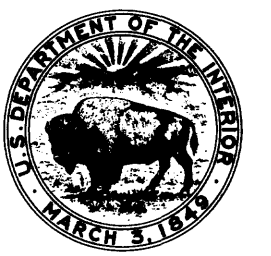
WATER-RESOURCES INVESTIGATIONS OF THE U.S. GEOLOGICAL SURVEY IN SOUTH DAKOTA

Compiled by E. F. LeRoux and E. M. Decker

U.S. GEOLOGICAL SURVEY

Open-File Report 82-912



July 1982

UNITED STATES DEPARTMENT OF THE INTERIOR

JAMES G. WATT, Secretary

GEOLOGICAL SURVEY

Dallas L. Peck, Director

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WATER-RESOURCES INVESTIGATIONS OF THE U.S. GEOLOGICAL SURVEY IN SOUTH DAKOTA

PROJECT STATUS SUMMARY

JULY 1, 1982

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INTRODUCTION

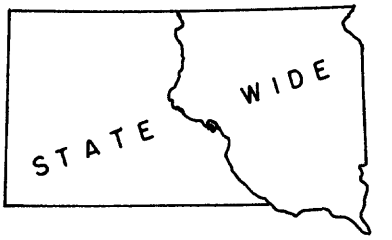
The overall mission of the U.S. Geological Survey's water resources program is to provide the hydrologic information and understanding needed for the best use and management of the Nation's water resources. For 88 years, the U.S. Geological Survey has studied the occurrence, quantity, quality, distribution, and movement of the surface and underground water that compose the Nation's water resources. As the principal Federal water-data agency the Geological Survey collects and disseminates about 70 percent of the water data currently being used by numerous State, local, private, and other Federal agencies to develop and manage our water resources. This nationwide program, which is carried out through the Water Resources Division's 46 District (State) offices and 4 Regional offices, includes the collection, analysis, and dissemination of hydrologic data and water-use information, areal resource appraisals and other interpretive studies, and research projects. Much of this work is a cooperative effort in which planning and financial support are shared by State and local governments and other Federal agencies.

In South Dakota, various parts of the U.S. Geological Survey program are conducted in cooperation with: South Dakota Department of Water and Natural Resources, Division of Geological Survey, Division of Water Quality, and Division of Water Rights; South Dakota School of Mines and Technology; East Dakota Conservancy Sub-District; Black Hills Conservancy Sub-District; Lower James Conservancy Sub-District; City of Sioux Falls; City of Watertown; U.S. Army Corps of Engineers; U.S. Bureau of Land Management; U.S. Bureau of Indian Affairs; and U.S. Bureau of Reclamation.

CURRENT PROJECTS

The project descriptions in this section show the location, project number, title, period of the project, cooperating agencies, project leader, purpose of the project, progress, plans, and completed reports.

SURFACE-WATER STATIONS (SD001)



Project leader: John R. Little

Project period: Continuous

Cooperators: South Dakota Department of Water and Natural Resources, East Dakota Conservancy Sub-District, Black Hills Conservancy Sub-District, City of Watertown, U.S. Bureau of Reclamation, U.S. Bureau of Land Management, U.S. Bureau of Indian Affairs, U.S. Army Corps of Engineers.

Problem: Surface-water information is needed for purposes of surveillance, planning, design, hazard warning, operation, and management, in water-related fields such as water supply, hydroelectric power, flood control, irrigation, bridge and culvert design, wildlife management, pollution abatement, flood-plain management, and water resources development. To provide this information an appropriate data base is necessary.

Objective: A. To collect surface-water data sufficient to satisfy needs for current-purpose uses, such as 1) assessment of water resources, 2) operation of reservoirs or industries, 3) forecasting, 4) disposal of wastes and pollution controls, 5) discharge data to accompany water-quality measurements, 6) compact and legal requirements, and 7) research or special studies. B. To collect data necessary for analytical studies to define for any location the statistical properties of, and trends in, the occurrence of water in streams, lakes, estuaries, etc., for use in planning and design.

Approach: Standard methods of data collection will be used as described in the series, "Techniques of water resources investigations of the United States Geological Survey." Partial-record gaging will be used instead of complete-record gaging where it serves the required purpose.

Results last year: Data were collected and published in U.S. Geological Survey Water-Data Report SD-80-1. No significant changes were made in the network.

Plans for 1982: Review the network, consult the cooperators as to their needs and expect to continue on about the same scale as last year. Data will be published in U.S. Geological Survey Water-Data Report SD-81-1, and requests for data will be answered.

Completed reports:

U.S. Geological Survey, 1981, Water resources data for South Dakota, water year 1980: U.S. Geol. Survey water-data report SD-80-1, 454 p.

U.S. Geological Survey, 1982, Water resources data for South Dakota, water year 1981: U.S. Geol. Survey water-data report SD-81-1, 365 p.

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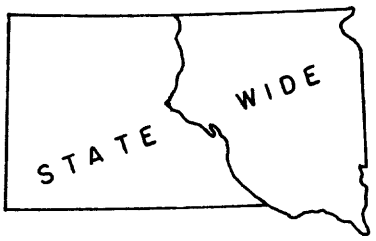
GROUND-WATER RECORDS
(SD002)



Project leader: John R. Little

Project period: Continuous

Cooperators: South Dakota Department of Water and Natural Resources, City of Sioux Falls.

Problem: Long-term water-level records are needed to evaluate the effects of climatic variations on the recharge to and discharge from the ground-water systems, to provide a data base from which to measure the effects of development, to assist in the prediction of future supplies, and to provide data for management of the resource.

Objective: A. To collect water-level data sufficient to provide a minimum long-term data base so that the general response of the hydrologic system to natural climatic variations and induced stresses is known and potential problems can be defined early enough to allow proper planning and management. B. To provide a data base against which the short-term records acquired in areal studies can be analyzed.

Approach: Evaluation of regional geology allows broad, general definition of aquifer systems and their boundary conditions. Within this framework and with some knowledge of the stress on the system in time and space and the hydrologic properties of the aquifers a subjective decision can be made on the most advantageous locations for observation of long-term system behavior. This subjective network can be refined as records become available and detailed areal studies of the ground-water system more closely define the aquifers, their properties, and the stresses to which they are subjected.

Results last year: Hydrologic data was collected for glacial and bedrock aquifers. All water levels for bedrock aquifers are either in the computer or ready for entry. Three open-file reports dealing with water levels throughout the state were published in the past year.

Plans for 1982: Continue collecting water-level data on existing observation wells and establish new observation wells in areas of poor coverage.

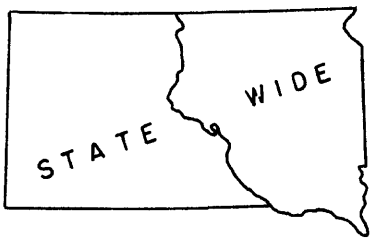
Completed reports:

Bradford, W. L., 1981, Water-level records for the Big Sioux aquifer, Minnehaha County, South Dakota: U.S. Geol. Survey Open-File Report 81-222, 50 p.

Bradford, W. L., 1981, Water levels in bedrock aquifers in South Dakota: U.S. Geol. Survey Open-File Report 81-627, 152 p.

Bradford, W. L., 1981, Records of water levels in unconsolidated deposits in eastern South Dakota: U.S. Geol. Survey Open-File Report 81-924, 253 p.

WATER-QUALITY STATIONS
(SD003)



Project leader: Norman F. Leibbrand

Project period: Continuous

Cooperators: U.S. Bureau of Indian Affairs, U.S. Army Corps of Engineers.

Problem: Water-resource planning and water-quality assessment require a nationwide base level of relatively standardized information. For intelligent planning and realistic assessment of the water resource, the chemical and physical quality of the rivers and streams must be defined and monitored.

Objective: To provide a national bank of water-quality data for broad Federal planning and action programs and to provide data for Federal management of interstate and international waters.

Approach: Operation of a network of water-quality stations to provide average chemical concentrations, loads, and time trends as required by planning and management agencies.

Results last year: There were no significant changes in the network. Water-quality data were published in the basic data release.

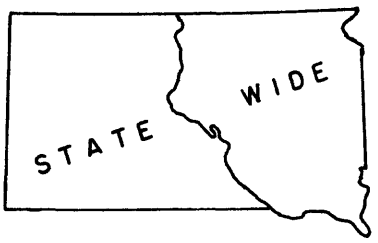
Plans for 1982: Simulation of missing records (data) for several stations will be done by regression analysis. Network will continue to be operated.

Completed reports:

U.S. Geological Survey, 1981, Water resources data for South Dakota, water year 1980: U.S. Geol. Survey water-data report SD-80-1, 454 p.

U.S. Geological Survey, 1982, Water resources data for South Dakota, water year 1981: U.S. Geol. Survey water-data report SD-81-1, 365 p.

SEDIMENT STATIONS
(SD004)



Project leader: Eugene B. Hoffman

Project period: Continuous

Cooperator: U.S. Army Corps of Engineers.

Problem: Water-resource planning and water-quality assessment require a nationwide base level of relatively standardized information. Sediment concentrations and discharges in rivers and streams must be defined and monitored.

Objective: To provide a national bank of sediment data for use in broad Federal and state planning and action programs and to provide data for Federal management of interstate and international waters.

Approach: Establish and operate a network of sediment stations to provide spatial and temporal averages and trends of sediment concentration, sediment discharge, and particle size of sediment being transported by rivers and streams.

Results last year: Data collected as scheduled and published in U.S. Geological Survey water-data report SD-80-1. There were no changes in the network.

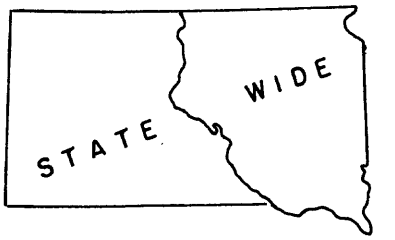
Plans for 1982: One new daily sediment station will be added on the White River near Oacoma, SD. Three sediment stations on the Missouri will be discontinued after the October 1981 samples are collected. Continue network operation.

Completed reports:

U.S. Geological Survey, 1981, Water resources data for South Dakota, water year 1980: U.S. Geol. Survey water-data report SD-80-1, 454 p.

