation, fish and wildlife. Evaluations indicated only a portion of these sites had potential for project development. The approximate location of one hundred sites where data was developed is shown on Figure 19. Reconnaissance data for these sites is listed in Table 9. The location of other sites was recorded during the reconnaissance of the Study Area, but no data was developed because opportunities for project development were not evident.

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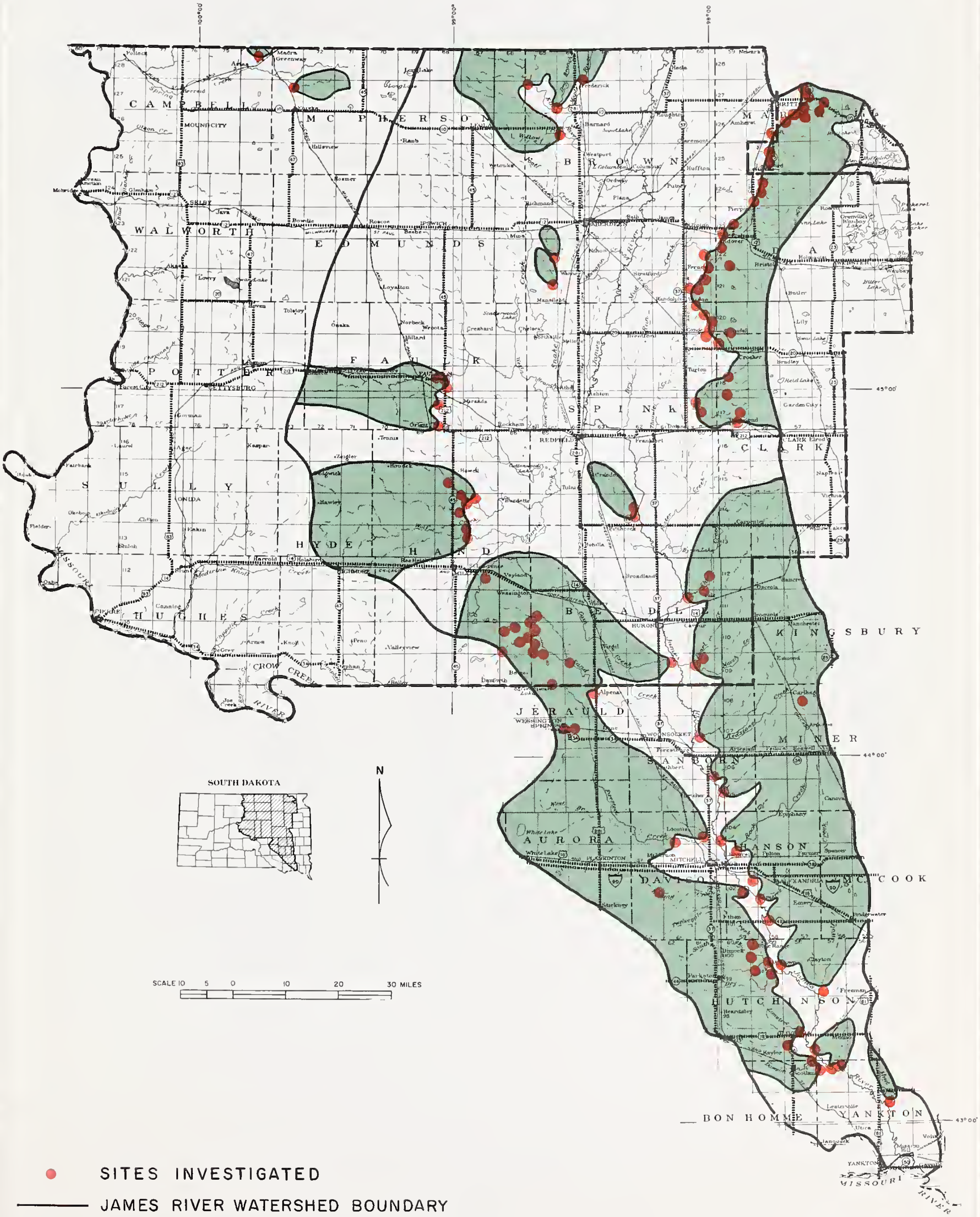
FIGURE 19
RESERVOIR SITES INVESTIGATED AND APPROXIMATE DRAINAGE AREA STUDY AREA



● SITES INVESTIGATED

——— JAMES RIVER WATERSHED BOUNDARY

— — — OAHE CONSERVANCY SUB-DISTRICT BOUNDARY

USDA-SCS-LINCOLN, NEBR. 1965

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TABLE 9

RECONNAISSANCE DATA ON RESERVOIR SITES, BY SUB-BASIN

Sub-Basin (Name)	Approx. D.A. (Sq.Mi.)	Depth Max. (Ft.)	Surface Area Max. (Acres)	Storage Max. (Ac.Ft.)
Cain	361	35	208	2,660
3/	71	19	95	580
Crandon-Hitchcock	18	33	556	3,449
Crow 2/	17	48	89	1,571
	2	42	50	876
	7	42	62	1,055
	4	28	37	351
	8	40	182	3,080
	17	55	202	4,750
	12	37	126	1,942
	9	45	153	2,742
	4	20	201	1,708
	8	10	221	1,543
	24	40	309	5,288
	3	50	46	831
	2	32	33	458
	2	36	32	417
Dry Run	7	20	95	600
Elm River	167	45	1,585	19,960
	378	30	3,475	24,900
	158	60	1,430	26,600
Mud	69	28	365	3,280
	14	20	195	1,830
	54	28	333	3,450
	7	30	62	680
	9	22	85	680
	49	44	400	7,550
	28	48	175	3,100
	24	26	118	1,056
	22	50	170	3,390
Pearl	277	33	635	6,068
	144	38	693	8,333
Shue	148	23	482	4,120
	172	41	770	9,415
	185	48	538	9,362

TABLE 9 (Cont.)

Sub-Basin (Name)	Approx. D.A. (Sq.Mi.)	Depth Max. (Ft.)	Surface Area Max. (Acres)	Storage Max. (Ac.Ft.)
Snake	298	22	340	2,515
	307	32	457	5,763
	26	9	490	2,490
	46	25	950	6,230
Timber	33	20	513	5,647
	7	20	59	493
	61	16	246	1,816
	11	18	60	517
	9	20	49	314
	11	25	119	885
	19	25	423	2,811
	4	40	59	487
	78	15	231	1,220
	78	23	311	2,040
	8	11	78	405
	9	15	206	1,524
	15	24	184	1,690
Turtle[1/]	117	25	343	2,556
	[1/] 376	20	274	2,123
	[1/] 144	25	341	2,510
	[1/] 147	35	830	9,304
	[1/] 7	15	228	2,343
	[1/] 73	25	190	1,848
Bloom[3/]	39	60	201	4,175
Dawson	75	80	759	20,730
Dry	121	80	919	35,019
Enemy	196	80	684	20,610
	77	28	816	7,450
Firesteel[1/]	555	27	822	8,474
	4	50	20	400
	6	36	78	1,056
Jim	67	30	262	3,554
	36	72	467	8,550
Johnson	47	50	222	3,660
Lone Tree	100	60	472	9,725
	24	60	320	5,083

TABLE 9 (Cont.)

Sub-Basin (Name)	Approx. D.A. (Sq.Mi.)	Depth Max. (Ft.)	Surface Area Max. (Acres)	Storage Max. (Ac.Ft.)
Menno & Wolf Creek				
Colony 3/	16	86	397	12,933
	23	87	430	13,233
	23	60	375	12,087
Morris	217	40	1,066	15,948
Mud	15	60	239	4,968
Pierre	81	55	387	8,607
Plano 3/	51	75	609	12,854
Plumb	50	90	792	16,190
Prairie	39	60	1,133	29,057
Redstone	308	55	360	7,200
Rock	261	35	375	10,480
	69	25	274	3,050
Sand	52	18	581	5,934
	30	100	158	4,445
	25	35	343	2,069
	11	14	916	7,526
	7	35	62	712
	7	35	96	1,013
	29	34	133	1,456
	12	24	116	1,190
	9	20	363	4,110
	51	90	150	5,652
1/	253	27	2,742	22,810
1/	285	45	7,640	124,000
Twelve Mile	108	40	423	8,715
	111	60	1,335	26,130
	279	60	1,167	26,847
	39	60	374	4,908
Wolf	495	80	2,192	56,296
Spring	64	30	145	1,813
		8	293	1,241

Source: River Basin Party Survey and USGS Quadrangle Sheets.

1/ Information taken from Bureau of Reclamation Topographic Sheets.

2/ Field Surveyed - Watershed Planning Party.

3/ Areas not identified on Sub-Basin Map.

POPULATION AND EMPLOYMENT

Changes in number of people (natural change and migration) are indications of a changing economy. Population is directly related to employment; therefore, the two are discussed as an introductory description of the economy of the Economic Study Area (Figure 20).

Population and employment, present and past, indicate the condition of the economy, and provide a limited insight into future conditions. Generally, increasing population and employment are considered indications of a healthy and growing economy. Decline in population suggests a faltering economy, although the end result for the remaining people may be a more prosperous and stable economy. Internal shifts of population suggest a reorganization of the economy is occurring. This Area has had both outward migration (a declining total population) and internal shifts (from rural to urban sector).

While the total population of the Area has declined since 1940, the population of the State of South Dakota and the United States has increased. The population changes in the State and the Area can generally be explained by differences in employment opportunities. Both the State and the Area have had a similar declining farm employment; however, the State as a whole has provided comparatively more non-farm employment opportunities. If the population of the Area is to increase, the urban areas must supply more non-farm employment opportunities.

There are 112 villages in the Area having a population of 2500 or less; these villages are classified as rural non-farm. Six cities in 1940 were classified as urban (population greater than 2500). People in the fringe areas of incorporated places not engaged in farming are included in total rural non-farm population (Table 12).

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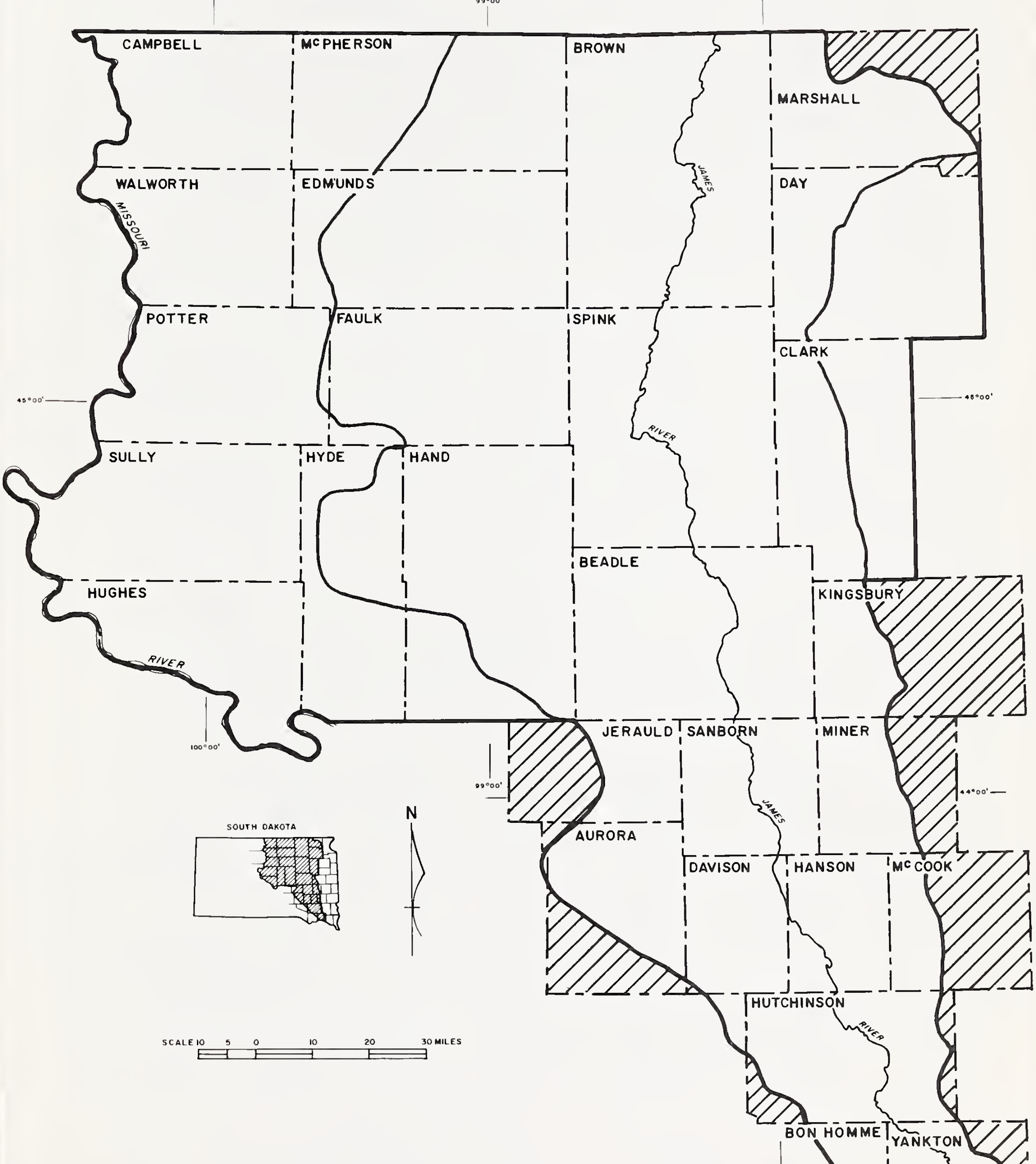
FIGURE 20

