

Jean C. Prior
Iowa Geological Survey

ANNUAL REPORT

of the

STATE GEOLOGIST

to the

GEOLOGICAL BOARD



Volume 48

31 December 1977

GEOLOGICAL BOARD

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Iowa
a place to grow

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Director and State Geologist

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December 6, 1977

TO: Governor Robert D. Ray, Chairman,
and Members of the Geological Board

Ladies and Gentlemen:

Herewith is the Annual Report of the State Geologist made in accordance with the requirements of the code of Iowa, Section 305.7 and Section 17.4. It describes the activities and accomplishments of the Iowa Geological Survey for the period of 1 July 1976 to 31 December 1977. The legal responsibilities of the Iowa Geological Survey are set forth in the Iowa Code, Chapters 305 and 84.

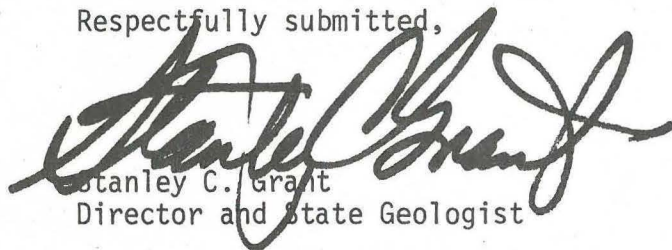
Please note that we have, at Board approval, extended the period of this report to 18 months. Our annual reporting period, as specified by Chapter 17.4, Code of Iowa, is the calendar year. To comply with the Code we will prepare the report on a twelve month basis again next year.

The Iowa Geological Survey continues to have increased responsibilities in research and technical service to state government and the citizens of Iowa. Demands for water related services continue to top the list. Numerous publications are ready for the printer. Direct forecasts for agencies and individuals continue to increase.

We have established water resources technical services as our highest priority. Mineral resources and surficial geology, including soils, are second and third priorities respectively. Other services necessarily fall lower on the list.

Rising costs and new service demands are causing us to cut back on services, re-evaluate programs, and seek appropriation increases. We are looking closely at the productivity of the United States Geological Survey in cooperative projects related to water resources. Increased federal costs are cutting sharply into project output.

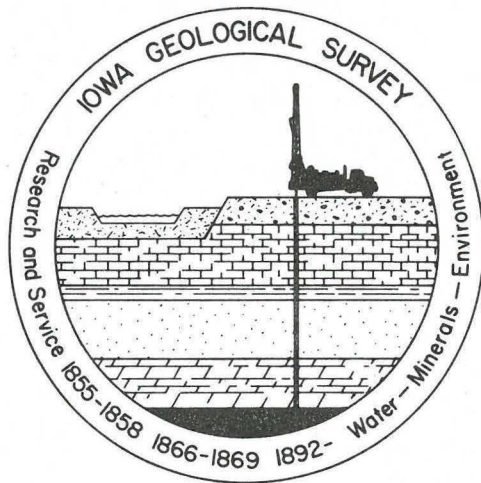
Respectfully submitted,



Stanley C. Grant
Director and State Geologist

SCG/apk

ANNUAL REPORT
OF THE
STATE GEOLOGIST
TO THE
GEOLOGICAL BOARD



VOLUME 48
31 DECEMBER 1977

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Iowa Geological Survey

ANNUAL REPORT

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FUNCTIONS OF THE GEOLOGICAL SURVEY

The fundamental function of the Geological Survey is to collect, interpret, and report information on basic geologic features and products of the state, including surface and groundwater. As the repository for all basic geologic and water data obtained in the state, the Survey makes every effort to secure all such data, and in turn, to make that data meaningful and available to all agricultural, industrial, and governmental organizations and to individual citizens that need that information.

In addition to the basic data program, the Survey conducts various research programs aimed at furthering the geologic and hydrologic knowledge of the state. The programs range from re-evaluation and manipulation of extant data to complex data gathering and interpreting surveys. To implement research in hydrology and to expedite topographic mapping in the state, the Survey uses the authority granted in Chapter 305.8, Code of Iowa, to cooperate with the Water Resources Division and the Topographic Division of the U.S. Geological Survey in cost-sharing programs. The knowledge gained through research will lead not only to better management of our known resources but to discovery, utilization, and protection of the resources of Iowa as well.

The basic method of information dissemination is in the formal reports published by the Survey. In the absence of a report on a particular area

of interest or where a detailed report is necessary for a specific purpose, unpublished special reports are provided. To further the value of the reports, the Survey acts in a consultative capacity (see fig. 1) to those who seek assistance. Except where the state can expect to acquire important information, consultations with private consulting firms are not performed, but our data bank and files are freely available for their use.

In its role as a consultant, the Survey has the responsibility of providing information about naturally occurring resources. In this context the Survey assumes a strong responsibility in advising local and regional planners as to the effects various land uses will have upon the environment under the existing geologic and hydrologic conditions of a given area.

The Survey is a resource agency for a variety of state agencies that exercise regulatory power. The research mandate given the Survey by the legislature separates us from the action agencies in such a way as to permit us to perform an unbiased service for the enforcement and action branches of government such as the Department of Agriculture, the Iowa Natural Resources Council, Iowa Conservation Commission, Iowa Department of Health, Water Pollution Control Commission, State Mining Board, and the Department of Transportation as well as county and municipal governmental units of the state.

Many aspects of environmental preservation require a detailed, sophisticated knowledge of the nature of the earth materials and the nature and behavior of water in a region. Our staff have the highly specialized training and experience in Iowa geology to fulfill these needs at minimal

cost to the state.

Figure 1 shows the table of organization for the Geological Survey for this date. Figure 2 shows the functional relationships of the Survey. During the past eighteen months the Survey has accomplished the following major tasks:

I. GEOLOGICAL SURVEY PUBLICATIONS

1. Anderson, R.R., 1976, Land-use in Iowa 1976 - an explanation of the map: Tech. Inf. Series No. 4, 35 p.
2. Garvin, P.L., Van Eck, O.J., 1976, Strippable coal reserve study in Lucas, Mahaska, Marion, Monroe, and Wapello Counties, Iowa: Limited publication, 27 p.
3. Gilmore, J.L., 1976, Gravity survey of the Randalia magnetic anomaly, Fayette County, Iowa: Rept. of Invest. 11, 28 p.
4. Gilmore, J.L., 1976, Summary of oil and gas test wells in Iowa, 11 p.
5. Gockel, D.J., 1976, Summary of ADP drill hole information: Part 1, northeast Iowa: Tech. Inf. Series No. 2, 109 p.
6. Hallberg, G.R., Koch, D.L., and Horick, P.J., 1976, Irrigation in Iowa: Tech. Inf. Series No. 5, 60 p.
7. Hallberg, G.R., and Van Zant, K.L., 1976, A late-glacial pollen sequence from northeast Iowa - Sumner bog revisited: Tech. Inf. Series No. 3, 17 p.
8. Hansen, R.E., and Steinhilber, W.L., 1977, Geohydrology of Muscatine Island, Muscatine County, Iowa: Water-Supply Bull. No. 11, 60 p.