U.S. Geological Survey, 1982, Water resources data for South Dakota, water year 1981: U.S. Geol. Survey water-data report SD-81-1, 365 p.

SOUTH DAKOTA WATER-USE DATA PROGRAM (SD007)



Project leader: Rick D. Benson

Project period: Continuous

Cooperator: South Dakota Department of Water and Natural Resources.

Problem: The water requirements in South Dakota for irrigation and energy development have increased considerably in recent years. As a result of the drought in 1976-1977 that affected the economics of the state, a state water plan is being prepared. An important part of the state water plan is a comprehensive statewide water-use assessment. Without adequate data on existing uses of water, predictions for future uses will be inaccurate.

Objective: To develop a statewide water-use data program that will include field collection procedures and computer storage, retrieval, manipulation, and dissemination of water-use data. During the first year of the project water-use data collection techniques will be developed and evaluated and the requirements for a water-use data handling system will be identified.

Approach: The USGS and the South Dakota Department of Water and Natural Resources will work together in developing a statewide water-use data program. The USGS will provide direction, management, and standards development to meet the national needs. The South Dakota Department of Water and Natural Resources will provide manpower and computer facilities for field collection and processing of water-use data to meet the local needs.

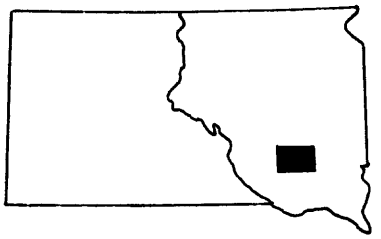
Results last year: The irrigation system questionnaire which will supply information for the national data system is operational. The water rights permit system is operational and the public water supply system is in the design stage.

Plans for 1982: The public water supply system will be completed and work will continue on the development of a wastewater treatment system.

Completed reports:

South Dakota Department of Natural Resources Development, 1979, South Dakota water-use data program: Administrative report, 26 p.

WATER RESOURCES OF DAVISON AND HANSON COUNTIES, SOUTH DAKOTA (SD047)



Project leader: Donald S. Hansen

Project period: 1977-1982

Cooperator: South Dakota Department of Water and Natural Resources.

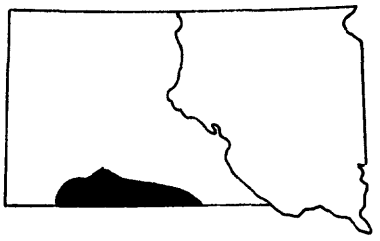
Problem: The counties are primarily agricultural, although the city of Mitchell is supported by some light industry and tourist trade. The water resources are not being fully developed because of a lack of data to guide developers. There was a critical water shortage in the city of Mitchell in 1976 and city officials had no idea where to go for supplemental supplies. The drought has accelerated interest in irrigation which could lead to overdevelopment. It is imperative that the city of Mitchell develop a water supply to supplement their surface reservoir which was dangerously depleted in 1976.

Objective: To provide the reliable and up-to-date basic data and analyses needed for water-resources evaluation and for the efficient use of these resources by agriculture and municipalities. Specifically, the study will concentrate on determining the availability of surface and ground-water resources, the operation of the hydrologic system as it influences availability, the quality of surface and ground water, and the effects on the hydrologic system of developing the water resources. Areas of current or potential hydrologic problems as related to water use will be identified.

Approach: Water resources will be evaluated using standard geologic and hydrologic techniques. Existing hydrologic data will be collected. A well inventory will be conducted and test drilling program completed during the first two field seasons. An observation-well network will be established and water samples collected for analysis. Aquifers will be delineated and hydrologic characteristics described. Pump tests, using existing wells, will be run whenever feasible. Miscellaneous discharge measurements will be made to supplement the permanent stream gaging station on Firesteel Creek and a discontinued site on the James River near Mitchell.

Results last year: Project activities were concerned primarily with report writing and review. These activities included final interpretation of all available hydrologic data and writing the progress report and the final interpretive report. The gravity report is in review.

Plans for 1982: Complete and correct final report review comments and publish report.



HIGH PLANS AQUIFER STUDY
(SD049)

Project leader: Carole L. Loskot

Project period: 1978-1982

Cooperator: Federal funding.

Problem: Interest in irrigation has increased in the last few years and there is some development in the area. A water-management oriented study is needed at this time to determine options and evaluate alternatives. There exists a lack of current data and lack of analyses of historic and current data needed to make management decisions on development and management of water resources.

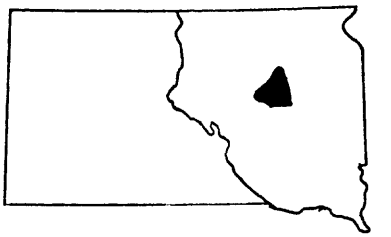
Objective: Describe the water resources of the Ogallala and Arikaree Formations; develop a water resources data storage and retrieval system compatible with the regional system; contribute to the development of a regional computer model of the aquifer system and develop a subsystem model for evaluation of local concerns; and evaluate water management alternatives as a basis for assessing various economic management alternatives.

Approach: Collect, evaluate, and analyze historical water-resources data. A data-collection network will be designed and operated to monitor water levels, pumpage, water quality, and precipitation. Additional information on aquifer thickness and permeability are needed in some areas. About 50 wells averaging 400 feet in depth will be needed. Preparation of reports will include: structure contour, isopach, potentiometric, and geochemical maps, and an interpretive text.

Results last year: A steady-state two-dimensional model of the Ogallala and Arikaree groups was constructed, calibrated, and verified. Remote sensing techniques were used to map crop types. Estimates of consumptive use were made based on the crop-type map.

Plans for 1982: Transient runs of the model will be performed. Report on the remote sensing techniques used, the modeling results, and the drilling program, will be written.

DIGITAL-MODEL STUDY OF THE GLACIAL AQUIFERS IN THE JAMES RIVER BASIN, EAST-CENTRAL SOUTH DAKOTA (SD051)



Project leader: Logan K. Kuiper

Project period: 1979-1982

Cooperator: South Dakota Department of Water and Natural Resources

Problem: The drought in South Dakota from 1974-76 and the curtailment of the planned Oahe Surface-Water Irrigation Project in 1978 have caused increased demands on the ground-water resources within many of the heavily agricultural areas of the James River basin. Requests to state agencies for irrigation-well permits have increased rapidly. The South Dakota Department of Water and Natural Resources has requested that the USGS cooperate with them in developing a digital model of the aquifer system in part of the James River basin which will be used as a basis for establishing a water-management program.

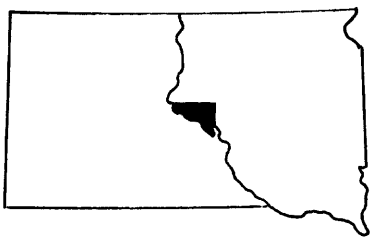
Objective: Develop and calibrate finite-difference two-dimensional digital models of the ground-water system in the James River basin. The calibrated digital models will be used to determine the long-term yield of the ground-water reservoir and the areal affects on water levels of selected pumping distribution plans with time. Once the models are developed, local water agencies can use them to help manage future ground-water withdrawals and recommend optimum pumping distribution.

Approach: The study will require some test drilling and hydrologic data collection, mostly in Spink County. Updating of data will be required in Beadle County. The data collected will be analyzed to define the glacial aquifer boundaries and identify areas of ground-water recharge and discharge; determine the aquifer thickness, direction of ground-water movement, and the hydrologic properties of the aquifers; and determine rates of natural recharge and discharge. Digital models will then be developed to determine the long-term yield of the glacial aquifer system and to test selected pumping distribution plans with time.

Results last year: The modeling, report, and report illustrations are nearing completion. Preliminary results indicate that some of the aquifers in the modeled area will be able to sustain present pumping rates, but that certain other aquifers will probably experience failure in 20-40 years.

Plans for 1982: Complete modeling, report, and report illustrations. Follow the report through the review, approval, and publication process.

WATER RESOURCES OF HUGHES COUNTY, SOUTH DAKOTA (SD052)



Project leader: Louis J. Hamilton

Project period: 1979-1983

Cooperator: South Dakota Department of Water and Natural Resources.

Problem: Little is known about the glacial aquifers of Hughes County; however, several extensive and productive aquifers mapped during an earlier U.S. Geological Survey study in Hyde County to the east probably extend into Hughes County. A knowledge of the hydrology of these and other aquifers will be valuable in future land-use planning and in the development of irrigation and rural water systems in the area. Housing developments are beginning in the areas outside the city of Pierre which may lead to the development of rural water systems and the need for additional hydrologic information.

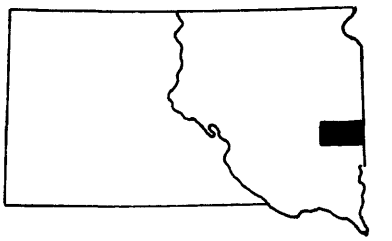
Objective: The objectives of the study are to provide the reliable and up-to-date basic data and analyses needed for water-resources evaluation and for the efficient use of these resources by agriculture, rural water systems, and municipalities. Specifically, the study will concentrate on determining the availability of surface and ground-water resources, the operation of the hydrologic system as it influences availability, the quality of surface and ground water, and the effects on the hydrologic system of developing the water resources. Areas of current or potential hydrologic problems, as related to water use, will be identified.

Approach: Water resources will be evaluated using standard geologic and hydrologic techniques. Existing precipitation, streamflow, and well data will be collected. A well inventory will be conducted, and a test drilling program will be completed during the first two field seasons. An observation-well network will be established and water samples collected for chemical analysis. Glacial and bedrock aquifers will be delineated and hydrologic characteristics described. Pump tests, using existing wells, will be run whenever feasible. Assistance from outside USGS will consist of a geologic study by the State Geological Survey and extensive test drilling by State drill rigs.

Results last year: Data collection continued. Well canvassing and drilling of test holes was completed. Potentiometric measurements and aquifer tests were made on major aquifers. Water samples were collected from domestic, municipal, and irrigation wells for complete chemical analysis, including analysis of trace constituents.

Plans for 1982: Compile and interpret basic data and develop a computer model of a major glacial aquifer. Prepare progress report and the final interpretive report for the study.

WATER RESOURCES OF LAKE AND MOODY COUNTIES, SOUTH DAKOTA (SD053)



Project leader: Donald S. Hansen

Project period: 1979-1983

Cooperator: South Dakota Department of Water and Natural Resources.