ECONOMIC STUDY AREA JAMES RIVER BASIN AND DESIGNATED MISSOURI RIVER SUB-BASINS SOUTH DAKOTA



ADDITIONAL AREA INCLUDED IN THE ECONOMIC STUDY AREA

ECONOMIC STUDY AREA IS COMPRISED OF TWENTY-SIX FULL COUNTIES. IT IS LARGER THAN THE AREA REFERRED TO AS THE "STUDY AREA" IN ALL OTHER SECTIONS OF THIS REPORT

USDA-SCS-LINCOLN, NEBR. 1965

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TABLE 10

TOTAL POPULATION: URBAN, NON-FARM, AND FARM
FOR 1940, 1950, 1960, AND PROJECTIONS FOR 1980, 2020

	1940	1950	1960	1980	2020
Total Population	244,580	240,006	235,536	246,000	398,000
Urban	52,619	68,297	76,518	107,000	241,000
Percent of Total	21.5	28.4	32.5	43.5	60.5
Rural	191,961	171,709	159,018	139,000	157,000
Percent of Total	78.5	71.5	67.5	56.5	39.5
Non-Farm	69,387	67,896	73,483	88,000	121,000
Percent of Total	28.4	28.3	31.2	35.8	30.4
Farm	122,574	103,813	85,535	51,000	36,000
Percent of Total	50.1	43.2	36.3	20.7	9.1

TABLE 11

PERCENTAGE CHANGE OF POPULATION SECTORS BETWEEN SPECIFIED YEARS

	1940 1950	1950 1960	1940 1960	1960 1980	1980 2020	1960 2020
Total Population	- 1.9	- 1.9	- 3.7	+ 4.2	+ 62.3	+ 69.1
Urban	+29.8	+12.0	+45.4	+39.4	+125.8	+214.9
Total Rural	-10.6	- 7.4	-17.2	-12.8	+ 13.5	- 1.0
Rural Non-Farm	-2.2	+ 8.2	+ 5.9	+19.5	+ 41.5	+ 64.7
Rural Farm	-15.3	-17.6	-30.2	-40.6	- 28.9	- 57.8

From 1940 to 1960, rural non-farm and urban population increased 6 and 45 percent, respectively (Table 11). Rural farm population decreased about 30 percent during the same period. The net result was a 4 percent decline in total population.

TABLE 12

NON-FARM POPULATION AND POPULATION OF INCORPORATED PLACES BY SIZE GROUP

Size Group 1/	Number of Places	Population 1940	1950	1960
Fringe Area 2/		13,856	16,768	17,525
999 or Less	97	34,640	33,487	32,230
1,000 to 2,499	15	20,891	22,799	23,728
Urban (2,500 or over)	6	52,619	63,139	76,518
Total Non-Farm Population		122,006	136,193	150,001

Source: U. S. Census of Population

1/ Grouped by population in 1940.

2/ Non-farm population which lives outside the boundaries of incorporated places.

In 1960, the farm population comprised 36.3 percent of total population as compared to 50.1 percent in 1940. Rural non-farm population was 31.2 percent and urban (cities over 2,500) was 32.5 percent in 1960, while in 1940 these segments accounted for 28.4 and 21.5, respectively. These shifts illustrate the impact of a changing economy, including the effects of a changing agriculture; however, population shifts do not explain why the economy is changing.

The pattern of employment changes are similar to the population changes (Table 13 and Table 14). Agricultural employment (farm) was 51.2 percent of total employment in 1940, but by 1960 only 35.1 percent of all jobs were agricultural. Agricultural employment decreased 26.2 percent while non-agricultural employment was increasing 43.5 percent during the 1940 to 1960 period.

TABLE 13

EMPLOYMENT BY MAJOR INDUSTRY GROUPS

	1940	1950	1960	1980	2020
Total Employment	77,242	90,725	83,268	87,300	142,300
Agricultural Employment	39,580	40,838	29,218	17,300	12,300
Non-Agricultural Employment	37,662	49,887	54,050	70,000	130,000
Manufacturing			3,826	4,600	6,100
Other Commodity Producing			5,239	6,500	13,500
Non-Commodity Producing			39,703	58,900	110,400
Agricultural Employment as Percent of Total Employment	51.2	45.0	35.1	19.8	8.6

TABLE 14

PERCENTAGE CHANGE OF EMPLOYMENT

Percent Change Between Specified Years

	1940 1950	1950 1960	1940 1960	1960 1980	1980 2020
Total Employment	+17.4	- 8.2	+ 7.8	+ 4.8	+ 63.0
Agricultural Employment	+ 1.2	-28.4	-26.2	-40.7	- 28.9
Non-Agricultural Employment	+32.5	+ 8.3	+43.5	+29.5	+ 85.7
Manufacturing				+20.2	+ 32.6
Other Commodity Producing				+24.6	+107.7
Non-Commodity Producing				+48.3	+ 87.4

Historical trends are not sufficiently consistent to provide adequate indications of future growth. Non-agricultural employment increased 32.5 percent from 1940 to 1950, and increased only 8.3 percent during the 1950 to 1960 period. The Area is not an independent entity with entirely internal economic growth stimuli. Therefore, historical trends in employment have been modified by national and regional trends to recognize external factors. Agricultural employment trends have, in addition, been modified by national and regional changes in production efficiency, and related to future production from the area. Agricultural employment is estimated to continue to decline, dropping 40.7 percent by 1980, and an additional 28.9 percent by 2020. Agriculture is estimated to provide approximately 17,300 jobs in 1980 and 12,300 in 2020. Agricultural employment includes only employees directly associated with production of agricultural commodities. Employment in related industries ("agri-business") is not included. As agriculture inputs per farm increase in the future to provide the projected increased agricultural production, these related industries will expand and provide additional employment.

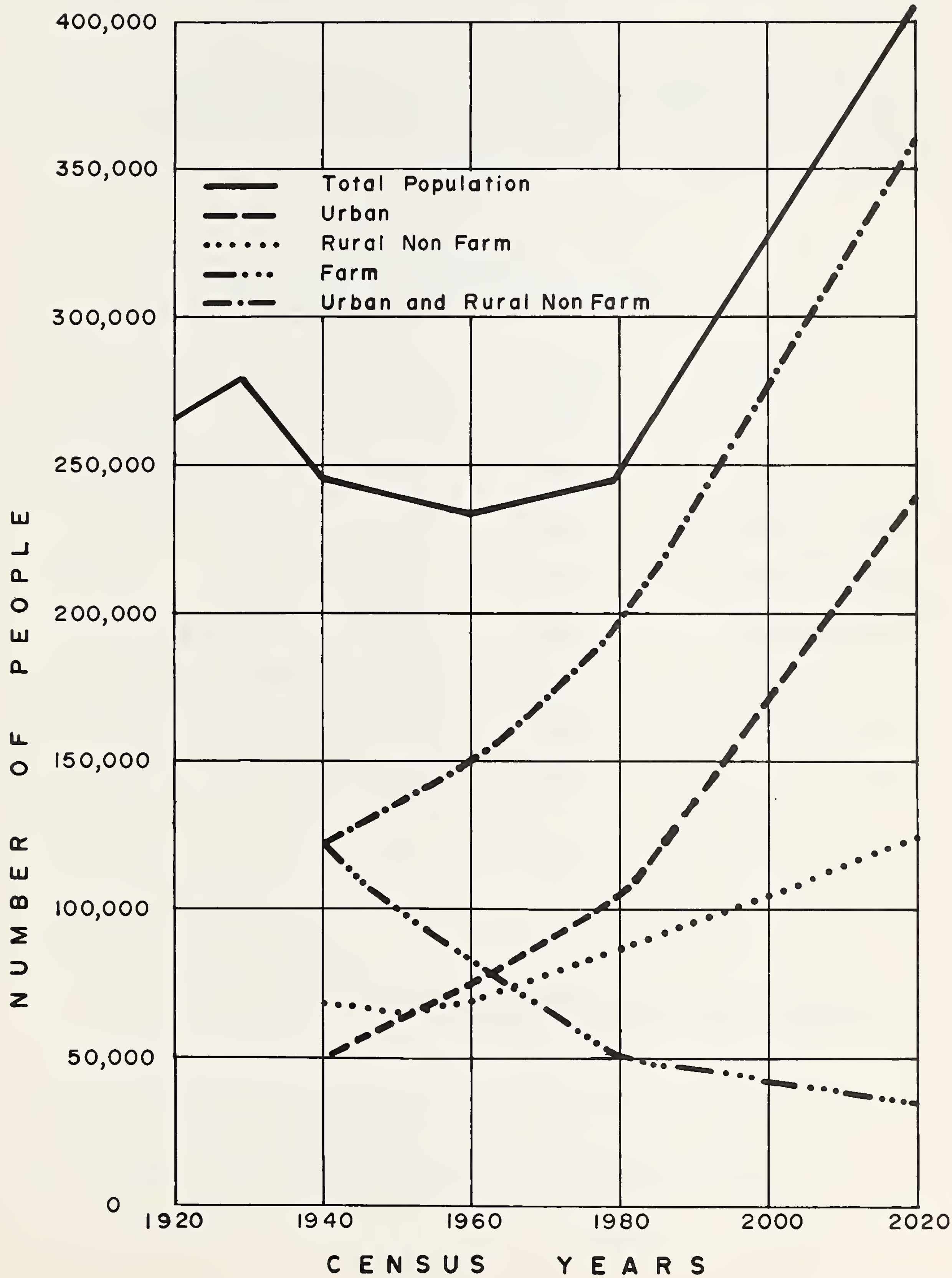
Non-agricultural employment is estimated to increase from 54,050 jobs in 1960 to 70,000 in 1980 and 130,000 by 2020, or increases of 29.5 percent and 85.7 percent, respectively. A major portion of this increase is in the non-commodity producing (service) sector of the economy. An increasing urban population requiring service, and a greater demand by the entire population for services, account for more jobs in the non-commodity producing section.

Population can be projected by assuming the ratio of employment to population in 1980 and 2020 will be similar to that existing in 1960. Rural farm population is estimated to decrease to 36,000 in 2020, a decline of 57.8 percent in 60 years (Figure 10). By 2020, urban population is estimated to be 241,000, a 214.9 percent increase. Rural non-farm population is estimated to be 121,000 in 2020, an increase of 64.7 percent.

The result of these changes is a total population of 246,000 in 1980 and 398,000 in 2020 (Figure 21). This represents an increase of 69.1 percent in the next 60 years. The rate of change indicated for the 1960 to 2020 period, while a reverse of 1940 to 1960 trend, is still a lower rate of increase than that projected for the Nation. Increasing employment and population does not, however, mean the Area will be more prosperous in terms of per capita net income. It should be noted that the increased employment and population are based on increased non-farm employment.

FIGURE 21

POPULATION



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These estimates of population and employment are essentially based on the current rate of resource development. The anticipated effect of projects such as the Bureau of Reclamation's Oahe Irrigation Unit has not been included.

No attempt is made to determine the location of the estimated population increase. It appears that most growth will occur in and around the six major cities with small increases in villages of 1,000 to 2,500. Table 15 shows population by Land Resource Areas in 1960. 1/ The pattern of population in 2020 will likely be similar.

TABLE 15

POPULATION BY LAND RESOURCE AREAS, 1960

	LRA 102	LRA 55	LRA 53	Study Area Total
Total Population	68,365	125,971	41,200	235,536
Area in Square Miles	5,198	11,433	6,488	23,119
Per Square Mile	13.2	11.0	6.4	10.2
Urban Population	9,279	52,750	14,479	76,518
Rural Population	59,086	73,211	26,721	159,018
Non-Farm	27,608	32,374	13,501	73,483
Farm	31,478	40,837	13,220	85,535

1/ Land Resource Area 53 includes data for LRA-63 and LRA-64 throughout this section of the report.

AGRICULTURE AND THE ECONOMY

Sales and Income

The economy of the Area is closely related to agriculture. Agriculture is the largest single source of personal income. Twenty-six percent of total personal income (Table 16) is from agriculture as compared to 25 percent for the State, 12 percent for the Upper Midwest States, and less than four percent for the United States.

TABLE 16

MAJOR SOURCES OF PERSONAL INCOME, 1963

	Thousands of Dollars	Percent of Total
Agriculture 1/	$119,088	26
Wholesale and Retail	80,356	18
Services	37,744	8
Government	54,218	12
Construction	25,604	6
Transportation and Utilities	17,864	4
Finance, Insurance, Real Estate	12,352	3
Manufacturing	15,139	3
Mining	555	2/
Other	657	2/
Property Income: Non-Farm) Transfer Payments) Military)	90,838	20
	$454,190	

Source: Business Research Bureau, State University of South Dakota.