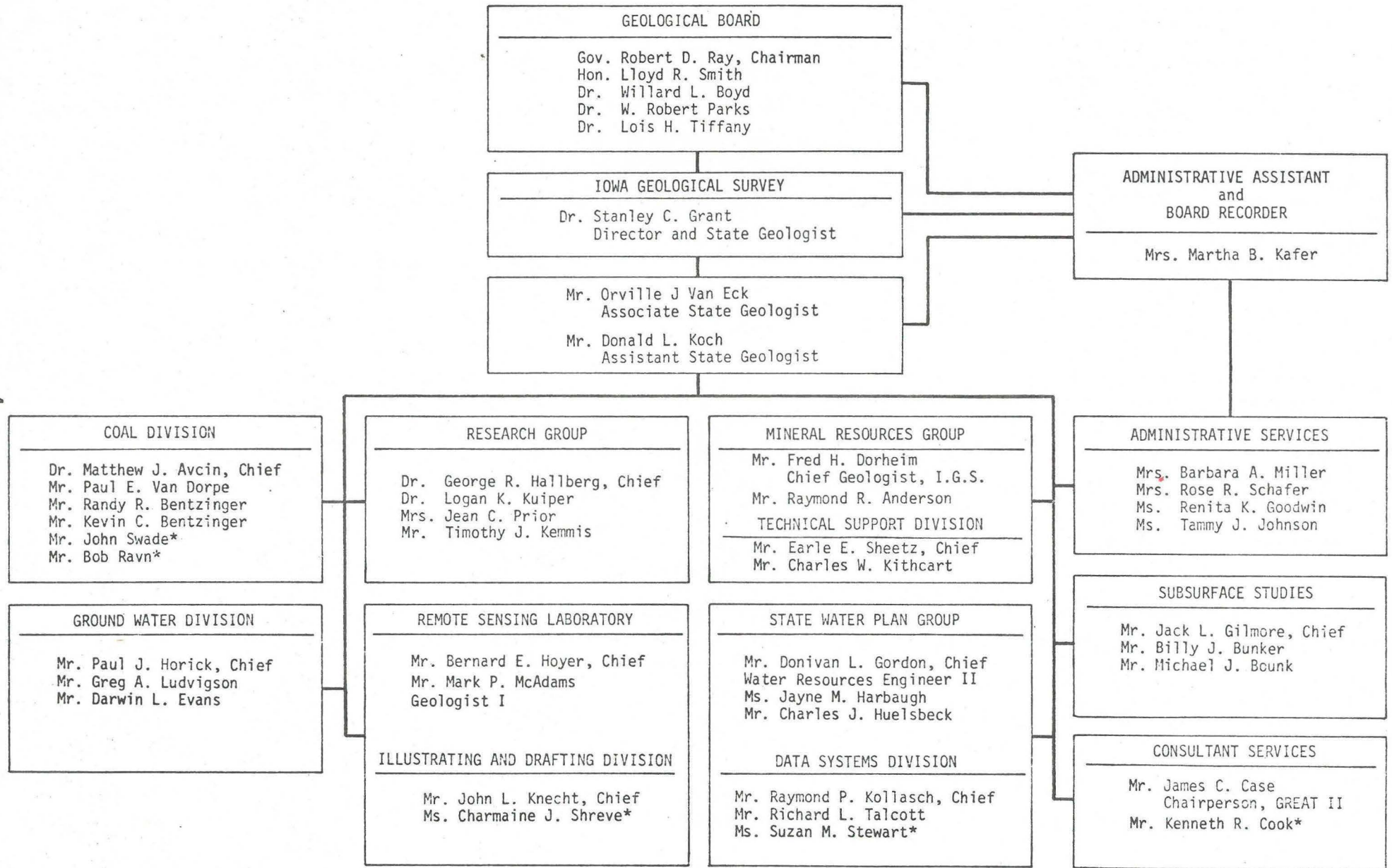


Figure I. Staff Organization and Responsibility Assignment.

*permanent part-time

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Research Cooperative Programs

U.S. Geological Survey
 Groundwater (50/50)
 Surface Water (50/50)
 National Aeronautics and
 Space Administration
 U.S. Bureau of Mines
 U.S. Geological Survey
 Geologic Division
 U.S. Department of Agriculture

Consultation, Advisory, and Data- Source Services

Iowa Department of Revenue
 Iowa Water Well Drillers
 Local and Regional Planning Commissions
 Iowa Counties and Municipalities
 Iowa Commerce Commission
 Iowa Development Commission
 Office for Planning and Programming
 Iowa State Department of Health
 Dept. of Environmental Quality
 Air Quality Commission
 Solid Waste Management Division
 Water Quality Commission
 Chemical Technology Commission
 Iowa State Hygienic Laboratory
 Iowa Department of Justice
 Iowa Natural Resources Council
 Iowa Department of Soil Conservation
 Iowa Agricultural Experiment Station
 State Archaeologist
 Iowa Department of Agriculture
 Iowa Department of Transportation
 Iowa Preserves Board
 Iowa Conservation Commission
 The University of Iowa
 Iowa State University
 University of Northern Iowa
 Iowa Department of Public Instruction
 U.S. Department of Agriculture SCS
 Iowa Citizens
 Private Industry
 Engineering Consultants

Participation in Other Agencies

Iowa State Map Advisory Council
 Iowa Conservation Education
 Council
 Iowa City Chamber of Commerce
 Environmental Concerns Comm.
 Dept. of Environmental Quality
 Inter-Agency Resources Council
 Dept. of Soil Conservation
 Land Rehabilitation Advisory
 Board
 Watershed Advisory Board
 Conservancy District Task
 Force
 U.S. Department of Agriculture
 Iowa-Cedar Rivers Basin
 Coordinating Committee
 Energy Policy Council

Fig. 2 Functional Relationships
 of the Iowa Geological
 Survey

9. Huelsbeck, C.J. et. al., 1977, Iowa Geological Survey Newsletter: Vol. 1, No. 2, 40 p.
10. Kuiper, L.A., 1976, Iowa ground water model: Open file report, 90 p.
11. Kuiper, L.K., 1976, A thermal model for the surface temperature of materials on the earth's surface: Tech. Inf. Series No. 1, 18 p.
12. List and index of publications of the Iowa Geological Survey, 1976, 43 p.
13. Prior, J.C., 1976, A regional guide to Iowa landforms: Ed. Series No. 3, 72 p.
14. Schuetz, J.R., and Matthes, W.J., Jr., 1976, Fluvial sediment data for Iowa: Tech. Inf. Series No. 6, 410 p.
15. Stewart, S.M., and Stanek, E.J. II, 1977, The impact of restricting beverage container use in Iowa: Open file report.