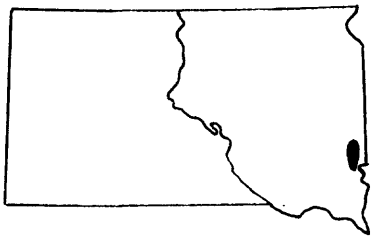
Problem: A reconnaissance study, which included part of Moody County, was completed in 1968 but contained little detailed analysis of the Big Sioux aquifer or other glacial aquifers. A knowledge of the hydrology of these aquifers is needed for land-use planning and development of irrigation and rural water systems in the area. The counties are quite heavily populated in the rural areas which should favor the development of rural water systems.

Objective: To provide the reliable and up-to-date basic data and analyses needed for water-resources evaluation and for the efficient use of these resources by agriculture, rural water systems, and municipalities. Specifically, the study will concentrate on determining the availability of surface and ground-water resources, the operation of the hydrologic system as it influences availability, the quality of surface and ground water, and the effects on the hydrologic system of developing the water resources. Areas of current or potential hydrologic problems, as related to water use, will be identified.

Approach: Water resources will be evaluated using standard geologic and hydrologic techniques. Existing precipitation, streamflow, and well data will be collected. A well inventory will be completed during the first two field seasons. An observation-well network will be established and water samples collected for chemical analysis. Glacial and bedrock aquifers will be delineated and hydrologic characteristics described. Pump tests, using existing wells, will be run whenever feasible. Assistance from outside USGS will consist of a geologic study by the State Geological Survey and extensive test drilling by State drill rigs.

Results last year: Project activities were concerned primarily with collection and interpretation of hydrologic data. These activities included test drilling, construction of observation wells and aquifer maps, and measurement of irrigation and observation wells.

Plans for 1982: Test drilling and observation well installation will be completed. Water sampling will be started and completed.



DIGITAL-MODEL STUDY OF THE BIG SIOUX AQUIFER IN MINNEHAHA COUNTY, SOUTH DAKOTA (SD054)

Project leader: Neil C. Koch

Project period: 1979-1982

Cooperator: East Dakota Conservancy Sub-District.

Problem: The water resources of the Big Sioux River basin are being developed rapidly. At present, the city of Sioux Falls pumps an average of about 12 mgd from shallow wells. By the year 2000 this water use is expected to double. Irrigation development is increasing and rural water systems are being developed within the county. The Big Sioux River and its tributaries are hydraulically connected to a glacial outwash aquifer. A systematic water-management program based on a model study to avoid overdevelopment is needed.

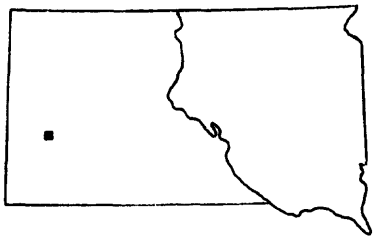
Objective: To develop a digital model of the aquifer system from Dell Rapids to Sioux Falls that can be used by state and local agencies to manage the water resources more effectively and to avoid serious overdrafts in this rapidly developing area.

Approach: Evaluate existing data and develop historical maps for aquifer simulation. Obtain current aquifer data and determine rates of recharge and discharge from existing hydrographs and precipitation records. Prepare maps of prepumping and current water table, saturated aquifer thickness, and areal distribution of coefficients. Prepare a hydrologic budget and develop a digital model to simulate the aquifer system. The U.S. Geological Survey model will be used and modified as needed. The calibrated model will be used to determine long-term yield of the aquifer and to test selected pumping distribution plans.

Results last year: Steady-state analysis has been completed using averages determined from 1970-1979 data. The model-computed water levels were on the average 0.8 foot different from the field water levels in 50 wells. The model was calibrated under transient conditions for 1976.

Plans for 1982: Computer runs will be made under different stress conditions to determine effect of greater development. Report preparation will be completed.

RAPID CITY URBAN HYDROLOGY STUDY
(SD055)



Project leader: Kimball E. Goddard

Project period: 1980-1982

Cooperator: South Dakota School of Mines and Technology.

Problem: Urban runoff from the Rapid City area has been recognized as a problem for many years. Specific problems which will be addressed by this study are the pollution of Rapid Creek and the sources, extent, and significance of the pollution. The project is a cooperative effort between several agencies. The primary responsibility of the U.S. Geological Survey is to provide instrumentation, obtain field information on precipitation and stream flow, and provide water samples for chemical analysis. The USGS will also determine basin characteristics, analyze all data, develop a computer model, and prepare a report on the data and its interpretation.

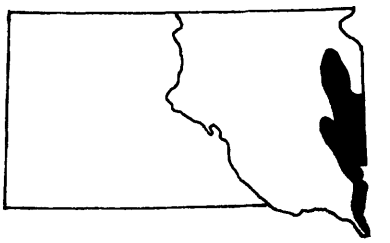
Objective: Define the quality and quantity of urban runoff within the physical boundaries of Rapid City, South Dakota. Specifically, the project is intended to provide information for proper fishery management of Rapid Creek by the Department of Game, Fish and Parks, and to provide basic information to be used by city planners in assessing management and planning options.

Approach: Five sampling stations equipped with manometer, water samplers, and rain gages will be placed in the area. Sampling will begin the summer of 1980, and 1981 and 1982 snowmelt and rainfall-runoff events will be sampled. Measurements will also be made and samples collected during storm events. Data will be analyzed and a computer model will be developed. A reconnaissance will be made of the basin to determine the physiographic, land use, and climatological factors which are important in predicting the runoff and pollutants. A quality assurance program will be coordinated between participating agencies.

Results last year: Project activities have been generally limited to collecting urban hydrology field data in Rapid City. Field data includes rainfall amounts at 10 sites, runoff volume at six sites, water-quality samples of baseline and storm runoff flows at six sites, atmospheric deposition samples at two sites, and some drainage basin characteristics. During FY81, 16 storm events were sampled. All discharge and water-quality data obtained to date have been entered into Watstore.

Plans for 1982: Continue to collect field data on all factors effecting urban runoff in the Rapid City area. Statistical analysis and modeling of data obtained during first two years of study will be completed and a report written.

A GEOCHEMICAL SURVEY OF GROUND WATER IN THE BIG SIOUX AQUIFER IN EASTERN SOUTH DAKOTA (SD057)



Project leader: Norman F. Leibbrand

Project period: 1980-1983

Cooperator: South Dakota Department of Water and Natural Resources.

Problem: The Big Sioux aquifer is one of the most heavily developed aquifers within the state of South Dakota. Concern about contamination, health problems, and steady degradation of the chemical quality of the aquifer has prompted local, private and governmental interests as well as government at the state level to propose that a water-quality study of the Big Sioux aquifer be undertaken. The ultimate goal of the study is the development of "best management practices" for future protection of the aquifer and for control programs if relationships can be established between health hazards and water quality.

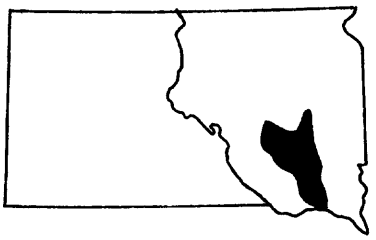
Objective: To define the geochemical variation and chemical character of the ground water in the aquifer. The project is intended to increase hydrologic knowledge through the application of known statistical methods of analysis to a small network of randomly selected sampling sites. Data generated from this project will be used by water managers for development of "best management practices" to preserve the quality of ground water in the aquifer. The data will also be studied by specialists in the health field to determine if relationships exist between water quality and disease.

Approach: Establish a random sampling network and initially select 27 ground-water sources to define geochemical variation in the Big Sioux aquifer. An analysis of variance technique will be used to obtain the geochemical variation and chemical character of the ground water in the aquifer. Statistical testing of the geochemical data will be done to determine whether more sampling sites are needed to adequately define the geochemical variation in the aquifer. The results of the study will be presented in a report describing the geochemical variation and detailing the methods and procedures used in establishing the statistical network.

Results last year: Project activities included the entry into WATSTORE of water-quality data that were generated from a geochemical survey during July 1980. Twenty-seven well sites were randomly sampled and 3 duplicates were collected for a total of 30 analyses. These data were analyzed using SAS ANOVA and SAS PROC CORR procedures. Conclusions made from this analysis shows that more random sampling will have to be done. One-hundred and thirty-five more sites were randomly selected and the sampling was started in June 1981.

Plans for 1982: Continue sampling the 135 randomly selected sites (5 separate geochemical surveys of 27 sites), enter the data into Watstore, and analyze the data using analysis of variance and correlation coefficients.

SEDIMENT STUDY OF THE JAMES RIVER BASIN BELOW FORESTBURG, SOUTH DAKOTA (SD058)



Project leader: John R. Little

Project period: 1980-1982

Cooperator: Lower James Conservancy Sub-District.

Problem: Improper land use, treatment, and management have allowed erosion and sedimentation to severely damage resources in the area. A large part of this area has inadequate quantities and poor quality domestic water, inadequate waste systems, and few recreation facilities. The Lower James Conservancy Sub-District requested the Soil Conservation Service (SCS) to undertake a soil erosion study in the area. The SCS does not have the equipment or expertise for a sediment study and has requested the U.S. Geological Survey (USGS) to design and conduct a sediment investigation in selected sub-hydrologic basins and on the main stem of the James River in the project area.

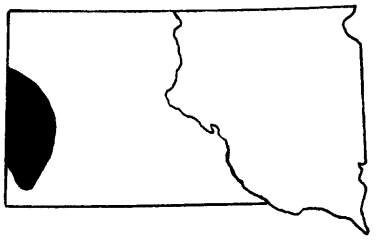
Objective: The responsibility of the USGS will be to quantify sediment delivery to the James River from 4 sub-basins selected jointly with the SCS. Sediment loads and chemical quality of the main-stem James River will be evaluated and quantified at selected sampling sites to aid in identifying other sediment sources. These sites will be used for future evaluations of the effects of the implementation of sediment and erosion control measures. The USGS will prepare interpretive reports which will contain maps and tables of data, data interpretations and descriptions of the hydrologic system with respect to sediment.