1/ Total personal income to agriculture; includes wages and salaries, property income (rent), commodity sales, and government payments.

2/ Less than one percent.

Livestock Feeding Important Segment of Economy

- SCS Photo SD-L-100

Livestock Feed Reserves Important in Semi-Arid Climate

- SCS Photo Sd-4976-19

Agriculture has significant impact on the non-farm sectors of the area economy. In 1958, expenditures for lumber, building materials, hardware, and farm equipment were 19 percent of total retail sales in South Dakota (Table 17). This category accounts for only 7 to 10 percent of the total retail sales in most states. This difference in percentage "is primarily due to farm equipment expenditures". 1/ In the Area, 23 percent of the total retail sales were in this category (Table 18). The limitations of relating sales by retail store type to agricultural activities should be recognized. Agricultural expenditures are part of the sales of all categories.

TABLE 17

PERCENTAGE OF SALES BY STORE TYPE

Store Types	1948	1959
Lumber, Bldg. Mat., Hdw., Farm Equipment	23	19
General Merchandise	11	9
Food Stores	17	20
Automotive	17	18
Gasoline Service Stations	7	9
Apparel and Accessory	4	4
Furniture, Home Furn., etc.	4	4
Eating, Drinking Places	7	6
Drug Stores	3	3
Other Retail Stores	7	8
Total	100	100

Source: Business Research Bureau, State University of South Dakota.

1/ Business Research Bureau, State University of South Dakota, Bulletin 67, Page 6.

TABLE 18

RETAIL SALES BY STORE TYPE

Store Type	1939	1948	1948	1958 (Percent) 1/
	Sales (Millions of Dollars)			
Lumber, Bldg. Mat., Hdw., Farm Equipment	7.9	58.4	62.2	23
General Merchandise	7.7	27.4	23.5	9
Food Stores	11.4	39.8	53.0	19
Automotive Dealers	9.1	43.0	48.0	18
Gasoline Service Stations	7.7	15.0	21.4	8
Apparel and Accessory Stores	2.6	10.5	14.4	5
Furniture and Home Furnishings	1.1	9.7	8.7	3
Eating and Drinking Places	4.8	16.3	16.1	6
Drug Stores, Proprietory Stores	2.9	5.3	7.3	3
Other Retail Stores	3.5	15.5	16.2	6
Total	58.7	240.8	270.7	100

Source: Business Research Bureau, State University of South Dakota.

1/ Sales by store type as percent of total sales in 1958.

The general relationship of agriculture to the total economy of the area is further shown by comparing local and national trends in per capita income. Total personal income in the United States increased 122 percent, and per capita personal income 72 percent, from 1948 to 1963. In South Dakota, the total personal income increased 60 percent, and per capita income 33 percent, during the same period. In the Area, total personal income increased 34 percent from 1950 to 1960 (Table 19), and per capita income increased 37 percent, during the same period. The major reason for these differences is the greater dependence on agriculture as a source of income in the State and Area when compared to the Nation.

TABLE 19

PERSONAL INCOME, 1940, 1950, 1960

	1940	1950	1960
Personal Income 1/	95,260,000	327,967,000	440,311,000
Percent Change		+244%	+34%
Per Capita Income 2/	389	1,366	1,869
Percent Change		+251%	+37%

Source: South Dakota Business Research Bureau

1/ Personal income; includes wages and salaries, proprietor's income, property income and transfer payments less social insurance.

2/ Personal income divided by total population.

Transportation and Markets

Transportation facilities are adequate to meet the needs of the agricultural economy and provide access to markets and trade areas. The area is served by railroads, bus, truck, and air lines.

The Area has a network of federal, state, and local roads. This system includes 1,870 miles of hard-surfaced and 535 miles of gravel-surfaced roads in the South Dakota State Trunk Highway System. The Federal Interstate Highway System also crosses the Area.

The Area is within relatively economical shipping distance to major livestock markets. In addition, a number of local buying stations and auctions are located throughout the Area. Facilities for the handling of grain are available throughout the Area.

FARM CHARACTERISTICS

Number and Size of Farms

The number of farms has decreased since 1930, and the average size of farms has increased. This decline in number of farms has been the result of the consolidation of farm units as farm people moved to non-farm employment.

The Area had 23,282 farms in 1959, as compared to 27,161 in 1949, and 33,337 in 1930. This is a 14 percent reduction in the last ten years, and 30 percent in the last 30 years (Table 20). It is expected that a decline in number of farms will continue.

Farm numbers in the three Land Resource Areas have all declined at different rates. Land Resource Area 53 had the greatest decrease, losing 18 percent of its farm units in the last ten years, while LRA 55 and LRA 102 had decreases of 14 and 13 percent, respectively. The difference in rate of change between the LRA's is partially explained by differences in the type and original size of farm.

Number of farms are projected from estimates of total farm employment. This assumes that the number of employees per farm in 1980 and 2020 will be the same as in 1960. Since employment estimates for agriculture included consideration of changes in production efficiency as related to volume of production, the decrease in number of farms is compatible with increases in total production. It is estimated farm numbers will decline 40 percent in the 1960 to 1980 period, and an additional 29 percent between 1980 and 2020.

Changes in farm numbers reflect numerous changes in the agricultural structure, but basically these changes reflect increased output per man. Parallel to this is the ability of farmers to manage larger acreages, more livestock and equipment.

Average acreage per farm increased from 431 acres in 1930 to 617 acres in 1959 (Table 21). It is expected this increase will continue, and it is estimated that by 1980 average acreage per farm will be approximately 1,040 acres, and 1,450 in 2020.

TABLE 20

NUMBER OF FARMS BY YEAR AND PERCENTAGE CHANGE WITH PROJECTIONS FOR 1980 AND 2020

Area	No. 1930	% Chg. 30-40	No. 1940	% Chg. 40-50	No. 1950	% Chg. 50-60	No. 1960	% Chg. 60-80	No. 1980	% Chg. 80-20	No. 2020
LRA 102	11,122	- 7	10,329	- 4	9,869	-13	8,611	-47	4,702	-29	3,340
LRA 55	16,905	-13	14,761	-12	13,061	-14	11,196	-38	6,910	-29	4,912
LRA 53	5,310	-11	4,709	-10	4,231	-18	3,475	-36	2,213	-29	1,572
STUDY AREA	33,337	-11	29,799	- 9	27,161	-14	23,282	-41	13,830	-29	9,825

TABLE 21

AVERAGE ACREAGES PER FARM AND PROJECTIONS FOR 1980 AND 2020

Area	1930	1940	1950	1960	1980	2020
	Acres					
LRA 102	293	315	329	378	690	970
LRA 55	421	482	545	636	1,030	1,450
LRA 53	756	852	948	1,155	1,810	2,550
STUDY AREA	431	481	528	617	1,040	1,450

Type of Farm

Farms are classified by type on the basis of their major source of income. This classification indicates the major characteristics of the agriculture of the Area. These characteristics are influenced by such physical factors as soil, rainfall, temperature, and topography.

Economic factors influencing type of farming include population, population distribution, transportation, production cost, and commodity prices. Fundamentally, agriculture in the Area is oriented to production of those commodities (cereal, grain, and meats) which can be readily shipped to the Nation's population centers. Production of more perishable commodities, vegetables and milk, are limited to supplying local demand.

Nearly 70 percent of the farms in the Study Area has livestock as the principal source of income (Table 22). The 50 percent or more criteria that establishes type of farm does not measure the amount by which livestock sales exceed sales of other commodities. A comparison of livestock sales to total sales shows that Land Resource Area 53 has greater emphasis on livestock, especially beef cattle, than LRA 55. The principal agriculture components in LRA 102 are feed grains and livestock feeding.

TABLE 22

FARMS BY TYPE AS PERCENTAGE OF ALL FARMS, 1959

	Type of Farms 1/						
Area	Cash Grain	Other Field Crop	Poultry	Dairy	Livestock	Gen.	Misc. 2/
LRA 102	9.4	0.1	0.8	6.8	63.6	9.2	10.0
LRA 55	7.3	0.1	0.9	3.1	73.8	4.3	10.5
LRA 53	10.5	- -	0.2	2.8	70.4	6.9	9.2
STUDY AREA	8.6	0.1	0.7	4.4	69.5	6.5	10.1

Estimated from representative county data.

Source: U. S. Census of Agriculture, 1959.

1/ Farms grouped by major source of income.

2/ Farms which have no single segment of income representing more than 50% of total.

Farm Tenure

Approximately three-fourths of the farm operators in the Area owned at least part of their land in 1959 (Table 23). This is about the same as for South Dakota (73.5%), but slightly under the national average of 79 percent. There has been a tendency for an increasing proportion of farm operators to own at least part of their land.

The increase in the proportion of part-owners reflects the necessity for larger acreages to enable farmers to take advantage of economics of scale, and simultaneously the problem of acquiring the necessary capital. This is especially true of LRA-53 where livestock grazing is the major enterprise.

TABLE 23

TENURE OF FARM OPERATORS AND AVERAGE SIZE OF FARMS
BY TYPE OF TENURE, 1954 AND 1959

Area	All Operators 1954	All Operators 1959	Full Owners 1954	Full Owners 1959	Part Owners 1954	Part Owners 1959	Managers 1954	Managers 1959	Tenants 1954	Tenants 1959
Tenure of Farm Operators										
	- - -	- - -	- - -	- - -	Percentage	- - -	- - -	- - -	- - -	- - -
LRA 102	100	100	32.7	33.1	34.7	36.8	0.1	0.2	32.4	29.7
LRA 55	100	100	29.9	31.0	41.5	44.7	0.3	0.2	28.2	24.0
LRA 53	100	100	23.5	26.0	51.7	53.6	0.3	0.4	23.5	19.9
STUDY AREA	100	100	29.8	30.9	41.2	43.6	0.2	0.3	28.8	25.2
Average Size of Farm										
	- - -	- - -	- - -	- - -	Acres	- - -	- - -	- - -	- - -	- - -
LRA 102	350	380	260	280	450	490	2,300	2,470	310	330
LRA 55	560	640	380	430	740	840	1,960	1,770	460	510
LRA 53	1,020	1,160	690	710	1,280	1,490	2,080	4,020	760	860
STUDY AREA	580	617	390	420	790	890	2,100	2,620	460	500

Source: U. S. Census of Agriculture, 1959, based on representative counties.

Investment in Farms

Investment and changes in investment are difficult to accurately determine because of the simultaneous changes in inventory and dollar value. Available data indicates increases in investment in land, buildings, livestock, machinery and equipment, and grain and feed stocks. Total investment has increased both for the Area and per farm.

The total investment in agriculture in 1959 was approximately 1,258 millions of dollars (Table 24). The major portion is in land and buildings valued at $752 million. Livestock, machinery and equipment, and stocks of grains and feed represent an additional $506 million.

Agricultural investment in the Area can be expected to increase as land values go higher and inventories keep expanding. Larger farms and the substitution of machinery and equipment for labor will result in substantially greater investment per farm.

TABLE 24

INVESTMENT IN AGRICULTURE

	Investment Per Farm	Total Investment
	(Dollars)	(Million Dollars)
Land and Buildings 1/	$32,274	$ 752
Livestock 2/	9,433	220
Machinery and Equipment	8,320	194
Feed Stocks	3,942	92
	$53,969	$1,258

1/ U. S. Census of Agriculture, 1959.

2/ SRS Crop and Livestock Report, 1961.

Sales and Income

The volume and dollar value of sales of farm products in the Area has increased. The value of all farm products sold totaled 164 million dollars in 1949 and 190 million dollars in 1959, an increase of 16 percent (Table 25). The value of all farm products sold per farm averaged $8,049 in 1959 (Table 26).

Livestock sales represent 87 percent and crop sales 13 percent of total cash sales.

Twenty percent of the total number of farms in the Area had gross receipts of less than $2,500 per year. 1/ Twenty-five percent had gross receipts of $2,500 to $5,000 per year, 49 percent $5,000 to $20,000, and six percent had excess of $20,000 (Table 27).

Gross income to agriculture in 1959, including the value of products consumed on the farm and the rental value of dwellings, was $264 million. Net farm income is estimated to be $114 million or 26 percent of the total personal income of the Area.

TABLE 25

VALUE OF ALL FARM PRODUCTS SOLD
BY LAND RESOURCE AREAS

Area	1940	1944	1949	1954	1959
	Thousand Dollars				
LRA 102	12,887	40,114	54,690	58,075	63,555
LRA 55	14,837	54,619	74,178	81,971	78,749
LRA 53	5,553	24,200	34,738	36,896	48,179
STUDY AREA	22,279	118,933	163,606	176,942	190,483

1/ The farms with gross receipts of less than $2,500 include some part-time and retirement farms, and therefore overstate the number of low-income farms.