II. GEOLOGICAL SURVEY PUBLICATIONS IN PREPARATION

Work on the following publications continues intermittently between projects of higher priority:

1. Cagle, J.O., and Heinitz, A.J., Water resources of south-central Iowa: Water Atlas No. 5.
2. Dorheim, F.H., Underground mining in Iowa, exclusive of coal: Public Inf. Circ. No. 9.
3. Hallberg, G.R., and Wollenhaupt, N.C., Shrinkage data for Iowa soils: Tech. Inf. Series.

4. Horick, P.J., and Steinhilber, W.L., Jordan aquifer of Iowa: Misc. Map Series 6.
5. Hoyer, B.E., Development and testing of operational flood mapping techniques: Pub. Inf. Circ. No. 6.
6. Huelsbeck, C.J. et. al., Iowa Geological Survey Newsletter: Vol. 1, No. 3.
7. Ludvigson, G.A. et. al., Water resources of east-central Iowa: Water Atlas No. 6, in press.
8. Miller, G.A., Highland, J.D., and Hallberg, G.R., Highway soil engineering data for major soils of Iowa: Tech. Inf. Series.
9. Prior, J.C., et. al., Environmental geology atlas of Linn County: Misc. Map Series.

The Metric System will be utilized in forthcoming publications of the Survey. To facilitate use, metric units will be presented along with the English equivalents until 1983. Thereafter, only metric units will be used.

III. EXTRINSIC PUBLICATIONS

1. Aeromagnetic map of Iowa, 1976: U.S. Geological Survey, Geophysical Investigations Map GP - 910.
2. Geological Highway Map, Northern Plains Map, 1978: Am. Assoc. Pet. Geologists, in preparation.
3. Hatch, J.R. et. al., 1976, Sphalerite in coals from southeastern Iowa, Missouri, and southeastern Kansas: U.S. Geological Survey, open file report 76 - 796, 26 p.

4. Hallberg, G.R., 1977, The use of COLE values for soil engineering evaluation: Soil Sci. Soc. Am. Jour., V. 41, No. 4, p. 775 - 777.
5. Hallberg, G.R., Home sewage disposal and water resources: in Iowa State Univ. Ext. Ser., Exp. Sta. Special Report, in preparation.
6. Hallberg, G.R., Agriculture and water resources: in 2nd Ann. Midwestern Conf. on Food and Social Policy, Iowa State Press, in preparation.
7. Hallberg, G.R., Wollenhaupt, N.C., and Miller, G.A., A century of soil development in loess- derived spoil in Iowa: Soil Sci. Soc. Am. Journ., in preparation.
8. Hansen, R.E., 1977, Bedrock topography of north-central Iowa: open file report.
9. Hoyer, B.E., McAdams, M.P., and Hallberg, G.R., 1976, Development and testing of operational flood mapping techniques: in Proc. Am. Soc. Photogramm., Seattle, Wash., p. 485 - 498.
10. Hoyer, B.E., McAdams, M.P., and Hallberg, G.R., 1977, The development of an aerial flood-mapping technique: (abs.), Geol. Soc. Am. Abs. with Prog., V. 9, No. 5, p. 607 - 608.
11. Kuiper, L.K., The computational efficiency and Taylor expansion derivation of approximating equations to the groundwater flow equation: Water Resources Res., in preparation.
12. Prior, J.C., 1977, A preliminary geological survey along the Great River Road in Iowa: in Iowa's Great River Road Cultural and Natural Resources, V. II, p. 433 - 498.

13. Zietz, I., et al, 1976, Aeromagnetic map of Iowa - color coded intensities: U.S. Geological Survey, Geophysical Investigations Map GP - 911.

Publication sales increased over the past ten years from about \$1,600 in 1968 to nearly \$18,000 in 1977 (fig. 3). Several factors account for this increased demand for topographic, geologic and hydrologic information:

1. Availability of the popular 7-1/2 minute topographic map quadrangle (and earlier 15 minute quadrangles) has increased topographical map coverage from about 25% of the State in 1967 to 69% in 1977. Topographic maps are in various stages of completion over another 25% of the State. These maps are utilized by engineers in planning pipeline routes for hydrocarbon products, distribution lines for rural water systems, and for location of electrical power lines and transportation routes. The maps are relied upon for many other construction projects where information is needed for vertical control and slope analysis or where information is required for drainage basin studies and zoning of flood plains.
2. An awareness by society in the past decade of the necessity to live in a rational state of balance with nature has resulted in a greater appreciation of our natural surroundings. Fossils and Rocks of Eastern Iowa (1967) and The Minerals of Iowa (1974) were extremely well received by the public. A Regional Guide to Iowa Landforms, the latest publication in our Educational Series, has been praised by the public