Approach: The USGS will establish a network of 7 sediment sampling stations in the Lower James River basin; 4 on selected tributaries and 3 daily stations on the main-stem James River. Automatic sediment samplers and stage recorders will be installed near the mouth of each of the four tributaries. An interpretive report will be prepared by the USGS in which the data will be summarized, suspended sediment loads calculated and annual yields will be calculated for the sub-basins. Sediment loads will be calculated and the chemical quality of main-stem river water will be evaluated and described.

Results last year: Project planning and field reconnaissance conducted. A network of 7 sediment sampling stations in the Lower James River basin was established and a program of sample collection was begun.

Plans for 1982: Continue collection of sediment data in Lower James River basin at 3 gaging stations on main stem and at 4 tributary gaging stations. Continue computation and compilation of streamflow and sediment data and begin preparation of interpretive report.

QUALITY AND AVAILABILITY OF GROUND WATER IN THE BLACK HILLS AREA, SOUTH DAKOTA AND WYOMING (SD059)



Project leader: Kathy D. Peter

Project period: 1981-1984

Cooperators: South Dakota Department of Water and Natural Resources, Black Hills Conservancy Sub-District.

Problem: Increasing development in the Black Hills area is placing increased demands on the ground-water system. The data and interpretations at the scale necessary to make specific management decisions are not available. There is concern about the effects of unplugged or improperly plugged uranium test holes, concern about the effect proposed withdrawals from the Madison aquifer will have on streams and aquifers in South Dakota, and concern about the effect of the numerous septic systems on the quality of water in the Minnelusa Formation, the principal aquifer supplying water to the residents in the area.

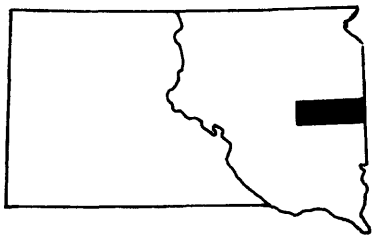
Objective: Evaluate the quality and quantity of ground-water resources of the sedimentary aquifers in the Black Hills area of South Dakota and eastern Wyoming. Evaluate the effects of septic systems on aquifers in the Piedmont Valley area. Develop the data base necessary for application of a digital model(s) to predict the effects of potential stress on the ground-water systems.

Approach: Streamflow and spring discharge data will be obtained as needed to evaluate net aquifer recharge. Water samples from wells in the Piedmont Valley area will be collected and analyzed. Additional wells will be inventoried and evaluated for prospective water quality and water-level observation networks. The U.S. Geological Survey three-dimensional model will be used to predict the affects of stresses on the system and simulate recharge. Reports on quality and availability of ground water will be prepared.

Results last year: Preliminary maps of water levels and water quality of the Madison and Minnelusa were prepared. Spring discharges were measured. Literature searches were performed. A summary of ground-water quality was prepared. Two new surface water gaging sites were selected on South Rapid Creek and French Creek. A planning report was written.

Plans for 1982: Measuring of water-level and spring discharges will continue. Potentiometric maps will be made. Water chemistry samples will be collected from wells and springs. Water chemistry maps will be prepared. Flumes will be installed at selected springs and measurements of discharge will be made at regular time intervals. A preliminary digital model will be constructed. Available information on mineralogy, secondary permeability, and thickness will be compiled.

WATER RESOURCES OF BROOKINGS AND KINGSBURY COUNTIES, SOUTH DAKOTA (SD060)



Project leader: Louis J. Hamilton

Project period: 1981-1986

Cooperator: South Dakota Department of Water and Natural Resources.

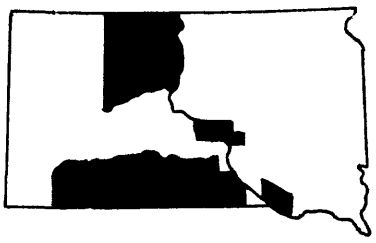
Problem: The study will help to complete the overall water resources picture in eastern South Dakota. A complete knowledge of the hydrology of the aquifers will be valuable in future land-use planning and in the development of irrigation and rural water systems in the area. Identification of significant new sources of ground water would undoubtedly encourage some changes from dryland to irrigation farming. The counties are quite heavily populated in the rural areas which should favor the development of rural water systems. The recent drought conditions have increased local interest in irrigation development from ground-water sources.

Objective: To provide the reliable and up-to-date basic data and analyses needed for water-resources evaluation and for the efficient use of these resources by agriculture, rural water systems, and municipalities. Specifically, the study will concentrate on determining the availability of surface and ground-water resources, the operation of the hydrologic system as it influences availability, the quality of surface and ground water, and the effects on the hydrologic system of developing the water resources. Areas of current or potential hydrologic problems as related to water use will be identified.

Approach: Water resources will be evaluated using standard geologic and hydrologic techniques. Glacial and bedrock aquifers will be delineated and hydrologic characteristics described. Pump tests, using existing wells, will be run whenever feasible. A geologic study will be made by the State Geological Survey and there will be extensive test drilling by State drill rigs. A preliminary report discussing the major aquifers will be prepared. A final report on the hydrology will be published by the State Geological Survey and a report on the geology of the county will be prepared by a State Geological Survey geologist.

Plans for 1982: Project planning and initial field reconnaissance. Existing basic data will be collected and tabulated. The well canvass (including QW field analysis) will begin and test-drilling and observation-well programs will be planned and initiated.

PLANNING STUDY FOR AN EVALUATION OF THE WATER RESOURCES OF THE INDIAN OWNED TRUST LANDS IN THE MISSOURI RIVER BASIN IN SOUTH DAKOTA (SD062)



Project leader: Lewis W. Howells

Project period: 1982

Cooperator: U.S. Bureau of Indian Affairs.

Problem: The United States has been joined as a party in general water rights adjudications in South Dakota initiated by the State of South Dakota. The issues in the case concern the determination of the quantity and priority dates of the water rights held by the United States, and water rights held in trust for Indian reservations. The Geological Survey has been requested by the Bureau of Indian Affairs and the Solicitor of the Department of the Interior to make a comprehensive study of the hydrology of the watersheds involved as a basis for resolving the adjudications.

Objective: The purpose of this planning study is to determine what hydrologic and geologic information is available and what additional information needs to be gathered for a detailed evaluation of the water resources of the study areas. From the results of the planning study, an estimate will be made of the financial and manpower resources necessary to obtain and evaluate the additional hydrologic data needed to determine the quantity and quality of the water resources in the area.

Approach: A review will be made of data currently in reports or in files of governmental and private organizations. The data will be evaluated to determine the approximate areal extent and general hydrologic conditions of the major aquifers. Areas of unknown or poorly known hydrologic conditions will be identified and surface-water data needs will be evaluated. Estimates will be made of the financial and manpower resources needed to gather additional data and to assess the water resources at different levels of detail. A plan will be prepared for a detailed hydrologic study to meet the stated objectives.

Plans for 1982: Prepare a plan for a comprehensive study of the Indian owned trust lands in the Missouri River basin in South Dakota.

HYDROLOGIC CHARACTERISTICS OF THE JAMES RIVER IN SOUTH DAKOTA (SD063)

Project leader: Rick D. Benson

Period of project: 1982

Cooperator: U.S. Bureau of Reclamation.

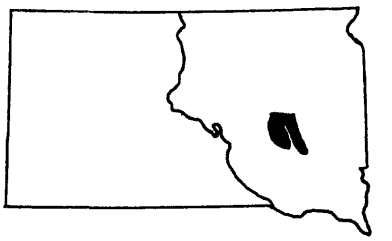
Problem: The Garrison Diversion Unit, as authorized by Congress in 1965, would provide for irrigation service to 250,000 acres within the Souris, Sheyenne, Wild Rice, and James River basins of North Dakota. Objections by Canada have caused the Bureau of Reclamation to consider alternate development plans which would increase potential impacts on South Dakota. A Bureau of Reclamation report has identified several items relating to the hydrology of the James River which require further study. The Bureau requested by memorandum dated February 26, 1982, that the Survey conduct these hydrology studies.

Objective: The purpose of this study is to more accurately define the hydrologic characteristics of the James River in South Dakota. Due to time and money constraints, a majority of the study effort will be devoted to the analysis of existing records. Specifically the study will analyze the operation of Sand Lake Wildlife Refuge, incremental flows gage to gage, tributary-main stem relationships, channel conditions and hydraulics, travel times, and ground water-surface water relationships. Based on the results of this preliminary study, the Survey will recommend additional studies necessary to adequately define the hydrologic characteristics of the James River.

Approach: Historic streamflow data will be used in conjunction with an evapotranspiration study to estimate average monthly water loss through the Refuge system and the river system and account for net gains and losses. The relationships between the occurrances of simultaneous flow events in the main stem and tributaries will be analyzed and velocity measurements will be made and cross-section data obtained in order to compute channel capacities at selected locations on the river. The Survey will provide an assessment of potential ground water-surface water interchange between the James River and underlying aquifer systems.

Plans for 1982: Project planning and field reconnaissance. Existing data will be collected and analyzed. A report will be prepared for the Bureau of Reclamation summarizing the results of the study.

DIGITAL-MODEL STUDY OF THE GLACIAL AQUIFERS IN A PART OF THE JAMES RIVER BASIN IN EAST-CENTRAL SOUTH DAKOTA (SD064)



Project leader: Neil C. Koch

Period of project: 1982-1984

Cooperator: South Dakota Department of Water and Natural Resources.

Problem: The drought in South Dakota from 1974-76, the curtailment of the planned Oahe Surface-Water Irrigation Project in 1978, and the near-drought conditions in 1980-81 have caused increased demands on the ground-water resources within many of the heavily agricultural areas of the James River basin. The South Dakota Department of Water and Natural Resources has requested that the U.S. Geological Survey cooperate with them in developing digital models of the aquifer system in part of the James River basin to be used as a basis for establishing a water-use management program.

Objective: The purpose of this study is to utilize the modeling expertise of the U.S. Geological Survey to develop and calibrate finite-difference two-dimensional digital models of the ground-water system. The calibrated digital models will be used to determine the long-term yield of the ground-water reservoir and the areal affects on water levels of selected water-use plans. Once developed, water agencies can use the models to help manage future ground-water use and recommend optimum pumping distribution.