TABLE 26

AVERAGE VALUE OF ALL FARM PRODUCTS SOLD PER FARM
BY LAND RESOURCE AREAS

	1959
Land Resource Area 102	$ 6,850
Land Resource Area 55	7,650
Land Resource Area 53	11,770
Study Area	8,049

Source: U. S. Census of Agriculture, 1959

TABLE 27

FARMS CLASSIFIED BY GROSS RECEIPTS
BY LAND RESOURCE AREA

		Gross Receipts				
Area	All Farms	Over $20,000	$10,000-$20,000	$5,000-$10,000	$2,500-$5,000	Less Than $2,500
LRA 102						
Number	8,611	318	1,076	2,772	2,463	1,989
Percent	- -	3.7	12.5	32.2	28.6	23.1
LRA 55						
Number	11,196	616	1,791	3,717	2,788	2,284
Percent	- -	5.5	16.0	33.2	24.9	20.4
LRA 53						
Number	3,475	469	952	956	601	500
Percent	- -	13.5	27.4	27.5	17.3	14.4
Study Area						
Number	23,282	1,490	3,958	7,450	5,751	4,600
Percent	- -	6.4	17.0	32.0	24.7	20.1

Source: U. S. Census of Agriculture, 1959.

LAND USE AND PRODUCTION

Major Land Use

Analysis of the soil resources is based on the Conservation Needs Inventory. This inventory established the quality and quantity of land within the Area available for use in agricultural production.

There are 14,355,858 acres classified as farm land in the Area. The largest segment, 57 percent, of this land is utilized as cropland. Pasture and range account for 41 percent, and the remaining 2 percent is in woodlands and other uses such as farmsteads, lots, and wasteland (Table 28).

TABLE 28

INVENTORY ACREAGE BY MAJOR LAND USE BY LAND RESOURCE AREAS1/

Land Resource Area	Cropland	Pasture Range	Forest	Other	Total
102	2,001,035	786,447	26,467	85,206	2,899,155
55	4,105,498	2,450,238	44,748	91,639	6,692,123
53 2/	2,033,299	2,663,170	27,597	40,514	4,764,580
Total	8,139,832	5,889,855	98,812	217,359	14,355,858

1/ Conservation Needs Inventory of acreage and major land use.

2/ Includes 9,512 acres in LRA 54 and 363,155 acres in LRA 63.

Evaluation Soil Groups

From this basic data, the soils of the Area are grouped into 13 "Evaluation Soil Groups". Soils within each group have similar requirements, limitations, yields, and treatments.

These Evaluation Soil Groups are as follows:

Group A - Soils that generally are without hazards and limitations on use.

Group B - Soils predominantly on bottom land and in alluvial positions, and have wetness problems resulting from stream overflow or run-in water from adjacent lands.

Group C - Bottom land and depression soils having a wetness problem resulting from inadequate drainage. Some of these soils are affected by high water table but are rarely flooded.

Group D - Soils in enclosed depressions and on poorly drained bottom land having wetness problem resulting from ponding where no outlet exists.

Group E - Soils which are unsuitable for cropping because of stoniness, erosion, and steepness of slope.

Group F - Clayey soils with claypan development on slopes up to 3 percent.

Group G - Soils predominantly on slopes up to 3 percent without serious limitations except climate.

Group H - Same soils as F but on steeper slopes (3 to 9 percent).

Group J - Same soils as G but are on steeper slopes (3 to 11 percent).

Group K - Coarse-textured soils with low moisture storage capacity and considerably susceptible to wind erosion.

Group L - Same soils as K but on steeper slopes with higher susceptibility to erosion, and includes areas of dunes and hummocks.

Group M - Soils with thin surface over a dense compact sub-soil with very slow permeability and secondary erosion problems.

Group P - Soils moderately shallow over gravel, and are somewhat droughty.

The acreage and major use of these Evaluation Soil Groups are shown in Tables 29, 30, and 31.

TABLE 29

INVENTORY ACREAGE OF EVALUATION SOIL GROUPS BY MAJOR LAND USES

Land Resource Area 102

Evaluation Soil Group	Cropland	Pasture Range	Forest	Other	Total
A	493,178	73,767	3,701	12,117	583,763
B	9,488	2,146	- -	44	11,682
C	136,166	59,862	1,493	2,121	199,642
D	61,350	114,593	720	1,173	177,836
E	37,720	181,119	4,311	42,973	266,123
F	115,577	29,545	923	2,698	148,743
G	111,813	31,761	461	3,236	147,271
H	12,104	12,473	0	0	24,577
J	903,390	239,078	11,845	18,763	1,173,075
K	54,140	19,951	564	758	75,413
L	0	0	0	0	0
M	236	47	0	0	283
P	65,873	22,105	2,449	1,320	91,747
Total	2,001,035	786,447	26,467	85,207	2,899,155

TABLE 30

INVENTORY ACREAGE OF EVALUATION SOIL GROUPS BY MAJOR LAND USES

Land Resource Area 55

Evaluation Soil Group	Cropland	Pasture Range	Forest	Other	Total
A	- -	- -	- -	- -	- -
B	104,379	44,525	769	1,154	150,827
C	238,373	261,683	3,099	1,589	504,744
D	97,115	285,196	3,277	1,153	386,741
E	32,062	251,015	46	8,610	291,733
F	438,610	243,687	1,241	3,879	687,417
G	1,982,682	547,423	20,401	42,061	2,592,567
H	48,299	26,023	230	772	75,324
J	784,192	488,688	5,208	23,563	1,301,651
K	298,313	130,915	9,138	6,150	444,516
L	1,345	2,605	- -	- -	3,950
M	30,406	125,529	- -	- -	155,935
P	49,722	42,949	1,339	2,708	96,718
Total	4,105,498	2,450,238	44,748	91,639	6,692,122

TABLE 31

INVENTORY ACREAGE OF EVALUATION SOIL GROUPS BY MAJOR LAND USES

Land Resource Area 53[1/]

Evaluation Soil Group	Cropland	Pasture Range	Forest	Other	Total
A	- -	- -	- -	- -	- -
B	120,421	65,687	11,010	506	197,624
C	41,155	67,945	99	388	109,587
D	30,380	230,394	485	99	261,358
E	39,299	672,571	46	12,843	724,759
F	150,818	171,434	0	1,101	323,353
G	520,120	282,017	3,740	6,516	812,393
H	42,454	142,562	133	883	186,032
J	961,338	924,427	5,082	16,750	1,907,597
K	34,964	12,852	592	136	48,544
L	1,491	5,707	5,929	0	13,127
M	21,047	66,213	0	0	87,260
P	69,812	21,361	481	1,292	92,946
Total	2,033,299	2,663,170	27,597	40,514	4,764,580

1/ Includes 9,512 acres in LRA 54 and 363,155 acres in LRA 63.

Cropping Pattern

Cropland in the Area is utilized for the production of a number of crops (Table 32). These include the food grains, spring and winter wheat, and rye which utilize 17 percent of the cropland, and feed grains and roughages which utilize 71 percent. Minor crops, fallow, and idle acreage account for the remainder of the cropland acreage. The 5,779,000 acres of cropland used for feed grains and roughages, together with the 5,899,000 acres of pasture and range, account for over 80 percent of all land in agriculture uses.

The production from a major portion of the Area is marketed through livestock. Thus, a discussion of production from the farm lands of the Area is most meaningful when related to the livestock production. A discussion of projected livestock production requirements, as related to the production of livestock feeds and the effect on cropping patterns, is made in a latter section.

Currently 163,000 acres of land in Evaluation Soil Groups E and M are being utilized as cropland. These soils are not considered suitable for use as cropland because of erosion hazards and low productivity. Ideally, all of this land should be converted to other uses such as grazing. However, because of location and tract size, some of these soils are often cultivated in conjunction with the more suitable cropland soils.

Assuming that conversion of 80 percent of land in Evaluation Soil Groups E and M is feasible, then nearly 130,000 acres should be converted to non-crop uses.

Because of the large amount of land in the "current cropland not harvested category" which is suitable for production of crops, it is assumed that this conversion will be accomplished without reducing the acreage in crops. The cropping pattern is not changed from "current normal" except for the reduction in "cropland not harvested". The reduction in cropland not harvested is offset by an increase in the pasture and range acreage.

The 1980 and 2020 cropping patterns are assumed to remain basically the same as the "current normal" cropping pattern. As explained above, land conversion from crop to pasture is adjusted in the cropland not harvested category. Irrigation acreage is assumed to replace non-irrigated crop acreages, acre for acre. The 1980 and 2020 non-feed crop acreages are adjusted to meet projected requirements by shifting land in and out of the cropland not harvested category.

The validity of these adjustments is supported by the existence of more than one million acres of land in Evaluation Soil Groups A, G, and J which are currently cropland not harvested.

TABLE 32

CURRENT NORMALIZED ACREAGES OF CROPS AND PASTURE

	Land Resource Area			
	102	55	53	Area Total
Total Cropland	2,001,035	4,105,498	2,033,299	8,139,832
Nonirrigated Cropland	1,997,165	4,099,298	2,032,569	8,129,032
Corn for Grain	661,000	577,000	197,000	1,435,000
Corn for Silage	49,000	174,000	92,000	315,000
Sorghum for Grain	40,000	36,000	4,000	80,000
Sorghum for Forage 1/	10,000	34,000	21,000	65,000
Winter Wheat	1,000	38,000	61,000	100,000
All Spring Wheat	21,000	505,000	474,000	1,000,000
Oats	470,000	593,000	237,000	1,300,000
Barley	8,000	183,000	29,000	220,000
Rye	7,000	106,000	22,000	135,000
Flax	5,000	197,000	68,000	270,000
Soybeans	19,000	2,000	0	21,000
Other Crops	8,000	41,000	7,000	56,000
Alfalfa	196,000	505,000	199,000	900,000
Other Tame Hay 2/	31,000	76,000	183,000	290,000
Cropland Pasture	100,000	26,000	30,000	156,000
Cropland not Harvested	371,165	1,006,298	408,569	1,786,032
Crop Failure	- -	- -	- -	340,000
Summer Fallow	- -	- -	- -	326,000
Government Diversion	- -	- -	- -	995,000
Idle	- -	- -	- -	125,032
Irrigated Cropland	3,870	6,200	730	10,800
Corn for Grain	1,500	2,360	590	4,450
Alfalfa	750	1,610	45	2,405
Sugar Beets	1,550	1,860	- -	3,410
Sorghum for Grain	- -	370	- -	370
Cropland Pasture	70	- -	95	165
Pasture and Range	786,447	2,450,238	2,663,170	5,899,855
Improvable	376,000	996,000	1,470,000	2,842,000
Improved	222,000	341,000	259,800	822,800
Other	88,447	630,238	406,370	1,125,055
Cut for Hay	100,000	483,000	527,000	1,110,000
Forest and Woodlands	26,467	44,748	27,597	98,812
Grazed	6,467	11,748	9,597	27,812
Not Grazed	20,000	33,000	18,000	71,000
Other Land	85,206	91,639	40,514	217,359
Total Land in Farms	2,899,155	6,692,123	4,764,580	14,355,858

1/ Includes silage and dry forage.
2/ Includes all tame hay other than alfalfa.

Current and Projected Yields

The cropping pattern and the average and high-level management yield of each crop for each Evaluation Soil Group, including the yields of pasture and range, were estimated. The estimated yields for the Evaluation Soil Groups were then adjusted to agree with the current normal yield for the Area. This current normal yield (Table 33) was calculated from the 1939-62 record of total acreage and total production of each crop. A normalizing technique was used to remove the abnormalities caused by weather or other hazards which would make data for a single year unreliable as a base.

The high-level management yields were then adjusted to reflect the changes made during the process of normalizing in the average management yields. It is then assumed that these high-level yields represent the average yields in year 2000 (Table 33). Using this data on cropping patterns and yields by Evaluation Soil Groups, the production of crops in 1980 and 2020 was estimated.