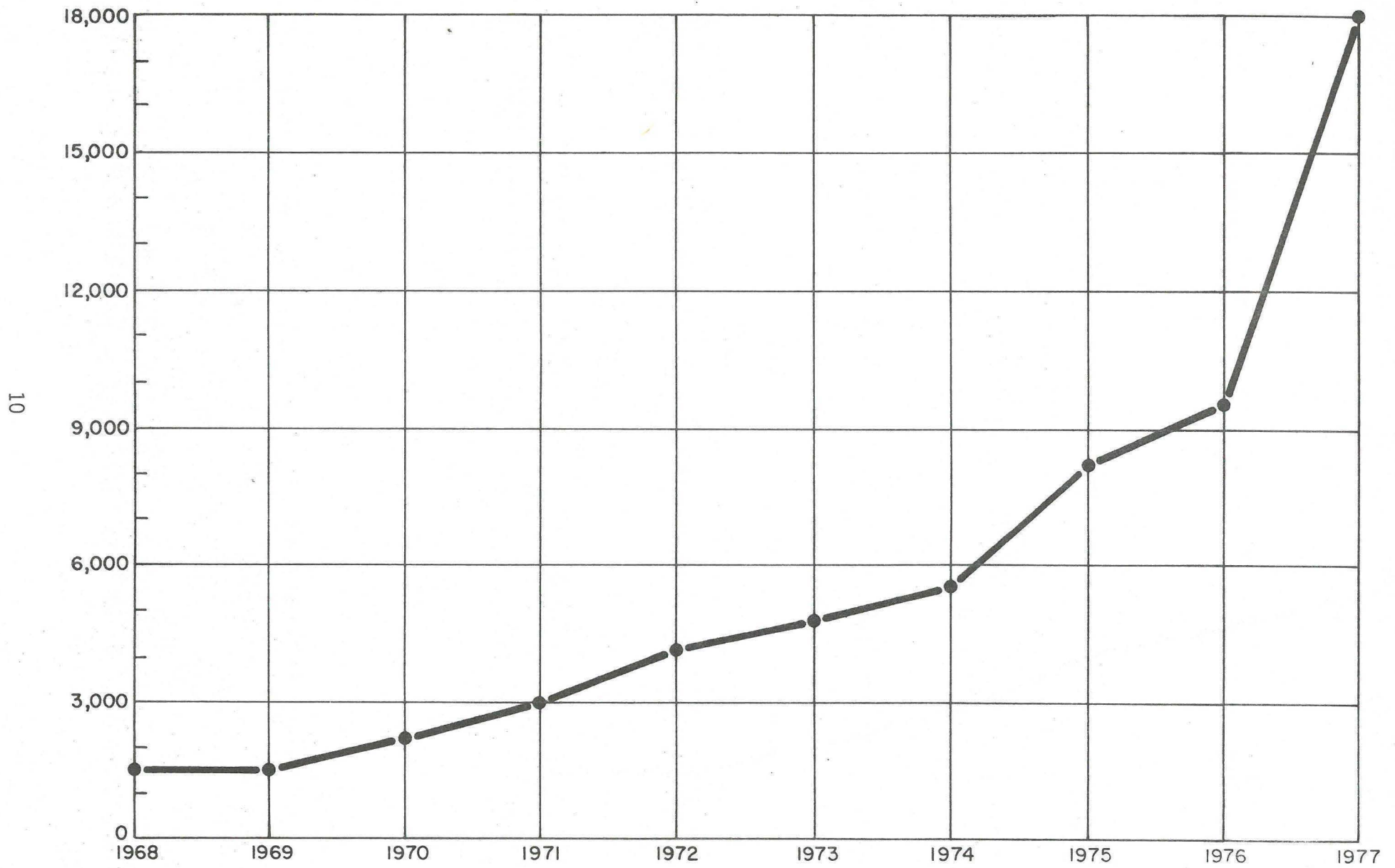


Figure 3. Publications Sales by Calendar Year.

sector and by elementary science teachers. It contributed greatly to the record 1977 sales income.

3. The format for presentation of water resources information was changed so that the information can be readily understood and used by those with no background in geology or geohydrology. Publication of The Water Story in Central Iowa in 1965, and Mississippian Aquifer of Iowa in 1973 confirmed the need for less esoteric reports, with supporting illustrations, that can be utilized by engineers, well contractors and private citizens in planning and developing water supplies. Publication of The Jordan Aquifer in Iowa and The Water Story in East-Central Iowa in 1978 will add significantly to the amount of easily available information on water resources.

IV. CONSULTATIVE, ADVISORY, AND DATA-SOURCE SERVICES

Water Availability Requests

Requests for information on ground-water resources for domestic, irrigation, municipal, industrial, and other uses constitute a continuously increasing portion of work assigned to staff of both the Groundwater Division and the Subsurface Division. Information is provided on water availability and water quality for each potential aquifer source at the respective development site. Extant data is summarized in the form of letter reports, or, when information is needed immediately, as telephoned reports. The requests derive from a wide range of users as follows:

<u>Category</u>	<u>No.</u>
Municipal	190
Industrial	55
Domestic	145
Feedlots	13
Irrigation	170
Recreational	20
Rural Water Districts	30
Housing Developments	32
Other	70
Total	<u>725</u>

This total is nearly three times higher than the total for the last Annual Report. The increase is related directly to the recent drought cycle and primarily reflects a high interest in the use of water for irrigation and the inadequacy of many shallow municipal wells to supply the needed amounts of water during periods of aquifer stress.

Well Logging

Drill cuttings from approximately 80 wells were logged for a total footage of about 35,000 feet. Because in most well drilling procedures a sample is collected for each 5-feet of drill penetration, the detailed logging (descriptive and colored graphics) of 35,000 feet of drill samples means a microscopic study of about 7,000 individual samples.

With the continuing load of service work, the number of sample sets and total footage logged has decreased markedly over the last seven years. Currently, samples from about 7,000 wells remain to

be studied. Emphasis is being placed on the logging of deep municipal and industrial wells and those wells located within special project areas, such as the coal exploration program and the northwest Iowa Study of the Cretaceous and alluvial aquifers.

Oil and Gas Administrator

The State Geologist is designated Administrator of Oil and Gas under Chapter 84, Code of Iowa. In this capacity the Geological Survey reviewed and processed 23 applications for drilling permits during the period of 1 July 1976 to 31 December 1977. All but one of these were issued to Natural Gas Pipeline Company of America for injection/withdrawal wells at their underground storage facilities at Cairo and Columbus City, Louisa County. The remaining permit was for an oil exploration test hole in western Taylor County and was issued to the C.R.L. Corporation.

Drilling statistics accumulated in the administration of Chapter 84 were reported quarterly to the Iowa Natural Resources Council and monthly to the American Petroleum Institute.

The Geological Survey continues to serve as consultant to the Iowa Commerce Commission in the review of procedures being followed by Northern Natural Gas Company in the abandonment of the Vincent gas storage facility. The original acreage under lease for this facility when abandonment began in 1971 was 12,373 acres. Gas Storage Agreements on approximately 10,133 acres on the outer periphery of the field have been dropped through December, 1975. This leaves 2,240 acres remaining under lease. The total gas-in-place as of August 26, 1977 was 2,624,811 Mcf (thousand cubic feet).

Requests for Information

The Survey regularly responds to a large number of requests for geologic and hydrologic information. With the onset of public concern over environmental and energy problems, the number of requests has increased substantially. The manner in which the requests are answered is largely predicated by the nature and scope of the request.

For those requests that are general in nature, one of the publications of the Survey often will fulfill the needs. For those of a more specific or localized nature a special letter report is prepared. These reports are generally interpretive.

In contrast to the requests for interpretive reports, we also are called upon to supply much data. Recognizing this need some time ago, we have worked to develop an automated geologic and hydrologic data bank. These efforts have progressed to the point where we now can provide such data to well drillers, planning agencies, engineers, and so forth rapidly with comparatively little demand on staff time and at a nominal cost to the user.

Coincident with the public concern about energy and environmental problems has come a greater demand for public addresses by staff members. These have ranged from short presentations to various service groups to seminars devoted to specific subjects. The results have been gratifying in that there seems to have developed among the general public an entirely new appreciation of our earth resources.