Approach: The existing information base includes data and analyses from cooperative countywide water resources studies in four conties. The study will require hydrologic data collection and some test drilling by the South Dakota Geological Survey, mostly in Beadle and Sanborn Counties. Updating of data will be required in Miner and Hanson Counties. The accepted U.S. Geological Survey digital model will be used and modifications will be made as needed. It will be used to determine the long-term yield of the glacial aquifer system and to test selected water-use and pumping distribution plans with time.

Plans for 1982: Project planning and initial field reconnaissance. Existing water-use and other basic data will be collected and tabulated. The well canvass (including QW field analysis) will begin and the test-drilling and observation-well programs will be planned and initiated.

HYDROLOGIC-DATA PROGRAM

Surface Water

Surface-water discharge (streamflow) and stage (water level) data (table 1) are collected for general hydrologic purposes such as assessment of water resources, areal analyses, determination of long-term trends, research and special studies, or for management and operational purposes. Each year surface-water gaging stations are added and others are terminated; thus, the U.S. Geological Survey has both a current and historical file of hydrologic data. All data collected are stored in the Survey's National Water Data Storage and Retrieval System (WATSTORE) and are available on request to water planners and others involved in making decisions affecting the State's water resources. These data can be retrieved in machine-readable form or in the form of computer-printed tables or graphs, statistical analyses, and digital plots. Local assistance in the acquisition of services or products from WATSTORE can be obtained from the District Chief, U.S. Geological Survey, Water Resources Division in Huron.

Water-quality data are obtained at many of the surface-water stations (table 2) and also at other surface-water sites where discharge and stage are not measured routinely. In addition to monitoring the quality of surface water in South Dakota, some of these stations also are part of a U.S. Geological Survey nationwide network known as the National Stream Quality Accounting Network (NASQAN), which is used to detect nationwide trends in water quality.

Table 1.—Surface-water stations in operation in South Dakota, July 1, 1982

[Classification: B, benchmark or long-term change station; C, current-purpose station; H, hydrologic station to meet objective of defining regional streamflow characteristics; P, principal stream station to meet objective of measuring principal unregulated streams; R, regulated stream station required to meet objective of defining regulated flow; S, stage. Equipment: D, digital water-stage recorder; M, servo-manometer unit; R, graphic water-stage recorder; T, telemark. Cooperation: A, U.S. Army Corps of Engineers; BHC, Black Hills Conservancy Sub-District; BIA, Bureau of Indian Affairs; BLM, Bureau of Land Management; BR, Bureau of Reclamation; EDC, East Dakota Conservancy Sub-District; F, Federal; LJC, Lower James Conservancy Sub-District; MRB, Missouri River Basin; NR, Department of Water and Natural Resources; NURP, National Urban Runoff Program; WAT, City of Watertown; WYO, State of Wyoming.]

Station number	Station name	Classification	Gage Equipment	Period of record		Cooperation
				Begin	End	
06334500	Little Missouri River at Camp Crook	CP	DM	1903 1956	1906	NR
06354860	Spring Creek near Herreid	BH	DM	1962		NR
06355500	North Fork Grand River near White Butte	CR	DM	1945		NR
06356000	South Fork Grand River at Buffalo	BH	DMR	1955		NR
06356500	South Fork Grand River near Cash	C	MR	1945		A
06357500	Grand River at Shadehill	CR	D	1943		BR
06357800	Grand River at Little Eagle	CR	DMT	1958		F,A
06359500	Moreau River near Faith	CP	DM	1943		A
06360500	Moreau River near Whitehorse	CP	DMRT	1954		F,A

Table 1.—Surface-water stations in operation in South Dakota, July 1, 1982--Continued

Station number	Station name	Classification	Gage Equipment	Period of record Begin	Period of record End	Cooperation
06392900	Beaver Creek at Mallo Camp, near Four Corners, Wyoming	C	MR	1974	1982	BLM
06392950	Stockade Beaver Creek near Newcastle, Wyoming	C	MR	1974	1982	BLM
06395000	Cheyenne River at Edgemont	CP	DR	1903 1928 1946	1906 1933	NR
06400000	Hat Creek near Edgemont	C	R	1905	1906	NR
06400870	Horsehead Creek near Oelrichs	C	DM	1981		NR
06400497	Cascade Springs near Hot Springs	C	DM	1976	1982	BLM
06401500	Cheyenne River below Angostura Dam	CR	D	1945		BR
06402000	Fall River at Hot Springs	CR	R	1937		A
06402500	Beaver Creek near Buffalo Gap	BC	D	1937		NR
06403300	French Creek above Fairburn	C	DM	1981		NR
06404000	Battle Creek near Keystone	CH	DM	1945 1961	1947	NR
06404989	Grace Coolidge Creek near Game Lodge, near Custer	CH	MR	1976		BHC
06406000	Battle Creek at Hermosa	CH	DM	1949		NR
06408500	Spring Creek near Hermosa	CH	DM	1949		NR

Table 1.--Surface-water stations in operation in South Dakota, July 1, 1982--Continued

Station number	Station name	Classification	Gage Equipment	Period of record Begin	Period of record End	Cooperation
06408700	Rhoads Fork near Rochford	C	DM	1981		NR
06409000	Castle Creek above Deerfield Reservoir, near Hill City	BC	MR	1948		F
06409500	Deerfield Reservoir near Hill City	S	MR	1947		MRB
06410000	Castle Creek below Deerfield Dam	CR	DM	1946		BR
06410500	Rapid Creek above Pactola Reservoir, at Silver City	CR	DR	1953		NR
06411000	Pactola Reservoir near Silver City	S	MR	1956		MRB
06411500	Rapid Creek below Pactola Dam	CR	R	1928 1946	1932	BR
06412500	Rapid Creek above Canyon Lake, near Rapid City	CR	MR	1946		NR
06413650	Lime Creek at mouth at Sioux Park, at Rapid City	C	D	1981		NURP
06413700	Rapid Creek above Water Treatment Plant, at Rapid City	C	DM	1980		NURP
06413800	Deadwood Avenue Drain at mouth, at Rapid City	C	D	1981		NURP
06414000	Rapid Creek at Rapid City	CR	DMT	1903 1942	1906	A
06414700	Rapid Creek at East Main Street, at Rapid City	C	DM	1980		NURP

Table 1.—Surface-water stations in operation in South Dakota, July 1, 1982--Continued

Station number	Station name	Classification	Gage Equipment	Period of record		Cooperation
				Begin	End	
06416000	Rapid Creek below Hawthorne Ditch, at Rapid City . . .	C	DM	1946 1980	1953	NURP
06416300	Meade Street Drain at Rapid City	C	DM	1980		NURP
06418900	Rapid Creek below Sewage Treatment Plant, near Rapid City	C	DM	1981		FNR
06421500	Rapid Creek near Farmingdale	CR	DM	1946		BR
06422500	Boxelder Creek near Nemo . .	CH	DM	1945 1966	1947	NR
06423010	Boxelder Creek near Rapid City	CH	D	1978		NR
06423500	Cheyenne River near Wasta	CR	DM	1914 1928 1934	1915 1932	A
06425100	Elk Creek near Rapid City	C	DM	1979		NR
06425500	Elk Creek near Elm Springs .	CP	DM	1949		NR
06428500	Belle Fourche River at Wyoming-South Dakota State line	CR	D	1946		F
06429500	Cold Springs Creek at Buckhorn, Wyoming	C	MR	1974	1982	BLM
06429905	Sand Creek near Ranch A, near Beulah, Wyoming . . .	C	DM	1976	1982	BLM
06430000	Murray Ditch at Wyoming-South Dakota State line . .	CR	R	1954		WYO,NR

Table 1.—Surface-water stations in operation in South Dakota, July 1, 1982—Continued

Station number	Station name	Classification	Gage Equipment	Period of record		Cooperation
				Begin	End	
06430500	Redwater Creek at Wyoming-South Dakota State line	C	D	1929 1936 1954	1931 1937	WYO,NR
06431500	Spearfish Creek at Spearfish	C	DM	1946		NR
06433000	Redwater River above Belle Fourche	C	DM	1945		NR
06433500	Hay Creek at Belle Fourche	BH	D	1953		A,F
06434500	Inlet Canal near Belle Fourche	CR	D	1945		BR
06436000	Belle Fourche River near Fruitdale	CR	DM	1945		NR
06436170	Whitewood Creek at Deadwood	C	DM	1981		FNR
06436190	Whitewood Creek near Whitewood	C	DM	1981		FNR
06436760	Horse Creek above Vale	CH	DM	1962		MRB
06437000	Belle Fourche River near Sturgis	CR	DM	1945		NR
06438000	Belle Fourche River near Elm Springs	CR	MR	1928 1934	1932	A
06439000	Cherry Creek near Plainview	CP	D	1945		A
06439300	Cheyenne River at Cherry Creek	CR	MRT	1960		A
06440000	Missouri River at Pierre	C	T	1971		F
06441000	Bad River near Midland	CP	DM	1945		A

Table 1.--Surface-water stations in operation in South Dakota, July 1, 1982--Continued

Station number	Station name	Classification	Gage Equipment	Period of record		Cooperation
				Begin	End	
06441500	Bad River near Fort Pierre . .	CP	MRT	1928		A
06441590	Missouri River at LaFramboise Island, at Fort Pierre	S	MR			F
06441595	Missouri River at Farm Island, near Pierre	S	MR			F
06442000	Medicine Knoll Creek near Blunt	CH	DM	1950		A,F
06442500	Medicine Creek at Kennebec	CH	DM	1954		A
06442950	Crow Creek near Gann Valley	CH	R	1971		MRB
06443005	Fort Randall Reservoir at Chamberlain	S	R			F
06446000	White River near Oglala . . .	BC	DM	1943		NR
06447000	White River near Kadoka . .	CP	R	1942		A
06447500	Little White River near Martin	BC	R	1938 1962	1940	NR
06449000	Lake Creek below refuge, near Tuthill	CH	DR	1938 1962	1940	NR
06449100	Little White River near Vetal	CH	DM	1959		MRB
06449300	Little White River above Rosebud	C	DM	1981		BIA
06449400	Rosebud Creek at Rosebud	CP	MR	1974		MRB
06449500	Little White River near Rosebud	CP	DR	1943		NR

Table 1.--Surface-water stations in operation in South Dakota, July 1, 1982--Continued