TABLE 33

CURRENT AND PROJECTED NON-IRRIGATED AND IRRIGATED YIELDS

	Unit	Basin Average			Land Resource Area - 102			Land Resource Area - 55			Land Resource Area - 53		
		Current	1980	2020	Current	1980	2020	Current	1980	2020	Current	1980	2020
Non-Irrigated Crops													
Corn for Grain	Bu.	30	38	54	35	42	57	26	31	41	19	23	29
Corn for Silage	Ton	4.5	5.7	8.1	4.8	6.1	8.8	4.6	6.0	8.4	2.9	3.4	4.4
Sorghum for Grain	Bu.	34	43	63	36	47	67	35	44	65	22	27	40
Sorghum for Forage	Ton	5.0	6.4	9.2	5.4	7.0	10.0	5.0	6.6	9.7	3.3	4.0	6.0
Winter Wheat	Bu.	17	22	32	17	26	36	17	23	34	16	21	31
Spring Wheat (All)	Bu.	17	21	29	20	28	34	18	23	32	16	19	26
Oats	Bu.	35	39	48	41	47	60	32	36	44	28	30	35
Barley	Bu.	22	24	28	26	28	32	24	27	33	22	24	27
Rye	Bu.	18	21	27	18	22	29	18	21	27	17	20	25
Flax	Bu.	9	12	18	11	14	21	10	12	18	8	10	14
Soybeans	Bu.	16	20	30	16	20	30	--	--	--	--	--	--
Alfalfa	Ton	1.3	1.5	2.1	1.6	1.9	2.5	1.3	1.4	1.6	1.0	1.2	1.5
Other Tame Hay	Ton	1.2	1.4	2.0	1.8	2.1	2.7	1.4	1.5	1.8	1.0	1.2	1.5
Cropland Pasture	AUM	2.1	2.4	3.0	2.4	2.7	3.4	1.9	2.2	2.7	1.4	1.6	2.0
Irrigated Crops													
Corn for Grain	Bu.	--	--	--	80	93	119	75	87	111	65	76	97
Alfalfa	Ton	--	--	--	4.0	5.1	5.7	3.8	4.8	5.4	3.6	4.5	5.1
Soybeans	Bu.	--	--	--	31	36	45	--	--	--	--	--	--
Pasture & Range													
Improvable	AUM	1.1	1.2	1.6	1.4	1.5	2.0	1.3	1.4	1.9	.8	.9	1.2
Improved	AUM	1.6	1.8	2.3	2.0	2.2	2.9	1.7	1.8	2.4	1.2	1.3	1.7
Other	AUM	1.0	1.1	1.3	1.3	1.4	1.6	1.2	1.3	1.5	.7	.8	1.1
Cut for Hay	Ton	.76	.87	1.10	1.10	1.25	1.55	.8	.85	.95	.5	.65	.95

Irrigation

Irrigated acreage in the United States increased from less than eight million acres in 1900 to more than 33 million acres in 1959. It is expected to expand despite evidence of increasing scarcities of water supplies, competing water uses, and surplus agricultural production. An irrigated acreage of approximately 42 million is forecasted for 1980, an increase of 26 percent over 1959 acreages. It is expected that a large portion of the increase will occur in sub-humid areas as a supplemental irrigation because of production efficiency.

Irrigation in South Dakota has not expanded as rapidly as in other areas of the Great Plains. In 1959, less than one percent of South Dakota's total cropland was under irrigation, about 115,000 acres. Approximately 20 percent (22,000 acres) of this irrigated acreage is located east of the Missouri River which includes all of the Economic Study Area.

Development of irrigation in the Area is uncertain. While irrigation in South Dakota east of the Missouri River doubled every three years since 1945, the Area had only 9,000 acres of irrigated land in 1963 (Table 34). Irrigation development is affected by numerous factors, including development cost, available capital, crop yields, product prices, production cost, weather cycles, and availability of suitable land and water. The availability of suitable land and a water source of suitable quality and quantity is crucial in irrigation development.

Projection of the amount of irrigation that will ultimately be developed is hazardous when considering the limited economic and physical data available, lack of insight into future governmental policy, and political factors.

Reconnaissance survey, together with U. S. Geological Survey reports, indicate a total of 147,000 acres within the Area which have irrigation potential. This figure reflects only those areas having an adequate quantity of water available from surface and subsurface sources within the Area, and excludes consideration of potential use of any imported water, particularly Missouri River water. Further, the irrigable land considered excludes those lands under consideration for irrigation with imported water. 1/

1/ Consideration of project developments using imports of water from the Missouri River are excluded from this Study. Such projects are under consideration by other agencies and detailed reports are available. The major portion of the irrigable lands included in Missouri River projects does not have an alternative source of water available; therefore, these lands were excluded without significant effect on the analysis.

TABLE 34

IRRIGATION POTENTIAL

	Resources Available				Present Use of Resource Current Acreage Irrigated By Source of Water (1963)			Potential Development of Irrigation By Source of Water 7/		
Area	Land 1/	Acreage Ground Water 2/	Acreage Surface Water 3/	Total Water 4/	From Ground Water 5/	From Surface Water 5/	Total 6/	Ground Water	Surface Water	Total
LRA 102	406,000	10,000	8,000	18,000	1,100	200	1,300	8,900	7,800	16,700
LRA 55	1,396,000	77,000	12,000	89,000	4,900	1,600	6,500	72,100	10,400	82,500
LRS 53	575,000	36,000	4,000	40,000	1,200	0	1,200	34,800	4,000	38,800
STUDY AREA	2,377,000	123,000	24,000	147,000	7,200	1,800	9,000	115,800	22,200	138,000

1/ Land Suitable for Irrigation: Determined from Conservation Needs Inventory. Represents the acreage of LCU's by LRA considered generally suitable for irrigation if properly developed and drained.

2/ Acreage of Land Having Adequate Groundwater Supply for Irrigation: Estimated from studies of groundwater available by location (county basis). Areas under consideration by USBR are excluded.

3/ Acreage of Land Having Adequate Supply of Surface Water for Irrigation: Surface water availability as estimated in terms of acre-feet of flow based on 80 percent chance. The potential acreage of irrigation thus estimated assumes storage sites are available for all available surface water. This calculation also assumes that use of 80% chance flows leaves adequate water for other uses.

4/ Total Land Area Having Adequate Supply of Water for Irrigation.

5/ Distribution of irrigated acreage according to source of water was made on basis of State Water Permits.

6/ Determined by using 1959 Census, 1959 through 1963 S. D. Crop & Livestock Reports, and 1963 SCS Reports. County data was used to distribute irrigated acreage of Land Resource Areas.

7/ Potential development is the difference between the total of estimated available land and water and the quantity currently utilized.

The major portion (84 percent) of the irrigation potential is provided by groundwater which under present institutional arrangements would be developed by the individual farmers. The remainder (24,000 acres) would be developed using surface water run-off either individually or by small projects. Project-type development of the surface water is the most likely because of the necessity for storage and the limited amount of storage sites available.

Full utilization of irrigation potential would be achieved by year 2020 if irrigation is developed at a rate of 2,300 acres per year. However, in the past ten years, development has been at a rate of 700 acres per year. If this current rate of development continues, the irrigated acreage would be about 54,000 acres in year 2020.

Irrigation requires considerable adjustment on the individual farms adding this major enterprise. Increased investment, labor, management, and operating capital are necessary. Thus, the impact on individual farms is an important consideration. The magnitude of the impact is altered when approached from community or regional viewpoint. Currently, irrigated acreage is only 0.13 percent of total cropland in the Area. With full development, irrigated acreage would be approximately 1.80 percent of total cropland.

Since the type of development being considered here is private development by individual farmers or possibly a small group of farmers, it is unlikely that even full development of irrigation potential will materially affect the rate of adjustment in farm numbers or farm size. Present changes in farm size, farm numbers, and population will continue in about the same manner with or without this irrigation development.

Corn, alfalfa, and sugar beets are currently (1960-64) the major crops irrigated in the Area (Table 35). However, the probability of sugar beets or similar crops remaining in the irrigated rotation is uncertain. Economic production of sugar beets, vegetables, and other specialty crops is closely related to the availability of processing facilities. The opportunity for irrigation of these crops exists in many areas. Availability of processing facilities is not necessarily assured by development of irrigation. Closing of South Dakota's sugar beet processing plant in 1965 is indicative of the uncertainty of forecasting irrigation of specialty crops.

For the foregoing reasons, projected irrigation is considered herein on the basis of three major crops: Alfalfa, corn, and soybeans (Table 36). Crops such as sorghum and pasture can be substituted for corn and alfalfa without making major changes in the analysis. Sugar beets have been grown in this area in the past; however, a very small acreage, if any, was grown during the 1965 crop year.

If irrigation develops to full potential acreage by 2020, the gross value of production of irrigated crops would be approximately 15 million dollars. This is about three times the value of production by 2020 if irrigation continues to expand at current rates (Table 37).

TABLE 35

ACREAGE OF IRRIGATED CROPS BY LAND RESOURCE AREAS

	LRA 102		LRA 55		LRA 53		STUDY AREA	
	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent
Total Irrig.1/	3,870	100	6,200	100	730	100	10,800	100
Corn	1,500	39	2,360	38	590	81	4,450	41
Alfalfa	750	19	1,610	26	45	6	2,405	22
Sugar Beets	1,550	40	1,860	30	--	--	3,410	32
Sorghum	--	--	370	6	--	--	370	3
Pasture	70	2	--	--	95	13	165	2

1/ As reported on land use questionnaires for 1963 crop year.

TABLE 36

ESTIMATE OF IRRIGATION YIELDS AND CROPPING PATTERN
CONSIDERING ONLY THE THREE MAJOR CROPS

Area	Crop	Percent Crop Of Irrig. Land 1960-2020	Yield1/ 1960	1980	2020
LRA 102	Corn	80%	80	93	119
	Soybeans	10%	31	36	45
	Alfalfa	10%	4.0	5.1	5.7
LRA 55	Corn	65%	75	87	111
	Alfalfa	35%	3.8	4.8	5.4
LRA 53	Corn	60%	65	76	97
	Alfalfa	40%	3.6	4.5	5.1

1/ Assumes current yields under high-level management will be the yields under average management in year 2000.

TABLE 37

VALUE OF PRODUCTION[1/] FROM IRRIGATED LAND 1960, 1980, AND 2020 AT TWO RATES OF DEVELOPMENT

	1960	1980	2020
	- - - - - - - - Thousands - - - - - - - -		
At Current Rate[2/]			
Acres	9	23	51
Value	$629	$1,877	$ 5,123
At Possible Rate[3/]			
Acres	9	55	147
Value	$629	$4,439	$14,768

1/ Computed using 1960 estimate of cropping pattern for three major crops, projected yields, and current normal prices.
2/ Irrigation development at rate of 700 acres per year.
3/ Irrigation development at rate necessary for full development by 2020 (2,300 acres per year).

Projected Production Requirements of Livestock and Livestock Products

Projections of livestock and poultry production for the Area are related to projected national commodity requirements. The projected national commodity requirements are allocated to the Missouri River Basin States, then to the State of South Dakota, and finally to the Area. These allocations are made on the basis of historical trends in the share of national production produced by the region, state, and Area (Table 38).

Therefore, the projections for the Area are made without consideration of productive capacity but rather the level of production which must be achieved in order to maintain the projected relative position in the Nation's agriculture. This assumes the projected share of national requirements represents a reasonable allocation of production requirements among all regions of the United States.

Further, this allocation provides a benchmark to which the productive capacity of the Area can be compared. Such a comparison makes possible some tentative conclusions as to the activities needed to achieve this volume of production. If the productive capacity required to produce this volume exists, then it indicates the probable future level of production. For this portion of the Study, it is assumed the future competitive position of the Area will be relatively the same as at the present.

Projected production requirements of livestock and livestock products are converted to requirements for feed units (Table 39). The yield of feed crops are also converted to feed units. In this manner, the production requirements for livestock and livestock products are translated into requirements for land.

Table 40 shows the total feed units required to produce livestock and livestock products, and the total productive capacity of the land and water resources to produce feed. A small shortage of productive capacity occurs in 1980 with a surplus capacity by 2020.

TABLE 38

PROJECTED LIVESTOCK AND POULTRY PRODUCTION REQUIREMENTS

			Projected Requirements	
		Current	1980	2020
		- - - - - - - Millions - - - - - - -		
Beef and Veal	lv. wt. lbs.	411	656	1,036
Lamb and Mutton	lv. wt. lbs.	28	31	48
Pork	lv. wt. lbs.	302	333	514
Poultry	lv. wt. lbs.	23	26	41
Milk	lbs.	557	528	820
Eggs	number	81	62	95

TABLE 39

TOTAL FEED UNIT REQUIREMENTS 1/

	Current	1980	2020
	- - - - - - - - - -	Millions	- - - - - - - - - -
Beef and Veal	5,590	7,413	9,312
Lamb and Mutton	440	459	707
Pork	1,510	1,498	2,296
Poultry	58	52	83
Milk	668	475	743
Eggs	33	21	29
Total	8,299	9,918	13,170

1/ Feed units required to produce the livestock products do not include export of feed grains or roughages.

TABLE 40

REQUIREMENTS FOR AND SUPPLY OF FEED GRAINS AND ROUGHAGES

	1960	1980	2020
	- - - - - - - -	Millions	- - - - - - - -
Feed Units Required to Produce Area Livestock Products 1/	8,299	9,918	13,170
Feed Units Available for Export 2/	1,572	1,874	2,489
Total Feed Unit Desideratum	9,871	11,792	15,659
Total Feed Units Produced 3/	9,871	11,698	15,891
Balance	0	-94	+232

1/ Using projected share of U. S. requirements.
2/ The quantity shown for 1960 was available for export out of the area and may or may not have contributed to a surplus as requirement for export was not determined. The same relationship of this quantity to the quantity required for the Area livestock production was assumed for 1980 and 2020.
3/ Projected yields and current normal land use and cropping pattern with irrigation acreages increasing at present annual rate (70 ac/yr).