Consultative Contacts

The Survey is often called upon to provide consultative services to various state agencies, industries, and individuals. These services frequently require interpretation of data and quite often on-site investigations in various parts of the state. The following tabulation indicates the approximate number of contacts that fall within this category:

<u>Agency or Group</u>	<u>No. of Contacts</u>
Iowa Natural Resources Council	110
Iowa Commerce Commission	9
Department of Environmental Quality	55
Iowa Conservation Commission	28
Iowa Department of Transportation	9
Office for Planning and Programming	4
Energy Policy Council	4
Iowa Department of Public Instruction	4
Iowa Department of Social Services	3
Iowa Health Department	8
Iowa Development Commission	5
Iowa Department of Justice	32
State Hygienic Laboratory	6
State Advisory Board for Preserves	4
State Archaeologist	9
State Historical Society	3
Iowa Department of Soil Conservation	16

<u>Agency or Group</u>	<u>No. of Contacts</u>
State Universities and Public Schools	78
Counties and Cities	98
Regional Planning Commissions	6
Federal Agencies (U.S.D.A., F.H.A., etc.)	67
Engineering Consultants	255
Water Well Drillers	214
Industry	96
Individual Citizens	412
Total	<u>1,535</u>

Sanitary Landfills, Toxic Wastes

The Geological Survey established geologic and hydrologic criteria to be included in the rules that govern sanitary landfill siting, under the jurisdiction of the Solid Waste Management Division, Department of Environmental Quality. These criteria are designed to protect the water resources of the state. To assist municipal and county governmental agencies in the selection of sites that will best meet the geologic and hydrologic criteria, the Geological Survey has upon request either furnished extant data, made on-site inspections, or conducted earth resistivity surveys on potential landfill sites. All counties in Iowa presently are delivering their wastes to approved landfills. Although Pottawattamie County has no approved site, wastes are being delivered to approved sites outside the county.

The Department of Environmental Quality has submitted a bill to the legislature that would provide authority to regulate industrial wastes in Iowa. Industrial wastes that are classified as

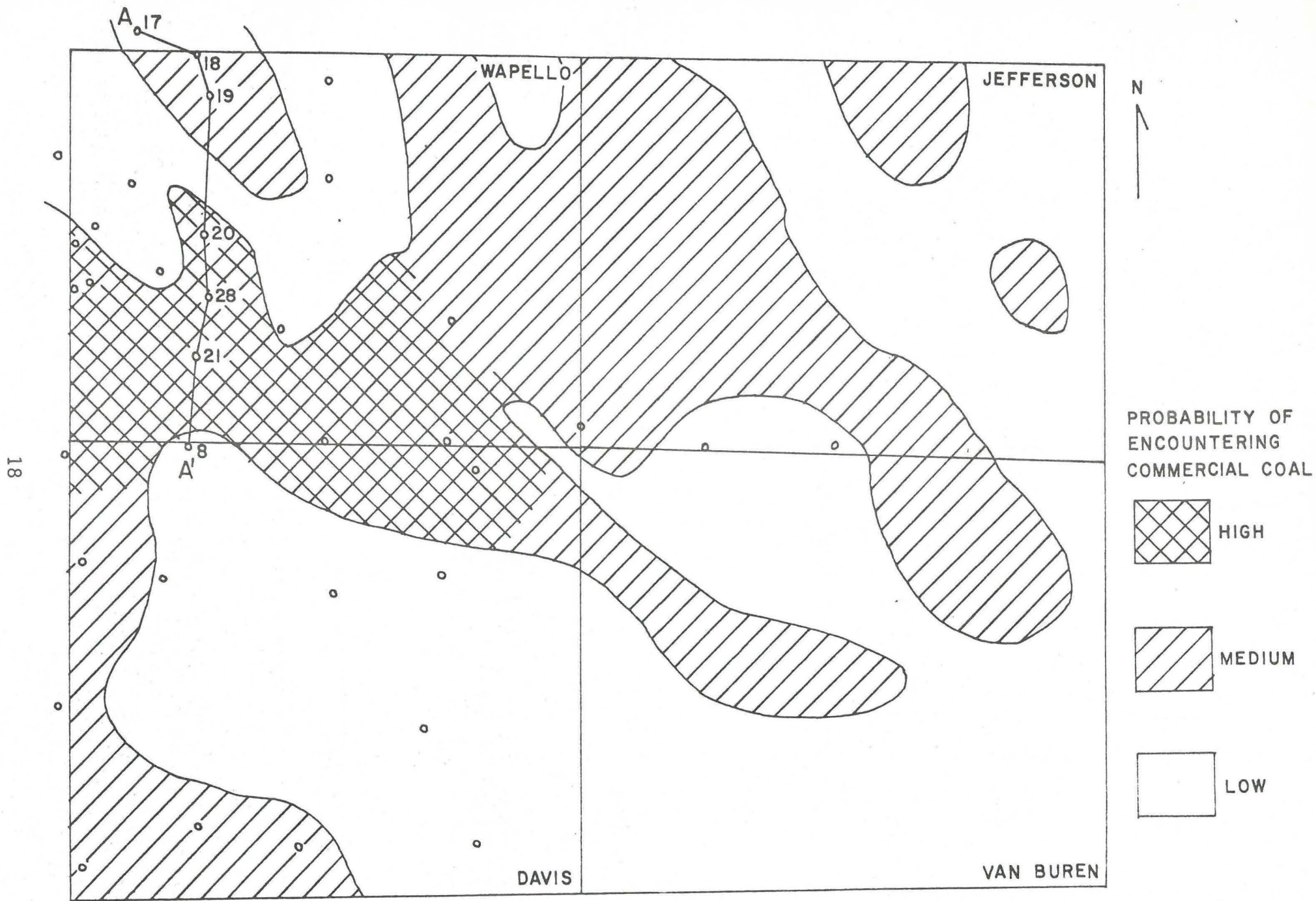
toxic wastes will require approved disposal sites. This will result in a significant increase in I.G.S. services, working in consultation with D.E.Q. Activity is already underway relative to the disposal of fly ash and sludge from coal-burning power plants.

V. RESEARCH

1. Coal Resource Program

The research goals of this program were presented in the 30 June 1974 Annual Report. An array of statistical data has been presented in prior reports to document progress of the program. However, during the present reporting period significant progress has been made in a number of research areas that allows the program to enter into a preliminary interpretive phase. This progress is reflected in the seven presentations by program staff at scientific meetings, and in a publication on coal chemistry which is in final preparation.

Practical application of these research gains has resulted in an increased understanding of the occurrence and character of Iowa coal. The economic potential for the development of coal in Study Area No. 1 is shown in figure 4. Coal thickness, apparent continuity of the coal seams, and the amount of data available were the primary criteria used to construct the map. Therefore, the area designated as high potential has yielded drilling data which indicates the presence of coal thick enough to be mined by either stripping or underground methods, dependant upon depth and lateral continuity of the coal seam(s). Similarly, those areas mapped as medium potential are characterized by thinner, less continuous coal



• IOWA GEOLOGICAL SURVEY RESEARCH HOLE

Figure. 4. Economic potential of coal study area no. 1.

seams, or the available data does not justify a higher characterization.