Station number	Station name	Classification	Gage Equipment	Period of record		Cooperation
				Begin	End	
06450500	Little White River below White River	CP	DMR	1949		NR
06452000	White River near Oacoma	BC	MRT	1928		F,A
06452278	Lake Francis Case near Platte	S	MR	1981		A
06453000	Missouri River at Fort Randall Dam	CR	R	1947		F
06453010	Missouri River at Greenwood	S	MDR	1981		F
06464100	Keya Paha River near Keyapaha	C	MD	1981		NR
06464500	Keya Paha River at Wewela	BC	DR	1937 1947	1940	NR
06466700	Lewis and Clark Lake at Springfield	S	MDR	1981		F
06467500	Missouri River at Yankton	CR	DMRT	1930		F,A
06471000	James River at Columbia	CR	MR	1945		NR
06471200	Maple River at North Dakota-South Dakota State line	BC	MR	1956		NR
06471500	Elm River at Westport	BC	DM	1945		NR
06473000	James River at Ashton	CR	DM	1945		MRB
06475000	James River near Redfield	CR	DR	1950		MRB
06476000	James River at Huron	CR	D	1928 1943	1932	NR
06476500	Sand Creek near Alpena	CH	DM	1950		NR
06477000	James River near Forestburg	CR	DRT	1950		NR
06477500	Firesteel Creek near Mount Vernon	CH	R	1955		NR

Table 1.--Surface-water stations in operation in South Dakota, July 1, 1982--Continued

Station number	Station name	Classification	Gage Equipment	Period of record		Cooperation
				Begin	End	
06478052	Enemy Creek near near Mitchell	C	DMR	1975		MRB
06478053	Pierre Creek near Alexandria	C	DM	1981		LJC
06478320	Plum Creek near Milltown	C	DMR	1981		LJC
06478390	Wolf Creek near Clayton	C	DM	1975		MRB
06478420	Lonetree Creek at Olivet	C	DMR	1981		LJC
06478500	James River near Scotland	CR	DMRT	1928		A,F
06478513	James River near Yankton	C	DM	1981		LJC
06478514	Beaver Creek near Yankton	C	DMR	1981		LJC
06478540	Little Vermillion River near Salem	BC	R	1966		F
06478690	West Fork Vermillion River near Parker	CP	DM	1961		NR
06479000	Vermillion River near Wakonda	CP	DT	1945		A
06479438	Big Sioux River near Watertown	BC	DM	1972		EDC,WAT
06479515	Willow Creek near Watertown	H	DM	1971		EDC
06479525	Big Sioux River near Castlewood	H	DM	1976		EDC
06479529	Stray Horse Creek near Castlewood	H	DM	1968		MRB
06479640	Hidewood Creek near Estelline	H	DM	1968		MRB
06479980	Medary Creek near Brookings	H	DM	1980		EDC

Table 1.--Surface-water stations in operation in South Dakota, July 1, 1982--Continued

Station number	Station name	Classification	Gage Equipment	Period of record		Cooperation
				Begin	End	
06480000	Big Sioux River near Brookings	CP	D	1953		NR
06480650	Flandreau Creek above Flandreau	C	DM	1981		EDC
06481000	Big Sioux River near Dell Rapids	CH	DMT	1948		A
06481500	Skunk Creek at Sioux Falls	BC	DMT	1948		A
06482020	Big Sioux River at North Cliff Avenue, at Sioux Falls	CH	DMT	1972		A
06482610	Split Rock Creek at Corson	CH	MD	1970		BR
06485500	Big Sioux River at Akron, Iowa	CP	DT	1928		F,A

Table 2.—Water-quality and sediment stations in operation in South Dakota, July 1, 1982

[Cooperation: A, U.S. Army Corps of Engineers; BM, Federal bench-mark station; EPA, U.S. Environmental Protection Agency; LJC, Lower James Conservancy Sub-District; MRB, Missouri River Basin; NASQAN, National stream-quality accounting network; NURP, National Urban Runoff Program; WY, State of Wyoming.]

Station number	Station name	Cooperation	
		Water quality	Sediment
06354860	Spring Creek near Herreid	A,MRB	
06357800	Grand River at Little Eagle	NASQAN	NASQAN
06360500	Moreau River near Whitehorse	NASQAN,A	NASQAN
----------	Coldbrook Reservoir near Hot Springs	A	
06409000	Castle Creek above Deerfield Reservoir, near Hill City	BM	BM
06412500	Rapid Creek above Canyon Lake, near Rapid City	NURP	NURP
06413650	Lime Creek at mouth at Sioux Park, at Rapid City	NURP	NURP
06413700	Rapid Creek above Water Treatment Plant, at Rapid City	NURP	NURP
06413800	Deadwood Avenue Drain at mouth, at Rapid City	NURP	NURP
06414000	Rapid Creek at Rapid City	NURP	NURP
06414700	Rapid Creek at East Main Street, at Rapid City	NURP	NURP
06416300	Meade Street Drain at Rapid City	NURP	NURP
06430500	Redwater Creek at Wyoming-South Dakota State line		WYO
06434500	Inlet Canal near Belle Fourche	MRB	
06436760	Horse Creek above Vale	MRB	
06437000	Belle Fourche River near Sturgis	MRB	
06438000	Belle Fourche River near Elm Springs	NASQAN	NASQAN
06439300	Cheyenne River at Cherry Creek	NASQAN,A	NASQAN
06440000	Missouri River at Pierre	NASQAN,A	NASQAN
06441500	Bad River near Fort Pierre	A	A
06442950	Crow Creek near Gann Valley	MRB	
06449100	Little White River near Vetal	MRB	
06449400	Rosebud Creek at Rosebud	MRB	
06452000	White River near Oacoma	NASQAN,A	NASQAN
06453000	Missouri River at Fort Randall Dam	NASQAN,A	NASQAN
06471000	James River at Columbia	NASQAN	NASQAN

Table 2.—Water-quality and sediment stations in operation in South Dakota, July 1, 1982—Continued

Station number	Station name	Cooperation	
		Water quality	Sediment
06473000	James River at Ashton	MRB	
06475000	James River near Redfield	MRB	
06476000	James River at Huron	MRB	
06477000	James River near Forestburg		LJC
06478052	Enemy Creek near Mitchell	MRB	
06478320	Plum Creek near Milltown		LJC
06478390	Wolf Creek near Clayton	MRB	
06478420	Lonetree Creek at Olivet		LJC
06478513	James River near Yankton		LJC
06478514	Beaver Creek near Yankton		LJC
06478500	James River near Scotland	NASQAN	NASQAN,LJC
06479529	Strayhorse Creek near Castlewood	MRB	
06479640	Hidewood Creek near Estelline	MRB	
06481000	Big Sioux River near Dell Rapids	MRB	MRB
06485500	Big Sioux River at Akron, Iowa	NASQAN	NASQAN

Ground Water

Water levels in wells, discharge of springs and wells, and water-quality data are key characteristics in monitoring ground-water trends; however, these hydrologic characteristics must be integrated with other observations and ground-water system studies in order to have the fullest meaning and usefulness. In South Dakota, the U.S. Geological Survey makes annual water-level measurements in a number of observation wells (table 3) in the bedrock artesian aquifers. Other wells, which are known as project wells, are used for specific (generally short-term) studies and, although they are not part of the observation-well program, data obtained from them also are available. In addition, the South Dakota Department of Water and Natural Resources maintains and measures 1,400 observation wells that are not listed in table 3.

Table 3.--Observation wells in bedrock aquifers
in South Dakota, July 1, 1982

[Well number: The wells are numbered according to a system based on the Federal land-surveys of South Dakota. The well number consists of the township number followed by "N", the range number followed by "W", and the section number, followed by a maximum of four upper-case letters that indicate, respectively, the 160-, 40-, 10-, and 2½-acre tract in which the well is located. These letters are assigned in a counter-clockwise direction beginning with "A" in the northeast quarter. A serial number following the last letter is used to distinguish between wells in the same tract. Thus, well 103N65W21ADCC is the well in the SW¼, SW¼, SE¼, NE¼, sec. 21, T. 103 N., R. 65 W.]

County	Well number	Aquifer	Date of first measurement
Aurora	101N66W34BBBC	Dakota Formation	7-19-60
	103N65W21ADCC	-----do-----	7-18-79
	103N65W21ADD	-----do-----	8-20-76
	103N65W21CAA	-----do-----	8-20-76
	105N64W13DDA	-----do-----	6- 9-61
Beadle	109N61W06BAAC	-----do-----	10-30-63
	109N64W33ACCD	-----do-----	11- 2-60
	110N62W 9BBAD2	-----do-----	10-16-67
	110N62W 9BBAD3	Greenhorn Limestone	7-16-68
	111N62W13DDDB	Dakota Formation	12-26-76
	113N65W16DDCD	-----do-----	11- 4-63
Bon Homme	92N61W 5DDB	-----do-----	4-12-60
	94N58W 1CCC	-----do-----	10- 5-60
	94N59W 6DABA	-----do-----	7- 7-67
Brookings	109N52W35DDC	-----do-----	4-27-63
	111N52W25DDCC	-----do-----	10- 9-63
Brown	122N60W 8CBBA2	-----do-----	6-21-60
	126N65W14ADD	Fall River Formation	5-25-60
	128N61W 5DCCC	Dakota Formation	5-26-60
Brule	101N70W 7CBBB	-----do-----	7-12-60
	103N67W25CAD	-----do-----	7-13-60
	104N70W26DCBC	Lakota Formation	3-23-59
	104N70W34DAAB	Dakota Formation	5-15-56
	105N68W11CDB	-----do-----	7-14-60

Table 3.--Observation wells in bedrock aquifers in South Dakota, July 1, 1982--Continued