Projected Production of Non-Feed Crops

The production of non-feed crops is projected using the same procedure used for projecting livestock and livestock products. Results of this procedure are a level of future production which is equivalent to the Area's current agricultural position relative to the Nation's agriculture. Therefore, it can be assumed that this level of production is one that can be attained, resources permitting, without shifting the relative position of this area to other producing areas.

These projected levels of production requirements in the target years divided by the projected yields (Table 33) for those years indicate the acreage of cropland necessary for production of the quantity required. In total, the additional land necessary to meet these projected production levels for non-feed crop is relatively small. An additional 113,000 acres will be needed in 1980 to produce the non-feed crop projected production requirements. However, only 98,000 additional acres will be required by 2020 (Table 41).

TABLE 41

PROJECTED NONFEED CROP PRODUCTION AND LAND REQUIRED TO OBTAIN THE PRODUCTION

		Projected Production Requirement		
		1960	1980	2020
		Thousands		
All Wheat	bu.	17,859	24,979	33,468
Rye	bu.	1,757	2,526	4,020
Flax	bu.	2,352	2,332	3,316
Soybeans	bu.	304	767	1,179

	Projected Land Requirement		
	1960	1980	2020
	Thousand Acres		
All Wheat	1,050	1,189	1,154
Rye	98	120	149
Flax	261	194	184
Soybeans	19	38	39

POTENTIAL PRODUCTION AND PROJECTED PRODUCTION AS RELATED TO REQUIREMENTS

Sources of Additional Productive Capacity

The maximum productive capacity of the Area has not been measured in preceding sections. Conversion of land to a more intensive use, drainage, flood control, and irrigation are all means of increasing production from land and water resources. Resource development may be accomplished by project-type action or by individuals. Production increases may also occur as a secondary effect from flood control projects.

It is desirable to consider the efficiency aspects of obtaining this increased agricultural production. Due to the limited scope of the Study, this has not been done. The following discussion presents only the magnitude of the potential production increase by various sources. Potential production increase by irrigation is discussed in a prior section of this report.

Land Conversion

There are nearly three and one-half million acres of land in the Area currently utilized as pasture and range which are suitable for the production of crops (Table 42). This is land in Evaluation Soil Groups A, G, J, F, H, K, and P. However, because of limited adaptability of crops and management restrictions, Evaluation Soil Groups H, K, and P are not considered feasible for conversion to cropland. Of the remaining soils, some portions are in tract sizes and/or locations as to be uneconomical to utilize as cropland. It is estimated that approximately 80 percent of Soil Gropps A, G, J, and F, or 2,425,000 acres, could be converted to cropland if increased production is needed.

The potential production from converted land is analyzed in terms of feed units. The production of land used as pasture or range is translated from animal unit months into feed units. Corn is used to estimate the production of the land when utilized as cropland, and is translated into feed units. No consideration is given to the cost of obtaining feed units from corn or from pasture or range.

This conversion, grass to cropland, would by 1980 increase production of feed units by 185 percent. Pasture production is 1,372 million feed units as compared to 3,909 million feed units from corn. The increase of 1,842 million feed units is an addition of 22 percent to the total feed production capacity of the Area.

Since corn yield increase for 2020 is projected at a higher rate than pasture and range yield, the resulting production increase from conversion in 2020 is higher. Pasture production in 2020 would be 1,755 million feed units and corn production 5,540 million feed units. Thus, conversion of 80 percent of the land suitable (ESG's A, G, J, F) from grazing to feed grains would increase production of the Area by 24 percent in 2020.

TABLE 42

ACREAGE HAVING POTENTIAL FOR CONVERSION
FROM GRASSLAND TO CROPLAND BY LAND RESOURCE AREA

	Evaluation Soil Group				
Area	A	G	J	F	H-K-P
	Acres				
LRA 102	73,769	31,761	239,078	29,545	54,529
LRA 55	- -	547,423	488,688	243,687	199,887
LRA 53	- -	282,017	924,427	171,434	176,775
Total	73,769	861,201	1,652,193	444,666	431,191

Total of Evaluation Soil Groups A, G, J, and F: 3,031,827 Acres

Total land in all Evaluation Soil Groups: 3,463,018 Acres

Source: Conservation Needs Inventory

Drainage

In Evaluation Soil Groups C and D, approximately 1,640,000 acres have wetness problems associated with inadequate natural drainage. Of these soils, about 650,000 acres are in Land Capability Classes III and IV which would produce larger yields with adequate drainage. Assuming economic feasibility, drainage of these areas would provide additional agricultural production.

Currently 314,000 acres in Land Capability Classes III and IV are utilized as cropland. Assuming the land use remains the same and using corn as an estimator of the production change for the cropland portion of the Area, the feed units added to the productive capacity are estimated as follows: In 1980, an additional 250 million feed units could be available, and approximately 288 million feed units by 2020. This would add approximately 2 percent to the total productive capacity of the Area.

Additional production could also be achieved by conversion to cropland after drainage of land currently utilized as pasture or range. This conversion would add another 175 million feed units to the productive capacity of the Area.

Flood Prevention

Flood control also serves to increase productive capacity. Approximately 269,000 acres are subject to flooding in the Area. One hundred twenty-three thousand (123,000) acres of this land are currently utilized as cropland. The increase in yield of corn is used as a measure of the added feed production that would result from protection of this land from flooding.

Flood protection on all land subject to flooding would increase the productive capacity of the Area. Assuming present cropping patterns, production would increase by 37 million feed units. This increases the total feed unit production by 0.3 percent and adds 667 thousand dollars to the value of production.

Projected Production as Related to Resources

The productive capacity of the Area's resources, with consideration of projected yields and land use, is compared to the projected production requirements allocated to the Area. The resources have the capacity to produce the quantities needed to satisfy projected requirements. This can be accomplished at the current rate of resource development (Table 40 and Table 41). However, this conclusion does not preclude resource development for purposes of attaining other objectives or meeting other requirements. Nor does it preclude the reorganization or development of resources which lead to more efficient production.

Changes in Agricultural Economy as Influenced by Changes in Production Levels and Efficiency

The projections of changes in agricultural employment and population give an appearance of decline in agriculture in the Area. However, the changes in production and production efficiency must be considered.

Table 43 shows the increase in cash farm receipts from marketings. Cash farm receipts from marketings (gross income excluding government payments) are estimated to increase from 251 million dollars in 1960 to 331 million in 1980 and 511 million in 2020. These increases from 1960 to 1980 and 2020 are 32 percent and 120 percent, respectively.

Consideration of the increases in total cash receipts and the decrease in number of farms illustrates a better economic position for the farmers of 1980 and 2020. Annual cash receipts per farm are estimated to increase from $10,800 in 1960 to $23,900 in 1980 and $55,200 in 2020. This is an increase of 122 percent from 1960 to 1980 and 412 percent by 2020. Given the assumptions of this analysis, cash receipts per farm in the Area will increase nearly as rapidly as projected for the Nation. The Water Resources Council Ad Hoc Committee projects the Nation's farms will increase cash receipts per farm by 122 percent by 1980 and 456 percent by 2020.

This indicates the current rate of progress in the Area is sufficient to maintain its position in the Nation's agriculture, and to improve the economic position of the farmers at the same time.

TABLE 43

ANNUAL CASH FARM RECEIPTS FROM MARKETINGS

	1960	1980	2020
	- - - - - - - - - -	Dollars	- - - - - - - - - -
Total Annual Cash Receipts	251,000,000	331,000,000	551,000,000
Percent Increase in Cash Receipts from 1960		+32%	+120%
Cash Receipts per Farm	10,800	23,900	55,200
Percent Increase in Cash Receipts per Farm from 1960		+122%	+412%

USDA PROGRAMS FOR WATER AND RELATED LAND RESOURCE DEVELOPMENT

SOIL CONSERVATION SERVICE

The Watershed Protection and Flood Prevention Act, P. L. 566, authorizes the Secretary of Agriculture to give technical and financial help to local organizations in planning and carrying out watershed projects. Watershed projects are for flood prevention, agricultural water management, recreation, municipal and industrial water supply, and fish and wildlife development.

Watershed applications are submitted by local people to the Secretary of Agriculture through the South Dakota State Soil and Water Conservation Committee and the Water Resources Commission. After approval by the State, a Preliminary Investigation Report is developed to determine physical and economic feasibility. If this report is favorable and acceptable to local people, a Work Plan is developed. The Work Plan outlines the developments required to alleviate the problems and needs for the watershed. It also lists the responsibilities to be carried out by the local people and the Government.

Resource Conservation and Development Projects are authorized by the Secretary of Agriculture to assist in developing and carrying out plans for a program of land conservation and land utilization. These projects are initiated and sponsored by local people to provide additional employment and economic opportunities. This legislation provides local people the opportunity to use other programs to implement their objectives.

Application of land treatment measures is basic to all project developments. Public Law 46, the Soil and Water Conservation Program, and P. L. 1021, the Great Plains Conservation Program, provide technical planning and application assistance. The Great Plains Conservation Program also provides cost-sharing assistance. This assistance is provided through cooperative agreements with Soil and Water Conservation Districts to individual farmers and ranchers.

AGRICULTURAL STABILIZATION AND CONSERVATION SERVICE

The Agricultural Stabilization and Conservation Service administers the Agricultural Conservation Program under the Soil Conservation and Domestic Allotment Act of 1936. Through this program, the Government shares with farmers and ranchers the cost of carrying out approved soil building and soil and water conserving practices. Related wildlife conserving and forestry practices are included. ACP funds are available for emergency conservation measures in designated disaster areas to control severe soil erosion, floods, or other natural disasters.

FARMERS HOME ADMINISTRATION

The Farmers Home Administration provides credit and management assistance to farmers and ranchers who cannot obtain needed credit from other sources. Section 8 of P. L. 566 provides the authority for the Federal Government to make loans to local organizations and agencies to finance their share of costs for carrying out works of improvement on watershed projects. They also provide assistance to: (1) Operate, develop, and purchase family farms; (2) To build or improve homes or farm buildings; (3) To develop community water systems or carry out soil conservation measures; and (4) To carry out other related programs. The Agency operates under three principal statutes: Consolidated Farmers Home Administration Act of 1961, Housing Act of 1949, and Economic Opportunity Act of 1964.

FEDERAL EXTENSION SERVICE

The Federal Extension Service is part of the cooperative extension service partnership. Three levels of government - Federal, State, and County - share in financing, planning, and carrying out extension educational programs. Extension Service acts as the education agency of USDA and the land-grant universities. Extension specialists work with other agencies to provide local people information relating to soil and water conservation programs. This work has been an integral part of USDA since 1914, when the Smith-Lever Act became law.

FOREST SERVICE

The Forest Service, in cooperation with States, industry and individuals, and other Federal Agencies, provides forestry and related services in a number of programs and activities including: (1) The Agriculture Conservation Program, 1939; (2) Rural Community Development Service, Executive Order 11122; (3) Food and Agriculture Act, 1962; (4) Watershed Protection and Flood Prevention Act of 1954, P. L. 566; (5) Cooperative Forest Management Act, 1950; (6) Cooperative insect and disease control, Forest Pest Control Act, 1947; (7) Cooperative fire protection, Clarke-McNary Act (Sec. 2), 1924; and (8) Cooperative tree distribution for forests, shelterbelts, and woodlots, Clarke-McNary Act (Sec. 4), 1924.

In addition, the Forest Service conducts research activities in the broad field of forest and related range resource management and use. Research knowledge thus attained is available to all interested agencies, institutions, and individuals.

STATE PROGRAMS FOR WATER AND RELATED LAND RESOURCE DEVELOPMENT

Through the years, the South Dakota State Legislature has developed laws to organize special-purpose districts. These districts allow local people to plan, construct, operate, and maintain specific developments or projects concerning soil and water. The five special-purpose organizations are Conservancy Sub-Districts, Soil and Water Conservation Districts, Watershed Districts, Irrigation Districts, and Drainage Districts.

CONSERVANCY SUB-DISTRICTS

Conservancy Sub-Districts give local people authority to plan, develop, and conserve the total water resources to their optimum beneficial use by all rural and city people. These districts have authorities to enter into contracts and agreements. They can finance projects through taxation and the sale of water service. These authorities allow the Sub-District to assist other special-purpose districts as well as other groups. One objective of the Sub-District is to assist with the coordination of plans and programs developed by various Federal and State Agencies.

SOIL AND WATER CONSERVATION DISTRICTS

Soil and Water Conservation Districts develop policies and programs to carry out the conservation of soil and water on individual farms. They are authorized to enter into cooperative agreements with State and Federal Agencies and individuals for the planning and construction of land treatment measures. These districts do not have tax authorities.

WATERSHED DISTRICTS

Watershed Districts contract with Federal Agencies for planning assistance and construction of watershed measures. These districts can provide local financing through taxation or assessments to provide funds for construction, cost sharing, easements, operation, and maintenance.

IRRIGATION DISTRICTS

Irrigation Districts give local people the authority to cooperate and contract with Federal and State Agencies and with individuals to deliver irrigation water to their land. The irrigation law provides for financing the construction and maintenance of canals, ditches, reservoirs, and other structures necessary to store and deliver water.