The relationship between the high and medium designations can best be explained with the aid of cross-section A-A' (fig. 5). Holes C.P. #17, #18, and #19 occur in an area mapped as having only medium economic potential, in spite of the fact that C.P. #17 and #19 show good coal thicknesses at strippable depths. Part of the reason for the designation can be found in C.P. #18 which shows a major interruption in the coal pattern. The second reason cannot be shown on the cross-section, but other data files at the I.G.S. indicate that extensive mining has occurred in this area, which may preclude mining at a reasonable scale. However, the portion of the cross-section including C.P. #20, #28, and #21 indicates the presence of more continuous coals, and background data indicate less disturbance by previous mining. Therefore, it has been included in the area of high economic potential. Hole C.P. #8 is typical of the area mapped as low potential, because the only coal present is too thin for underground extraction and much too deep for a surface operation.

In practical terms, the area mapped as high potential probably contains between 200 and 300 million tons of readily extractable coal. No estimate of coal tonnage has been made for the areas of medium and low potential, but coal extraction in these areas might become viable as coal value and demand increases.

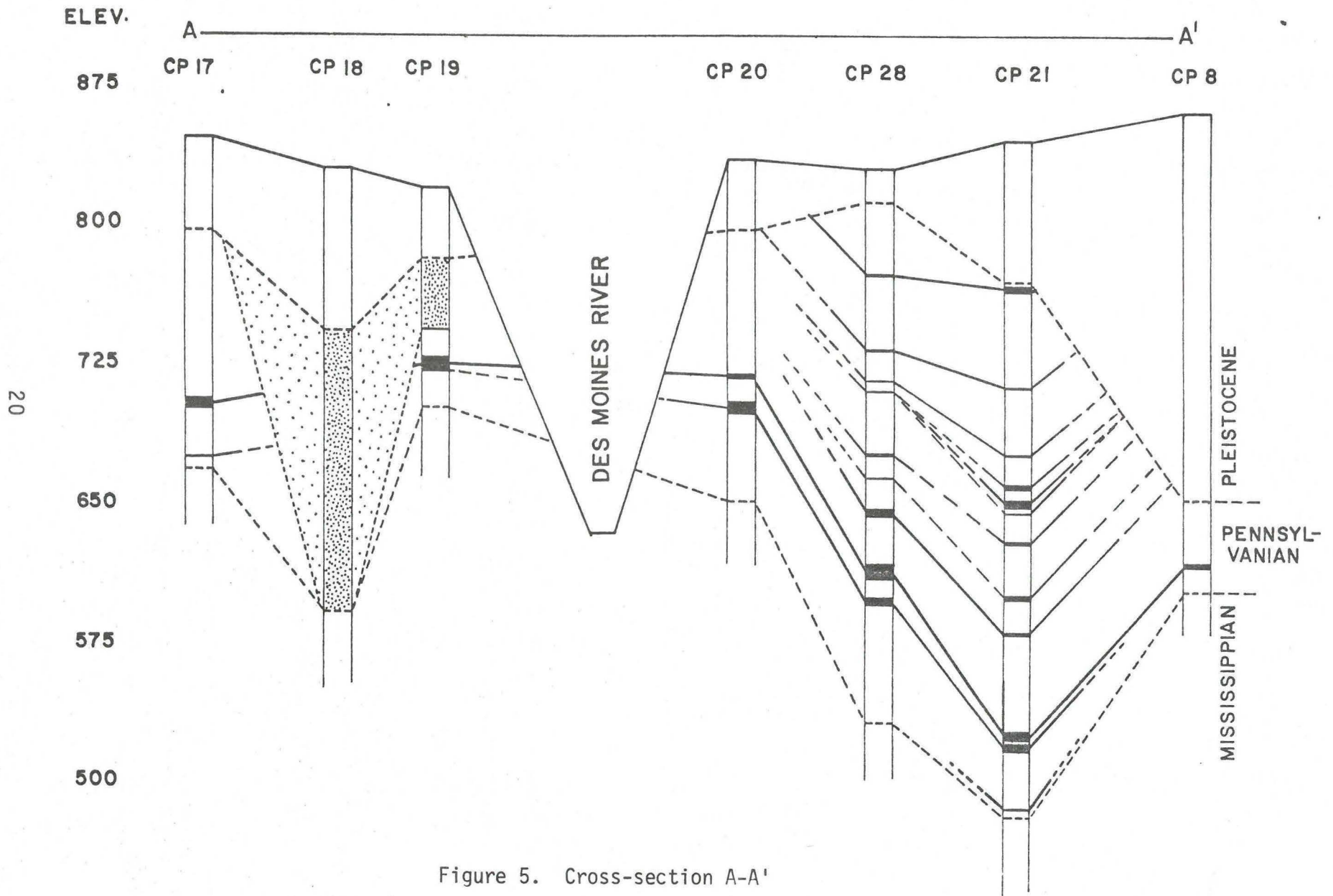


Figure 5. Cross-section A-A'

A summary of exploration drilling for the reporting period follows:

Number of drill holes.....	14
Total footage drilled.....	5,260
Number of coal seams.....	43
Total thickness of coal.....	44'5"
Coal seams exceeding 14"....	17

Significant progress has been made both in a practical sense and in terms of the goals of the program. However, because of the program's initial successes, additional requests and inquiries are being forwarded to the Survey almost daily, and these require information and data which the project has not had an opportunity to acquire.

It is increasingly apparent as more data accumulates that Iowa has the resource/reserve base to support a much larger coal industry than at present. However, the longer a rejuvenation of the industry is postponed, the more difficult it will be to accomplish. Over the next ten years Iowa utilities will be planning for a considerable increase in coal-fired generation capacity. One of the primary considerations in the design of future plants is the fuel to be burned. If the planners are not convinced that Iowa coal is available in sufficient quantities, at a reasonable cost, and that the environmental problems are manageable, they will design these plants to burn coal from other areas. Because of the marked difference in the burning characteristics of various coals, it would be difficult for such plants to switch to Iowa coal once they are

in operation. Therefore, the market for Iowa coal would remain limited and growth of the industry would be retarded.

2. Pleistocene Stratigraphy, Southwestern Iowa

The Geological Survey is participating in a joint project with the Nebraska Conservation and Survey Division (N.C.S.D.) to evaluate the Pleistocene stratigraphy of southwestern Iowa in relation to volcanic ash beds which may be radiometrically dated. Such dates will provide a framework for an absolute chronology of these deposits and is a significant aspect of safety analyses for proposed nuclear power-plant sites in Iowa and adjacent states. This work is supported by the National Science Foundation Grant No. DES 74-23535 to the N.C.S.D.

The N.C.S.D. is doing the test drilling, and N.C.S.D. and I.G.S. are jointly evaluating the stratigraphy and conducting laboratory analyses of the materials. Data on engineering and hydrologic properties are also being collected. A total of 13 sites have been test drilled and cored in Iowa with a total footage of approximately 1,890 feet. Data and conclusions from this study will result in modification of the standard stratigraphic nomenclature for North America.