County	Well number	Aquifer	Date of first measurement
Buffalo	106N69W15ABB	Dakota Formation	7- 7-60
	107N73W 1BBBA	-----do-----	10-13-71
	108N72W12BBCA	-----do-----	9-26-61
	108N73W35DDA	-----do-----	7- 7-60
	108N73W35DDA2	-----do-----	11- 6-73
	108N73W35DDA3	Inyan Kara Group	7-19-79
Butte	8N 2E21CD	Lakota Formation	6- 4-80
	8N 2E23DCCA	Inyan Kara Group	6-10-80
	8N 3E12DBBD	-----do-----	6- 4-80
	8N 3E33CCB	Minnelusa Sandstone	6- 4-80
	11N 6E23DCB	Inyan Kara Group	6- 4-80
Campbell	127N78W 5CDBA	Fall River Formation	5-24-67
	127N78W20DCDD	-----do-----	8-14-62
Charles Mix	94N64W26DBA	Dakota Formation	9-14-60
	96N63W 8CDA	-----do-----	9-14-60
	99N68W31DDDB	-----do-----	3-24-59
Clark	116N59W23DDAA	Dakota Formation	8-13-76
	119N59W 9CCCA	-----do-----	7-28-60
Clay	92N52W14DBBD	-----do-----	12- 7-70
	93N52W28AAD	-----do-----	6-21-61
	95N51W 7ADA	-----do-----	6-21-61
Codington	116N52W 2CBBC	-----do-----	2- 9-58
Corson	18N25E23DAD	Fox Hills Sandstone	7-15-80
	19N22E 1DB	-----do-----	7-15-80
	20N29E25BBBC	Pierre Shale	7-14-80
	20N30E31CD	-----do-----	7-14-80
	22N18E 4DBAC	Fort Union Formation	7-15-80
	22N19E32CBDA	Ludlow Member	7-15-80
	23N17E23ADCB	Fort Union Formation	7-15-80
Custer	3S 7E23DDAC	Lakota Formation	6- 5-80
	3S 7E35DBB	-----do-----	6- 5-80
	3S 8E17BACB	Graneros Shale	5-22-80
	4S 7E 1DAAB	Dakota Formation	6-11-80

Table 3.--Observation wells in bedrock aquifers in South Dakota, July 1, 1982--Continued

County	Well number	Aquifer	Date of first measurement
Custer (Cont.)	4S 7E28DBBC	Fall River Formation	5-22-80
	5S 6E12DAAD	Sundance Formation	5-22-80
	6S 6E15ABDD	Madison Limestone	6-11-80
Davison	104N61W30DAA	Dakota Formation	7-29-60
Dewey	12N22E 7ACC	Fox Hills Sandstone	7-16-80
	12N24E17CBBD	----------	7-15-81
	12N25E12BB	Fox Hills Sandstone	7- 6-80
	13N22E29AD	Pierre Shale	7-16-80
	14N29E36DBDD	----------	5-19-81
	15N26E12CDB	Dakota Formation	7-16-80
	15N30E26CBBB	----------	5-19-81
Douglas	99N64W 3BBA	Codell Sandstone Member of the Carlile Shale	6-12-61
Edmunds	121N68W 3AAAB	Dakota Formation	4-12-66
	121N68W11BCB	-----do-----	8- 9-62
	123N68W15CCCB2	-----do-----	8- 9-62
Fall River	7S 1E14BAAC	Sundance Formation	6-12-80
	7S 2E 3ACDD	-----do-----	6-12-80
	7S 5E12CDBB	Minnelusa Sandstone	6-13-80
	7S 6E 1AAAD	Fall River Formation	5-22-80
	8S 2E 8AADD	-----do-----	6-12-80
	8S 2E20DACC	Lakota Formation	6-12-80
	8S 2E36ADBB	Dakota Formation	6-12-80
	8S 3E32BDAB	-----do-----	6-12-80
Faulk	118N67W16DBCC	-----do-----	6-22-60
	119N66W11ABAA	-----do-----	6-23-60
	120N67W15AAAA	-----do-----	11-28-61
Grant	120N48W 2ABBB	Cretaceous sandstone, undifferentiated	7-31-62
	120N49W13CDCC	-----do-----	7-23-76
	121N47W36BBCB	-----do-----	7-23-76
Gregory	98N68W29BDCB	Dakota Formation	7-10-63

Table 3.—Observation wells in bedrock aquifers in South Dakota, July 1, 1982—Continued

County	Well number	Aquifer	Date of first measurement
Haakon	1N20E14DADB	Madison Limestone	7-23-80
	2N23E 4DA	Fall River Formation	7- 6-80
	3N23E10BCCA	Newcastle Sandstone	7-15-80
	3N24E35BCC	-----do-----	7-23-80
	6N18E31ABDB	-----do-----	7- 4-80
	6N22E13DC	Lakota Formation	7-23-80
	6N23E31DB	Fall River Formation	7-16-80
	8N23E26ACDA	Madison Limestone	7-23-80
Hamlin	113N55W23BBAB	Dakota Formation	10-10-63
Hand	110N67W 7CBBB2	-----do-----	5- 5-77
	113N69W 6DDBD	-----do-----	10- 4-62
	116N67W31DDDB	-----do-----	10-10-62
Hanson	104N57W27CCB	-----do-----	6-15-61
	104N58W13DCC	Codell Sandstone Member of the Carlile Shale	6-15-61
Hughes	108N74W15CBD	Dakota Formation	7-20-76
	111N74W15BDAD	-----do-----	7-20-76
Hutchinson	99N58W 6CCD	-----do-----	9-20-60
	99N60W 1BBBC	-----do-----	3-27-59
	99N61W 4AAD	-----do-----	9-16-60
Hyde	109N72W32BAA	-----do-----	5- 4-60
	109N73W12BDCB	Sundance Formation and Minnelusa Sandstone	6-24-70
	110N72W 1CDAA	Minnelusa Sandstone	6-24-70
	114N72W19CDD	Dakota Formation	6-24-60
	116N72W18DAAB	Inyan Kara Group	9-14-62
Jerauld	106N67W26CCDB	Dakota Formation	11- 3-78
	108N63W20DCB	-----do-----	4-27-61
Kingsbury	109N57W28AABA	-----do-----	6-21-62
	110N58W32CCBC	-----do-----	7-12-76
Lake	107N53W20BBC	-----do-----	7-17-61
	108N53W32BDD2	-----do-----	4-28-67

Table 3.--Observation wells in bedrock aquifers in South Dakota, July 1, 1982--Continued

County	Well number	Aquifer	Date of first measurement
Lawrence	6N 2E 4BDD	Minnekahta Limestone	6- 4-80
	6N 2E10BAB	Spearfish Formation	6-10-80
	6N 2E23BBBA	Minnelusa Sandstone	6- 2-80
	6N 4E21DBC	-----do-----	6-10-80
	6N 4E28BBA	Sundance Formation	5-28-80
	7N 1E14CCD	Minnelusa Sandstone	6- 4-80
	7N 1E20AAD	-----do-----	6- 2-80
	7N 1E21BBC	-----do-----	6- 2-80
	7N 1E26ACD	-----do-----	6- 2-80
	7N 1E29BBA	-----do-----	6- 2-80
	7N 1E30BDA2	----------	8-25-80
	7N 2E10BAD	Minnelusa Sandstone	4- -63
	7N 2E26BCDA	-----do-----	6- 3-80
	7N 2E32DD	Spearfish Formation	6- 4-80
	7N 4E 2BDBD	Fall River Formation	5-28-80
Lincoln	97N49W33AAAA	Dakota Formation	7- 6-61
	98N50W32AAAA2	-----do-----	8-22-79
McPherson	125N66W23ABAA	-----do-----	8- 8-62
	127N66W 5BBBD	-----do-----	8- 8-62
	128N66W 8BAD	Red River Formation	5-22-80
Marshall	127N58W19AABB	Dakota Formation	4-22-65
	127N58W23DAD	-----do-----	7- 1-70
	128N57W 3AABA	-----do-----	7-20-60
	128N59W24CBBB	-----do-----	6- 4-63
Meade	3N 6E23DCB	Spearfish Formation	6-29-80
	4N 9E 2ADD	Sundance Formation	5-28-80
	6N 5E19AAAC	Fall River Formation	5-28-80
	6N 5E21DABA	Inyan Kara Group	5-28-80
	6N 5E22DDBC	-----do-----	5-28-80
	7N14E25BDD	Newcastle Sandstone	6-23-80
Miner	108N55W22ADBA	Dakota Formation	6-16-61
Moody	106N48W13BAAC	-----do-----	7-13-61
	107N48W 3DCCC	-----do-----	7-13-61
	107N49W14ABCA	-----do-----	7-13-61

Table 3.--Observation wells in bedrock aquifers in South Dakota, July 1, 1982--Continued

County	Well number	Aquifer	Date of first measurement
Pennington	1N 7E 3BCDD	Minnelusa Sandstone	5-30-64
	1N 7E 3BCDD2	-----do-----	7-18-65
	1N 7E14CBB	Spearfish Formation	5-30-80
	1N16E31CDA	Fall River Formation	8-19-70
	1S16E 6AAB	-----do-----	2- -61
	2N 7E34BCCA	Minnelusa Sandstone	5-30-64
	2N 8E28BCB	Spearfish Formation	5-22-80
	2N12E13ACBA	Lakota Formation	9-23-75
	3S14E28DDA	Dakota Formation	6- 2-80
	4N17E 6BCCC	-----do-----	4-23-69
	4N17E 7BBCC	-----do-----	8-18-57
Perkins	13N14E 9DDA	Fox Hills Sandstone	6-17-80
	20N11E35BBA	Hell Creek Formation	6-18-80
	23N16E20ACAC	Fox Hills Formation	6-17-80
	23N17E31BBB	Ludlow Member	6-18-80
Potter	118N76W25AB	Dakota Formation	11-24-74
	120N76W33CDDB	Minnelusa Sandstone	7-24-76
Roberts	126N51W 9CCCA	Dakota Formation	6-20-62
	126N51W23CDD	-----do-----	6-18-62
	127N49W29BBBC	-----do-----	6-20-62
Sanborn	106N62W30BCBA	-----do-----	10-28-60
Spink	115N65W 4ADDC	-----do-----	3-15-66
	116N62W 5DDCC	-----do-----	3-15-66
	120N63W20DCC2	-----do-----	4-29-64
Stanley	3N25E32BC	Inyan Kara Group	6-23-80
	5N27E22CD	Madison Limestone	5-20-81
	6N28E27ABBA	Newcastle Sandstone	6-24-80
	7N25E 4BCB	----------	5-19-81
	7N26E20B	Fall River Formation	6-25-80
	7N28E18ACB	----------	5-20-81
Turner	96N53W36DDDA	Dakota Formation	7- 7-61
	97N54W 5AB	Niobrara Formation	3-31-66
	99N55W 1CAC	Dakota Formation	6-23-61