DRAINAGE DISTRICTS

Drainage Districts are administered by County Commissioners. The commissioners can plan and construct drainage projects when authorized by the majority of the people in a designated area. Levy assessments are made against the land benefited to pay the cost of construction and maintenance.

PROCEDURES AND DATA DEVELOPED

GENERAL

A Work Outline consisting of four principal stages was developed to guide the conduct of the Study. They are called: (1) Preliminary Stage; (2) First Stage; (3) Second Stage; and (4) Report Stage. The Preliminary Stage was for training personnel, acquiring equipment and materials, testing procedures, and gathering general data. The First Stage or Reconnaissance Stage was to inventory, in the field, problems and needs of the various sub-basins. During the Second Stage, the Staff technicians developed semi-detailed data for priority sub-basins based on information collected during the First Stage. Data prepared for priority sub-basins was applied to adjacent areas to determine the physical and economic feasibility for project development. The final or Report Stage was set up to complete the Study by developing the written report.

FIRST STAGE

The First Stage was conducted by the Basin Staff members generally working in pairs. A reconnaissance survey was made for each sub-basin. During this survey, the mainstem and principal tributaries were crossed every one to three miles. At each crossing, physical data was recorded relative to channel size, floodplain width, land use, soils, and property on floodplains. General observations of upland areas were made to note erosion, cover, available storage sites, and other sub-basin characteristics. When available, local farmers were interviewed to obtain information concerning flood and other damages. Meetings with SCS technicians, Soil and Water Conservation District Supervisors, Extension Agents, and other local leaders were held to obtain information relative to local problems and needs.

Existing public recreation, fish and wildlife areas were checked in the field. Information was obtained on water supplies for towns and cities. Consideration was given to the need for additional recreation, municipal water supplies, and potential irrigation. Potential irrigation development involved consideration of storage sites and suitable soils.

Summaries were prepared for each sub-basin describing the problems and needs. Preliminary conclusions were made relative to the opportunity for project development, and priority sub-basins were selected.

SECOND STAGE

Several factors were considered in selecting sub-basins for priority study. Included in these factors were: (1) Geographic Distribution; (2) Variety of Problems and Needs; and (3) Good Project Potential. Initially, eleven sub-basins were selected for semi-detailed study. Studies were not completed on several of these because of physical or economic limitations. Data developed for these priority sub-basins was used to evaluate other sub-basins with similar problems and needs.

Evaluations for this report generally follow the procedures for P. L. 566 investigations. The following summaries by the various technical fields indicate the source, references, and procedures used for project evaluation:

ECONOMICS

Purpose	Source and References
Crop Yields	S. D. Technical Guide S. D. Crop & Livestock Reporting Service S. D. State University Publications U. S. Senate Select Committee on Agriculture U. S. B. R. Oahe Irrigation Report U. S. Census of Agriculture Field Observations and Interviews
Land Use	S. D. Crop & Livestock Reporting Service USDA Conservation Needs Inventory Field Observations and Interviews
Cropping Patterns	S. D. Crop & Livestock Reporting Service U. S. Census of Agriculture Field Observations and Interviews
Farm Sizes	U. S. Census of Agriculture
Production Costs	Cost of Operating Farm Machinery, SCS-EWPU, 1962 S. D. Crop & Livestock Reporting Service Field Observations and Interviews

Purpose	Source and References
Crop Prices	S. D. Crop & Livestock Reporting Service
Damageable Values	Field Observations and Interviews
Damage Factors	Field Observations and Interviews (County Commissioners, City Officials, Farmers) U. S. Corps of Engineers P. L. 566 Work Plans
Population & Employment	U. S. Census of Agriculture U. S. Census of Population S. D. Business Research Bureau Publications Ad Hoc Water Resource Committee Office of Business Economics Upper Midwest Economic Study Report
Recreation Facilities	S. D. Department of Game, Fish and Parks Field Observations and Interviews ORRRC
Stream Flow Regulation	U. S. Bureau of Reclamation
Livestock Feeding Efficiencies	U. S. Study Commission - Texas, Resource Requirements for Meeting Projected Needs for Agriculture Production.
Agriculture Production Efficiencies	Ad Hoc Water Resource Committee USDA Agriculture Information Bulletin No. 233
Sales and Income	U. S. Census of Agriculture U. S. Census of Population S. D. Business Research Bureau Publications

Procedures

Flood Prevention.-

Crop and Pasture.- Basic data developed for crop yields, cropping patterns, cost of production, and prices for agriculture products was used to develop net return curves for each Land Resource Area. Damages were based on the difference in net returns under flood-free conditions and under present flooded conditions. Damage from flooded conditions varied by sub-basins. One type of damage was reduced yields caused by delayed seeding due to snowmelt run-off; another type was damage to growing crops, and in some instances a combination of the two existed.

Benefits were based on a percent reduction of damages. The basis for determining the damages and benefits varied as to the intensity of the investigation. Hydrologic data was available on selected watersheds in each Land Resource Area. Extrapolation of this data and farm interviews provided data for evaluation on additional sub-basins.

Road and Bridge.- Damageable values were based on field observation, and included such things as types of roads and bridges and number of crossings per mile of stream reach.

There are distinct differences in these factors between Land Resource Areas. Basic data collected from County Commissioners in each county, together with data from planned P. L. 566 projects, was used to establish a dollar damage for each square mile of contributing drainage area. Benefits were based on percent of control of the contributing area.

Other Agriculture.- Damageable values such as kind and density of fences, farm buildings, etc., were made from field observations. Interviews provided damage from such things as weed infestation and debris. From this basic data, other agriculture damages were computed on an acre-flooded basis by each Land Resource Area. Other agriculture damages are generally greatest from snowmelt run-off. Benefits were based on reduction of acres flooded.

Urban.- Analysis of urban damages was on an individual sub-basin basis, and no attempt was made to extrapolate data. Each sub-basin in which this damage was significant had hydrologic data available. The U. S. Corps of Engineers' report of damage to residential property by depth and value was used as a basis for these evaluations.

Agriculture Water Management.-

Irrigation.- Net return curves were developed by Land Resource Areas for present cropping patterns and yields. Cropping patterns under irrigation were developed, based on the predominant type of agriculture in each LRA. The basis for determining benefits were on the first increment of production, although the cropping pattern developed in all LRA's reflected a livestock economy. From this data, a net return per acre by LRA from irrigation was developed. This net return per acre was extrapolated to other sub-basins in which less intensive studies were made.

Drainage.- Benefits from drainage were based on increased production of wet areas and reduced production costs on areas associated with the wet areas. Two sets of net return curves were developed. One set reflected the cost of production where adequate drainage had not been completed, and the other reflected where drainage had been accomplished. Difference is the net reflected efficiency gains to the associated area. Net returns from increased yields were based on the average yields of present wet areas, and the yields of these areas after drainage. Net return curves were developed for each LRA for benefits that could be expected from drainage.

Non-Agriculture Water Management.-

Recreation.- Recreation benefits were not developed on a Land Resource Area basis. Basic data developed as to population density, existing facilities, use of facilities, and average use of recreation areas, if adequate facilities were available, provided a basis of determining need for further development. Proposed developments by other agencies of groups were considered when determining additional needs. Benefits were evaluated within a 50-mile radius; however, the principal use was from a 15-mile radius.

Stream Flow Regulation.- This analysis was made a part of a multi-purpose development in connection with the USBR Oahe Irrigation Project. Benefits were evaluated on regulating flood flows on the main stem for use by the USBR. The prolonged flow made possible by controlled release from floodwater retarding structures would reduce costs of pumping irrigation water for the USBR project.

Current Normal Cropping Pattern, Current Normal Yields, and Projected Yields.-

Current normal cropping patterns and yields were obtained from data compiled by the South Dakota Crop and Livestock Reporting Service for the years 1939 through 1962. In addition, diversions under the Feed Grain Program and Conservation Reserve Program are computed from Agricultural Stabilization and Conservation Service records. Regression curves were fitted to this data to determine the current normal harvested acreage, yield and total production for the Economic Study Area.

The current normal acreages and yields were used as a control in the estimation of cropping pattern and yields by Evaluation Soil Groups (ESG). Work Unit Conservationists for SCS divided the crop acreages between the Land Resource Areas in the county and among the Evaluation Soil Groups. The result is the best estimate of how the various soils (as defined in ESG's) of the Study Area are utilized.

Two levels of yields were estimated for each crop in each ESG in each Land Resource Area. The first yield estimate is the average yield achieved by all farmers assuming average management and practices on the particular soil group. The second yield estimate is the high-level yield which is defined as that yield achieved by the top five percent of the farmers.

The average yield estimates by ESG's were multiplied by the current normal acreage of each crop to compute total production for the Economic Study Area. Total production is then compared to the current normal production for that crop and adjusted to equal the current normal production. The yields for each ESG were adjusted to reflect the changes made in total production. The result is current normal yields for each crop on each soil group.

The high-level yields were adjusted by the same percentage as the average yields. This adjusted high-level yield is also the projected yield for the year 2000. Yields for 1980 and 2020 are determined from a linear relationship of current normal yields and projected yields for year 2000.

The data on irrigation yields using the above procedure is inadequate to create a reasonable normal or projected yield. Therefore, yields to irrigated crops are adjusted on the basis of 1953-1962 average yields. Projected yields are based on estimates from other sources.

Determination of Agricultural Commodity Requirements.-

In order to measure the adequacy of the resource base for future production of agricultural commodities, some logical share of future national requirements to be produced by the Study Area must be determined. This determination requires projections of future volume of agricultural production and a method of allocating production to given areas.

The projections of national requirements for agricultural production are based on national projections of population, per capita income, industrial uses of agricultural commodities, livestock feeding efficiencies, and net exports. The national requirements were then allocated to the Northern Plains States on the basis of historical share and expected changes. This percentage allocation is controlled by simultaneously allocating to all regions in the Nation. This allocation is made for the year 1980, and the percentage share is retained for the year 2020. Allocation of projected production for the Northern Plains is then allocated to South Dakota and to the Study Area, respectively, on the basis of historical shares of production.

File Data

A separate folder is available for each selected sub-basin containing data used for the economic study and evaluation.

A file containing the basic data developed and used for other sub-basins is available. This data includes the following by Land Resource Areas: (1) Crop yields; (2) Cropping patterns; (3) Land use; (4) Size of farms; (5) Cost of production; (6) Gross and net returns per composite acre for: (a) Dryland, (b) Irrigation, (c) Drainage; and (7) Road and bridge damages.

Other data includes: (1) Flood damage rates used for: (a) Agriculture lands; (b) Urban areas; (2) Irrigation costs; (3) Recreation basic data; (4) Storm weight factors for seasonal distribution; and (5) Description of Evaluation Soil Groups.

A summary sheet is in the file appendix listing all the sub-basins in the Study Area. Data shown in the summary is floodplain acres by land use, existing property subject to damage, and estimated annual damage for all categories used in economic evaluation procedures.

ENGINEERING

Purpose	Source and References
Topography	USGS Quadrangle Maps Field Surveys U. S. Army Maps USBR Topographic Maps
Drainage Areas	S. D. Highway Planning Maps U. S. Army Maps USGS Quadrangle Maps
Sediment Rates	S. D. Technical Guide National Engineering Memorandums
Design Data	SCS National Engineering Memorandums SCS National Engineering Handbooks
Construction Costs	SCS Cost Estimating Guide for South Dakota Local Contractors S. D. Watershed Operations
Irrigation	USBR Oahe Irrigation Project

Procedures

Design Criteria.-

Structures considered in this Study were classified into three classes: (a), (b), and (c). A number of factors are considered when classifying a structure.

Individual evaluations were made to determine storage requirements for sediment, conservation, and flood prevention. Fifty-year sediment storage was provided in all structures. Permanent storage in conservation pools was provided as required for water supply, recreation, and/or fish and wildlife. Temporary flood prevention storage was determined from the structure classification.

Emergency spillways were considered for all structures. It was assumed that these spillways to control and convey extreme storm run-off around the structures were of the vegetated type. Principal spillways were planned with a riser and barrel constructed from monolithic concrete or concrete pipe. Release rate through the primary spillway was determined by the downstream situation. Drawdown tubes to drain the reservoir were considered for all structures. For flood control, the principal spillway would normally be ungated, but gated spillways would be used on permanent storage pools.

Channel improvement capacities were determined from drainage curves or routed peaks. Designs were made using recognized engineering methods.

Physical data for all structure sites were obtained from topographic maps and field observations. Many structure sites were located in areas where USGS quadrangle maps gave complete coverage. In other areas, sites were surveyed in the field and topographic maps developed.

Centerline profiles were drawn from these topographic maps. Centerlines from USGS maps were checked in the field for many sites. These profiles were used to compute fill yardage on proposed structures in selected sub-basins. Stage-storage and stage-area curves were also computed from topographic maps for each reservoir site evaluated. Drainage areas for each proposed site were planimetered either from topographic maps or highway planning maps for South Dakota.