3. Irrigation in Iowa

The number of applications for irrigation permits received by the Iowa Natural Resources Council has increased markedly during the past two years. In response to the growing interest in irrigation in Iowa, and at the request of the Governor, the

Geological Survey began a review of the status of irrigation, including an analysis of the several uses of water for irrigation, the permitted rates and volumes of water withdrawal, the availability of water for irrigation, the climatic conditions (historical and present) that have resulted in the current trend of increased use of water for irrigation, the economics of irrigation, and the potential problems that follow as a consequence of irrigation, such as aquifer depletion, soil erosion, and increased energy consumption. This study was compiled for publication as Tech. Info. Series No. 5, Irrigation in Iowa. Staff involved in the compilation of this report have also presented this information at several regional Agricultural Extension Service meetings and at the Annual Soil District Commissioners Short Course.

4. Missouri River Litigations

At the request of the Iowa Attorney General's Office the Survey became involved in Federal litigations. In a number of actions, the U.S. Government and the Omaha Indian Tribe as plaintiffs have sued the State of Iowa and various Iowa landowners as defendants for title to approximately 11,000 acres of land adjacent to the Missouri River in Monona County.

The legal issues of riparian land ownership hinge upon the technical issues of how river movements occurred and how this land came into being. With the involvement of the Federal Government there is no statute of limitations, and most of the events at issue occurred during periods for which there are no longer any eyewitnesses. This necessitated the use of expert testimony, which the

Survey successfully provided at a cost of eight man-weeks of preparation and another five man-weeks in residence at the first trial.

Even though the U.S. District Court ruled in favor of the defendants, work has continued on these cases in preparation for:

1. The plaintiffs' appeal to the U.S. Circuit Court of Appeals (decision pending) and eventual appeal to the U.S. Supreme Court.
2. The initial hearing of the several remaining suits which are awaiting the Circuit Court decision of the first consolidated cases.

5. Cherokee Archaeological Site

The National Science Foundation awarded the Geological Survey \$5,842 as a subcontract to the University of Iowa to participate in the construction of an environmental model for the last 10,000 years in Iowa. The Cherokee Archaeological Site contains a series of horizons of soil development with associated human artifacts and events. These horizons were buried by earth materials that were washed into the Little Sioux Valley from the uplands. Data obtained on buried soils, artifacts, animal bones, burned seeds and wood, and snail shells have provided a unique opportunity to reconstruct the changing climate and environment of the region over approximately the last 10,000 years.

This study included a detailed analysis of the geomorphology, stratigraphy, and paleopedology of the Little Sioux Valley and its associated alluvial fans. The present valley of the Little Sioux

is unique because of its large size, complex terrace system, abundant gravel deposits, and complex drainage pattern. The present characteristics are the result of drainage derangement by glacial ice approximately 14,000 years ago. The valley was eroded at a rapid rate between 14,000 and 10,000 years ago. After this period the valley aggraded until about 2,500 years ago, when a new erosional cycle apparently began.

6. Crawford Creek Stratigraphic Study

Bones of potential cultural and historical interest were unearthed during the construction of a Soil Conservation Service dam on Crawford Creek, Ida County. Consequently, the State Historical Preservation Office requested that the Survey conduct an analysis of the geology of the area. Although it was concluded that the site was not culturally important, the determination was made that significant erosion had occurred within the creek basin sometime prior to 2,000 years ago. As a result of this erosion, most of the sedimentary record was removed for the period from 13,000 to 2,000 years ago.

7. Blue Lake Study

The Survey participated with the Iowa Conservation Commission and the Engineering Research Institute in a study of the geohydrology of Blue Lake, an oxbow lake in Lewis and Clark State Park, Monona County. Twelve test hole/observation wells were drilled by I.G.S. to define the sequence of sediments and to obtain data on groundwater levels in relationship to changes

in lake level. Principal conclusions of the study were that:

1. Dredging should be limited to the northern end of the lake,
- and 2. The present supplemental pumping system is ineffective-- to prevent recirculation of lake water, the recharge well should be relocated closer to the Missouri River.

8. Toxic Wastes, Salsbury Laboratories

Three I.G.S. staff members have worked cooperatively with the Department of Environmental Quality, Natural Resources Council, Salsbury Laboratories of Charles City, and E.A. Hickok & Associates to derive an optimal plan for the disposal of arsenical wastes and for monitoring changes in ground-water quality. The several phases of the work included:

- a) Construction of wells and setting recorders for monitoring water levels in the Cedar Valley Limestone Formation and in alluvial sediments of the Cedar River Valley.
- b) Analysis of the difference in hydraulic head for the two aquifer systems.
- c) Definition of areal withdrawal limitations to maintain the head differential.
- d) Earth-resistivity investigations to aid in the selection of a new, controlled disposal site.
- e) Review of several reports prepared by Hickok & Associates on proposed monitoring, waste-treatment, and disposal programs for the old disposal site, an interim storage site and a final long-term approved

disposal site.

9. GREAT II

In August, 1977 the Survey contracted with the U.S. Corps of Engineers, Rock Island District, to coordinate activities of the Dredged Material Uses Workgroup, Great River Environmental Action Team II (GREAT II). The workgroup will collect samples of dredged materials, analyze and describe constituents and properties of the materials, and investigate potential uses for the dredged materials. A legal study will be made of federal, state, and county statutes that may relate to the disposal of dredged material on private, city, county, or state lands.

10. Plum River Fault Zone

A detailed study of the Plum River Fault Zone was conducted as an outgrowth of the Carbonate Hydrology Project and structural mapping for the East-Central Iowa Water Atlas. The fault zone was defined in 1976 (Kolata and Buschbach, Ill. Geol. Survey Circ. 491) as part of a seismic hazard evaluation for a proposed nuclear power generation station near Savanna, Illinois.

The I.G.S. study demonstrated a westward extension of the fault into southern Linn County, Iowa, and narrowed the probable age of major faulting from the previously reported 200,000 - 395,000,000 years ago, to an older 300,000,000 - 395,000,000 years ago. Vertical displacement along the fault zone, and subsequent erosion, are the principal controlling factors for differences in the quantity of water available from wells on either side of the structure.

VI. COOPERATIVE RESEARCH

To implement geologic and hydrologic research in Iowa, the Geological Survey uses the authority granted in Section 305.8, Code of Iowa, to cooperate with federal agencies in cost-sharing programs.