Table 3.--Observation wells in bedrock aquifers in South Dakota, July 1, 1982--Continued

County	Well number	Aquifer	Date of first measurement
Union	93N50W 4DAA	Dakota Formation	6-30-61
	94N48W 6AAAC	-----do-----	7- 7-61
	95N49W16ACD	-----do-----	7- 7-61
Walworth	122N75W35CDDD	Sundance Formation	7-13-76
	123N78W 3BABA	Minnelusa Sandstone and Madison Limestone	7-14-76
	123N78W12BDCC	Dakota Formation	8-15-62
Yankton	93N54W 6CCD	-----do-----	4-28-65
	93N55W 4BBC	-----do-----	10- 6-60
Ziebach	13N18E29BBB	Fox Hills Sandstone	7-22-80
	13N21E31BDDA	----------	7-15-81
	14N20E 4DBD	Pierre Shale	7-22-80

SELECTED LITERATURE ON WATER RESOURCES

Because the number of publications pertaining to water resources in South Dakota is large, the publications listed below were selected to show the types of information available to those interested in or in need of water facts. Many of these publications are available for inspection at U.S. Geological Survey offices and at large public and university libraries. Also, the U.S. Geological Survey announces all its publications in a monthly report "New Publications of the Geological Survey." Subscriptions to this monthly listing are available free upon request to the U.S. Geological Survey, 329 National Center, Reston, VA 22092. A booklet entitled "Geologic and Water-Supply Reports and Maps for South Dakota," which includes reports on the geology of the State as well as water-resources reports, is available free upon request to the U.S. Geological Survey, 420 National Center, Reston, VA 22092.

USGS Professional Papers.—Professional Papers are sold by the U.S. Geological Survey, Branch of Distribution, 604 South Pickett Street, Alexandria, VA 22304.

P 600-D. Temperature variations of deep flowing wells in South Dakota, by D. G. Adolphson and E. F. LeRoux, in Geological Survey Research 1968, Chap. D, by U.S. Geological Survey, p. D60-D62. 1968.

P 650-B. Effects of reservoir filling on a buried aquifer of glacial origin in Campbell County, South Dakota, by N. C. Koch, in Geological Survey Research 1969, Chap. B, by U.S. Geological Survey, p. B169-B173. 1969.

P 813-B. Summary appraisals of the Nation's ground-water resources--Upper Mississippi Region, by R. M. Bloyd, Jr. 1975.

P 813-K. Summary appraisals of the Nation's ground-water resources--Souris-Red-Rainy Region, by Harold O. Reeder. 1978.

P 813-Q. Summary appraisals of the Nation's ground-water resources--Missouri Basin Region, by O. James Taylor. 1978.

P 877. The Black Hills--Rapid City flood of June 9-10, 1972: A description of the storm and the flood, by F. K. Schwarz, M. S. Peterson, and others. 1975.

P 1015. Proceedings of the first annual William Pecora Memorial Symposium, October 1975, Sioux Falls, South Dakota, by P. W. Woll and W. A. Fischer, editors. 1977.

USGS Water-Supply Papers.—Water-Supply Papers are sold at the above-listed Alexandria, Va., address.

W 1137-A. Missouri River basin floods of April-May 1950 in North and South Dakota, by R. E. Oltman and others. 1951.

W 1260-B. Floods of April 1952 in the Missouri River basin. 1955.

W 1298. Reconnaissance of geology and ground water in the lower Grand River valley, South Dakota, by P. C. Tychsen and R. C. Vorhis, with a section on Chemical quality of the ground water, by E. R. Jochens. 1955.

W 1425. Ground water in the Crow Creek--Sand Lake area, Brown and Marshall Counties, South Dakota, by F. C. Koopman. 1957.

W 1460-G. Ground-water resources of the lower Niobrara River and Ponca Creek basins, Nebraska and South Dakota, by T. G. Newport, with a section on Chemical quality of the water, by R. A. Krieger. 1959.

W 1475-D. Geology and occurrence of ground water at Jewel Cave National Monument, South Dakota, by C. F. Dyer. 1961.

W 1534. Progress report on wells penetrating artesian aquifers in South Dakota, by R. W. Davis, C. F. Dyer, and J. E. Powell. 1961.

W 1539-T. Geology and ground-water resources of the Lake Dakota plain area, South Dakota, by W. B. Hopkins and L. R. Petri. 1963.

W 1769. Chemical quality of surface waters, and sedimentation in the Grand River drainage basin, North and South Dakota, by C. H. Hembree, R. A. Krieger, and P. R. Jordan. 1964.

W 1800. The role of ground water in the national water situation, by C. L. McGuinness. 1963.

W 1865. Water resources and geology of Mount Rushmore National Memorial, South Dakota, by J. E. Powell, J. J. Norton, and D. G. Adolphson. 1973.

W 2024. Water resources of the Big Sioux River valley near Sioux Falls, South Dakota, by D. G. Jorgensen and E. A. Ackroyd. 1973.

W 2090. Ground-water levels in the United States, 1967-71--north-central States. 1973.

W 2163. Ground-water levels in the United States, 1972-74, north-central States. 1977.

USGS Circulars.--Single copies of circulars still in print are available free from the above-listed Alexandria, Va., address.

C 54. Geology and ground-water hydrology of the Angostura irrigation project, South Dakota, by R. T. Littleton, with a section on Mineral quality of the waters, by H. A. Swenson. 1949.

C 201. Ground-water resources of the Rapid Valley unit, Cheyenne Division, South Dakota, by A. J. Rosier, with a section on Surface waters of Rapid Valley, by L. J. Snell. 1953.

C 270. Chemical quality of water and sedimentation in the Moreau River drainage basin, South Dakota, by B. R. Colby, C. H. Hembree, and E. R. Jochens. 1953.

C 676. Estimated use of water in the United States in 1970, by C. R. Murray and E. B. Reeves. 1972.

C 765. Estimated use of water in the United States in 1975, by C. R. Murray and E. B. Reeves. 1977.

Water-Resources Investigations (WRI) Reports of the U.S. Geological Survey.--Reports in this series are available for inspection at the South Dakota and Reston, Va., offices of the U.S. Geological Survey. Selected reports may be purchased either as microfilm or hard copy from the National Technical Information Service (NTIS), U.S. Department of Commerce, Springfield, VA 22161; the NTIS ordering number is given in parenthesis at the end of the citation. Further information about these reports may be obtained from the District Chief, WRD, Huron.

WRI 35-74. A method for estimating magnitude and frequency of floods in South Dakota, by L. D. Becker. 1974. (PB-239 831/AS)

WRI 80-80. Techniques for estimating flood peaks, volumes, and hydrographs on small streams in South Dakota, by L. D. Becker. 1980. (PB-81 136 145)

WRI 80-100. Appraisal of the water resources of the Big Sioux aquifer, Brookings, Deuel, and Hamlin Counties, South Dakota, by N. C. Koch. 1980. (PB-81 164 584)

WRI 82-31. Magnitude and frequency of floods from selected drainage basins in South Dakota, by L. D. Becker. 1982.

USGS Water-Data Reports available only through NTIS.--The water-data reports listed below may be purchased as hard copy or microfiche only from the National Technical Information Service (NTIS), U.S. Department of Commerce, Springfield, VA 22161. They are available for inspection only at the South Dakota and Reston, Va., offices of the U.S. Geological Survey. The PB number in parenthesis is the NTIS ordering number.

SD-75-1 Water resources data for South Dakota--water year 1975, by U.S. Geological Survey. 1976 (PB-251 861/AS).

SD-76-1 Water resources data for South Dakota--water year 1976, by U.S. Geological Survey. 1977 (PB-266 453/AS).

SD-77-1 Water resources data for South Dakota--water year 1977, by U.S. Geological Survey. 1978 (PB-281 757).

SD-78-1 Water resources data for South Dakota--water year 1978, by U.S. Geological Survey. 1979 (PB-296 426).

SD-79-1 Water resources data for South Dakota--water year 1979, by U.S. Geological Survey. 1980 (PB80-195936).

SD-80-1 Water resources data for South Dakota--water year 1980, by U.S. Geological Survey. 1981 (PB82-101338).

SD-81-1 Water resources data for South Dakota--water year 1981, by U.S. Geological Survey. 1982.

USGS Hydrologic Investigations Atlases.--Hydrologic Investigations Atlases (and other maps of areas west of the Mississippi River) are sold by the Western Distribution Branch, U.S. Geological Survey, Box 25286, Federal Center, Denver, CO 80225.

HA-195. Hydrogeology of the glacial drift in the Skunk Creek--Lake Madison drainage basin, southeastern South Dakota, by M. J. Ellis and D. G. Adolphson. 1965.

HA-311. Hydrology of a part of the Big Sioux drainage basin, eastern South Dakota, by M. J. Ellis, D. G. Adolphson, and R. E. West. 1968.

HA-355. Hydrology of the Rosebud Indian Reservation, South Dakota, by M. J. Ellis, J. H. Ficken, and D. G. Adolphson. 1971.

HA-357. Hydrology of the Pine Ridge Indian Reservation, South Dakota, by M. J. Ellis and D. G. Adolphson. 1971.

HA-499. Geohydrology of Crow Creek and Lower Brule Indian Reservations, South Dakota, by L. W. Howells. 1974.

HA-511. Flood of June 9-10, 1972, at Rapid City, South Dakota, by O. J. Larimer. 1973.

HA-585. Geohydrology of the Cheyenne River Indian Reservation, South Dakota, by L. W. Howells. 1979.

HA-644. Geohydrology of the Standing Rock Indian Reservation, North and South Dakota, by L. W. Howells. 1982.

USGS Hydrologic Unit Maps.--Hydrologic Unit Maps are sold at the above-listed Denver address.

U.S. Geological Survey, 1976, Hydrologic unit map--1974 State of South Dakota.

USGS Open-File Reports and Maps.--Open-file reports which may be in manuscript form generally are not reproduced and distributed in quantity. These reports are available for inspection in the Huron, South Dakota, and Reston, Va., offices of the U.S. Geological Survey. Most numbered open-file reports may be purchased from the Open-File Services Section (OFSS), Western Distribution Branch, U.S. Geological Survey, Box 25425, Federal Center, Denver, CO 80225. Information on the availability of the unnumbered reports may be obtained from the District Chief, USGS, Water Resources Division, Huron, South Dakota.

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