Cost Estimates.-

Costs were computed for individual structures in the selected sub-basins. The six principal items considered for each structure were: (1) Fill yardage, including core trench and stripping; (2) Principal and emergency spillways; (3) Drawdown works; (4) Foundation drains; (5) Seeding and riprap; and (6) Fencing. The estimated cost for these items was based on present construction costs in South Dakota. The total of these individual items represented the engineer's estimate. To determine the estimated installation cost, a percentage was added to the engineer's estimate for contingencies, engineering services, and other costs. This percentage varied by project size and location.

Cost curves were developed using data developed from the selected sub-basins, Watershed Work Plans, and other sources. From these curves, it was possible to estimate costs for other sub-basins in terms of cost per acre-foot of storage or cost per square mile of drainage controlled.

Land development costs for irrigation were computed to include land leveling, farm distribution systems, drainage, and other structural measures. These costs were used on the basis of a dollar per acre of irrigated land. Project distribution systems and pumping costs were also developed and used on this basis.

File Data

Material recorded on standard size engineering sheets (21' x 30') are as follows: (1) Sub-basin base maps; and (2) Topographic maps of reservoir sites with stage-storage data. County highway maps with sub-basin boundaries and First Stage observation points are filed. Other engineering file data by sub-basins includes field survey notes, channel and flood-plain cross-sections, channel profiles, structure centerline profiles, and stage-storage curves. Preliminary design data and cost estimates for certain structural measures are a part of the engineering file.

HYDROLOGY

Purpose	Source and References
Drainage Areas	County Highway Maps USGS Quadrangle Maps Field Reconnaissance
Hydrologic Soil Groups	S. D. State University, Generalized Soil Map F. S. 134A S. D. Technical Guide
Vegetative Cover and Condition	S. D. Crop & Livestock Reporting Service Field Reconnaissance

Purpose	Source and References
Stream Flow Data	USGS Water Supply Papers
Precipitation	U. S. Weather Bureau, Daily Climatological Bulletins and Technical Paper No. 40
Evaporation	SCS NEH-4 Hydrology
Channel and Floodplain Cross-Sections	Engineering Field Surveys
History of Flood Events	Interviews with Local Residents Local Newspaper

Procedures

Sub-Basin Drainage Area.-

In every sub-basin within the Study Area, there are certain areas that classify as non-contributing to streams. These areas vary from a few square miles in the lower reaches of the James River to several hundred square miles in the central and northern portion of the Study Area. Non-contributing areas are characterized by numerous small and large depressions. The large and deep depressions are commonly referred to as prairie potholes, and can generally be blocked out in large areas. The small and shallow depressions are more scattered. Maps do not show all these areas, and in some cases they are not easily detected in the field.

Table Number 3 in this report shows the estimated contributing drainage area of each sub-basin. These areas were estimated from available maps and by a limited amount of field reconnaissance. In some instances, these contributing areas will vary considerably from those that are shown in water supply papers. It is important to point out that these depressional areas do exist, and could have a significant effect in estimating water yields and storm run-off used in the design of any structural measure.

Run-Off Curve Numbers.-

Procedures as outlined in SCS hydrology Handbook, Section 4, Supplement A, were used to obtain run-off curve numbers. The percentage of different hydrologic soil groups and the types and conditions of vegetative cover for each sub-basin were used to arrive at a weighted average run-off curve number.

Water Yields.-

In estimating water yields for 80 and 50 percent chance of occurrence for each sub-basin, the following information and procedures were used:

1. Only tributaries having stream gage records for ten years or longer were used.

2. The drainage area above each stream gage that would contribute for years of average run-off was estimated. For drainage having large natural or man-made lakes, adjustments were made to account for net annual evaporation loss.

3. For each tributary having stream flow records, total annual run-off by water years was plotted, and a frequency curve drawn to obtain values for an 80 and 50 percent chance.

4. For sub-basins having no stream flow records, extrapolation of data from gaged sub-basins was used. Adjustments were made to reflect location, size, soil cover complex data, and other characteristics.

5. A water yield chart noted in SCS South Dakota Engineering Handbook for Work Unit Staffs was used for sub-basins where data from stream flow records was not applicable.

Storm Run-Off.-

All stream flow records were studied for storm run-off from snowmelt and rainfall. In all cases for the period of record, the greatest amount of run-off (volume) and the maximum peak discharge resulted from snowmelt run-off. These records were for drainage areas of 200 square miles or more. The reverse is usually true for small areas of less than 50 square miles. Also field interviews indicated that flooding was greater and occurred more frequently from snowmelt run-off than from rainfall run-off.

Data from stream flow records was plotted on log-log paper and curves were drawn to show the relationship of: (1) Duration (time in hours of storm run-off) to drainage area in square miles; (2) CFS per inch of run-off to drainage area in square miles.

Frequency curves for snowmelt run-off were drawn using data from stream flow records. Triangular hydrographs were developed using curves described above.

Rainfall run-off frequencies were computed using Weather Bureau Technical Paper No. 40 and the weighted run-off curve number. Run-off in inches was read from Figure 3.10-1, Hydrology Handbook, Section 4, Supplement A. Hydrograph development was the same as used for snowmelt run-off.

Flood Prevention Evaluations.-

Hydrologic evaluations were made for six sub-basins. A field reconnaissance was made for each sub-basin to obtain the flood damaged area, contributing drainage area, location of valley cross-sections to be surveyed, and other general hydrologic information needed.

Channel and floodplain cross-sections were surveyed about one mile apart for agriculture areas, and every block in urban areas. Additional cross-sections were surveyed in urban areas where constrictions were encountered. Also elevations for urban property subject to damage were taken.

Triangular hydrographs for different frequencies were developed and flood routed through stream reaches using the Wilson Method. Peak discharges were obtained from these routings for each evaluation reach or read from a curve plotted to cfs per inch of run-off versus drainage area.

Acres flooded by depths and/or duration for different frequencies were determined for the agriculture areas. Water elevations for urban areas were determined for different frequencies. Water elevations were made for frequencies up to, and including, a 100-year storm event for present conditions, and for future conditions, assuming works of improvement installed.

Agriculture and Non-Agriculture Water Management Evaluations.-

Estimated water yields were determined for sub-basins that were investigated for the purpose of irrigation, municipal water, and recreation.

File Data

Hydrologic information and data retained in the files include hydrologic evaluations and engineering surveys of the following sub-basins: (1) Elm River; (2) Timber Creek; (3) Sand Creek; (4) Enemy Creek; (5) Rock Creek; (6) Twelve Mile Creek (Pony Creek Watershed); and (7) Turtle Creek (Shaefer Creek Watershed). Basic hydrologic information and data that were collected, developed, and used for all sub-basins in the Study Area are also available. Maps indicating non-contributing areas by sub-basins are in the hydrology file.

RECREATION[1/]

Purpose	Source and References
Existing public recreation facilities, and types of basic facilities	S. D. Department of Game, Fish and Parks U. S. Corps of Engineers
Past and present use of existing facilities	State Game, Fish and Parks Department U. S. Corps of Engineers
Proposed new development of public recreation facilities	U. S. Bureau of Reclamation U. S. Corps of Engineers S. D. Department of Game, Fish and Parks
Population projected future requirements for recreation	S. D. Statistical Reports U. S. Census of Population ORRRC
Species of Fish & Wildlife	S. D. Department of Game, Fish and Parks
Land Management for Fish and Wildlife	S. D. Department of Game, Fish and Parks Bureau of Sport Fisheries and Wildlife, Game Management by Aldo Leopold Duck Production Studies on the Prairie Potholes of South Dakota, Specific Scientific Report - Wildlife No. 32, U. S. Fish and Wildlife Service
Fish and Wildlife, James River Basin & Missouri Tributaries Included in the Oahe Conservancy Sub-District, S. D.	S. D. Department of Game, Fish and Parks Bureau of Sport Fisheries and Wildlife

1/ Data concerning recreation, fish and wildlife was summarized and evaluated for this Study by the SCS Biologist in South Dakota.

Procedures

Project types of development will have limited effect upon most game species. Most of the wildlife in the Basin can be classified as farm game, i.e., species associated with diversified agriculture. Their numbers are dependent principally upon the use and management of private farm lands.

Recreational development units lend themselves to the larger project type of development; therefore, the major portion of the investigation and analysis was confined to water-based facilities for recreation.

All existing recreation areas were inventoried. These included areas along the Missouri River, natural lake areas, state parks, state recreation areas, and cooperative parks.

An analysis of the use of the present facilities was made. A study of the number of visits per person when adequate facilities were available was also conducted. Based on population of the Study Area, this provided a basis of determining the potential visitor days that could be expected if adequate facilities were available within a reasonable driving distance. The difference between present use and potential use established a base for further development needs of the Study Area. Some areas needed only better basic facilities, while other areas required new water-based facilities.

A further breakdown by needs was made by areas. These needs were based on population and facilities available within a fifteen-mile radius. Facilities that have been proposed by Federal or State Agencies and other groups were considered before determining additional needs.

A report pertaining to the fish and wildlife aspects of the Study Area was prepared by the South Dakota Department of Game, Fish and Parks and the Bureau of Sport Fisheries and Wildlife. It contains an inventory of fish and wildlife habitat, populations, and utilization. Some of the tentative reservoir sites and diversions studied by the Basin Staff were checked and rated. A compilation and rating of fishing waters are also a part of the report.

File Data

Included as a part of the Economics file is a list of state parks, state recreation areas, and cooperative parks showing: (1) Water areas; (2) Land areas; (3) Facilities available; (4) Condition of facilities; (5) Population in a fifteen-mile radius; and (6) Number of visits in 1963.

Areas for possible development showing: (1) Population in a fifteen-mile radius; and (2) Estimated annual use.

Visitation trends from 1960-1963 for selected recreation areas in the Study Area. Also on file is a list of state public shooting areas, and proposed fish and wildlife developments for the Oahe Irrigation Unit.

A fish and wildlife summary dated October 1, 1965, prepared by the South Dakota Department of Game, Fish and Parks and the Bureau of Sport Fisheries and Wildlife, is a part of the file data.

GEOLOGY

Purpose	Source and References
Surface and Sub-Surface Geology	R. F. Flint, 1955, Pleistocene Geology of Eastern South Dakota, U. S. Geological Survey Professional Paper 262
	E. P. Rothrock, 1933, Water Supplies and Geology of Lake Kampeska, South Dakota, S. D. Geological Survey
	E. P. Rothrock, 1941, Sources of Water Supply for the City of Miller, S. D., S. D. Geological Survey
	E. P. Rothrock, 1946, The Surface of a Portion of the James Basin in South Dakota, S. D. Geological Survey
	E. P. Rothrock, 1955, Ground Water Reservoirs Near Aberdeen, South Dakota, S. D. Geological Survey

Purpose	Source and References
	K. Y. Lee, 1956, Geology and Shallow Water Resources of the Blue Blanket Valley and Hoven Outwash, Potter County, South Dakota, S. D. Geological Survey K. Y. Lee, 1957, Geology and Shallow Water Resources Between Hoven and Bowdle, South Dakota, S. D. Geological Survey L. Howelk and Fred Steece, Geology and Ground Water Resources of Sanborn County, South Dakota, U. S. Geological Survey SCS National Engineering Handbook, Sec. 16

Procedures

Permeability rates were developed for sample areas by conducting in-place hydraulic conductivity tests. From these tests, spacing distances for sub-surface drains were computed by Donnan's spacing formula. (NEH-Sec. 16, Page 3-47.) Some soil samples were collected and tested for total soluble salts.

Available acquifer data was collected and tabulated within the Study Area. The data includes thickness of permeable sands and gravels and their areal extent. This information was taken from reports of investigations published by the U. S. Geological Survey and the South Dakota State Geological Survey. This information was used to determine the pump irrigation potential within the Study Area.

File Data

The following data is a part of the engineering file:

1. Artificial recharge possibilities of the acquifer underlying Sand Creek sub-basin.

2. Drainage investigations on the floodplain of Sand Creek sub-basin.

3. Permeability investigations on the floodplains of Moccasin and Foot Creek sub-basins.

4. Effect of artesian wells on groundwater acquifers.

SOILS

Purpose	Source and References
Soil and Topographic Conditions Affecting Run-Off	Geological Survey Professional Paper 262 Available Published Standard Soil Surveys Field Sheets for Standard Soil Surveys Available General Soil Maps Field Reconnaissance
Irrigable Soils	SDSU, Generalized Soil Map FS-134A Available Standard Soil Surveys USBR Reconnaissance Sheets USGS Ground Water Resource Reports
Evaluation Soil Groups	Soil Legends for All Counties

Procedures

Available soil data from 20 counties, supplemented by brief field investigations, was used to make soil interpretations in the Study Area.

Soils in each sub-basin were placed in Hydrologic Soil Groups for use by the hydrologist in determining run-off. Irrigable soils were located where there appeared to be opportunities for irrigation projects. Evaluation Soil Groups were developed for each Land Resource Area for use by the economist to determine present and future production.

File Data

The Hydrologic Soil Groups and the Evaluation Soil Groups are a part of the hydrology and economic files. Maps indicating the general location of irrigable soils are filed with the engineering data.