During the current reporting period, the survey continued a 50/50 cost-sharing cooperative program with the Water Resources Division of the U.S. Geological Survey. The objectives of the program are threefold: (1) to inventory the groundwater resource, which involves an overall appraisal of groundwater occurrence and quality in an aquifer or basin-wide organization of information; (2) to maintain surveillance of the groundwater resources which involves maintaining a network of observation wells to determine water-level and chemical quality changes; and (3) to maintain a system for collection and compilation of basic records of daily stage and flow rate of streams and the concentration and total load of sediments carried by streams. The data gathered in these programs form the foundation for good water-management policies and comprehensive planning.

In addition to the broad program objectives, the Iowa Geological Survey is actively cooperating in the following research projects:

1. Hydrology of Carbonate Aquifers of the Eastern Iowa Groundwater District.

The research objectives for this project were outlined in the 30 June 1973 Annual Report.

The integration of surface and subsurface geologic and hydrologic data that includes analyses of core samples, down-hole geophysical logs, and information from pumping tests, permits delineation of the major water bearing zones of the region. Previously, little was known concerning the relationships of these zones to the regional structure and stratigraphy. The Silurian age rock units, although generally considered to constitute a good aquifer, historically have been undifferentiated in subsurface work. Core drilling alone has not solved this problem, but combined with bore-hole geophysics, recognizable horizons have been observed within the system. One of these zones outcrops as the main cavern zone of the Maquoketa Cave System in Jackson county.

Results of this study will be presented in publications under four major topics:

- a) Correlation of geophysical well log records with principal zones of production as determined by packer tests.
- b) Stratigraphic and structural parameters - a description of the physical container.
- c) Geochemistry of the aquifer system.
- d) Digital modeling of the aquifer.

A later phase of the study will include testing and refinement of the digital model with data derived from pumping tests at selected sites. Work on this phase was postponed as a consequence of the mid - 70's drought and reassignment of staff to investigate water resources in northwest Iowa.

2. Hydrology of the Alluvial and Cretaceous Aquifers of Northwest Iowa.

Alluvial Aquifer Study

Interest in irrigation has increased because of the likelihood of continued drought conditions in parts of Iowa during 1976-1977, especially in northern and western Iowa. In the summer of 1976 the Iowa and U.S. Geological Surveys initiated an investigation of the availability of water from the alluvial aquifers of interior streams in these regions. The Floyd River valley between Hinton and Sheldon was selected as the first study area. Data will derive from an inventory of water withdrawals for municipal, irrigation, and domestic use, geophysical exploration for thick alluvial sand and gravel deposits, and drilling and aquifer testing. The extent and spatial distribution of sand and gravel deposits within the Floyd River valley have been reasonably well defined with the completion of a series of 103 test holes that average about 60 feet in depth. Test pumping at selected sites will aid in quantification of the water resources of this alluvial system. In the meantime, water levels are being monitored to determine the magnitude of fluctuation between dry and wet periods.

Cretaceous Aquifer Study

The Cretaceous aquifer, generally referred to as the Dakota Sandstone, is the principal source of water for domestic use and crop irrigation in the upland areas of northwest Iowa. Although it is known that yields are sufficient to support irrigation in some

areas of the region, an intensive research program is essential in order to define the capacity of the aquifer system to support irrigation on both a local and regional basis. Regionally, the volume of water in storage is estimated at between 300 thousand and 7 million acre-feet. The lower value is approximately equivalent to the volume of water presently authorized for irrigation over the entire State, but recharge to the aquifer is estimated at between only 1 thousand and 30 thousand acre-feet per year. Extensive irrigation could result in large-scale mining of water from this aquifer, that is, withdrawals at a rate faster than the aquifer is recharged. Detailed information is needed on the thickness and lateral continuity of the several sandstone units within the Cretaceous sequence, as well as data derived from pumping tests before a reasonable water management program can be established. For these reasons, the Iowa Natural Resources Council (INRC) placed a ban on new irrigation withdrawals from the Cretaceous aquifer, effective 15 June 1977.

A registration program for research wells was authorized by INRC in June, 1977. Under this program, landowners who have made application for the withdrawal of water from the Dakota Sandstone, and for whom a hearing has been held, are eligible to drill a production well and to utilize the water for beneficial use, within the limitations agreed to by contract. Furthermore, the contract requires that a test hole shall be drilled at the site of the proposed production well to a depth sufficient to penetrate into the rock unit subjacent to the Cretaceous System and that an obser-

vation well shall be completed in the same water-producing horizon as the finished production well. Data from a pumping test will be analyzed to determine the geologic and hydrologic parameters of the Cretaceous aquifer. To date, three landowners have participated in this program.

The Iowa and U.S. Geological Surveys began a drilling program as part of the Cretaceous aquifer study in July, 1977. As in the above research well program, test holes are drilled through the entire sequence of Cretaceous rocks. Eight test holes have been drilled to date, one of which was drilled for core recovery. Nearly all previously drilled wells in the region, whether for municipal, domestic, or irrigation use, penetrate only to the upper or middle portion of the Cretaceous sequence. With complete penetration, we are obtaining valuable data that will aid in defining the physical limits of the aquifer system. Drilling problems do not always permit recovery of drill cuttings from the test holes, but geophysical logs can be used to fill these gaps in the information base.

In addition to the research well registration and IGS - USGS drilling project, substantive data is being accumulated from other wells drilled by area contractors. Geophysical logs are obtained from as many of these wells as time and scheduling will permit.

Notwithstanding the impact of irrigation on available water resources, some areas have been burdened with water supply and/or quality problems for many years. Within the limitations of available funding, water samples will be collected for chemical analyses to

determine the relationship of water quality to depth and environment of deposition of the host rock.

3. Jordan Aquifer Research

The Jordan aquifer constitutes the most widespread source of relatively large yields of good to moderate quality groundwater in Iowa. It is the source of supply for many municipalities and industries in the state. As a result, the capabilities of the aquifer to meet the withdrawal demands are being severely taxed in some areas. This is evidenced by significant losses in hydraulic head at a number of points in the state. For example, at Ottumwa the pressure head has decreased 100 feet in 70 years, at Grinnell 100 feet in 80 years, and at Mason City 140-200 feet in 57 years. In an artesian aquifer such as the Jordan, these affects have to be widespread.

To determine just how widespread and significant the head loss is, we have conducted inventories on all wells in the state that produce water from the Jordan aquifer. The inventory includes measurement of the depth to the non-pumping water level to determine what head loss has occurred. We are also gathering well production records to determine how much water has been pumped from the aquifer at that point. From these data we will be able to not only define the historic loss of hydraulic head in the aquifer but also to predict future loss. The information is to be presented in a Water Atlas. Also to be included are maps depicting variations in water quality in the aquifer.

The INRC adopted a new policy governing withdrawals from the Jordan aquifer, effective 15 July 1977. Elements of the policy are: (1) no new permits will be granted for withdrawals for irrigation except where the rate of withdrawal is less than 200 gallons per minute; (2) no permits will be issued for once-through cooling systems for electrical generating plants; (3) permits for industrial use will not be granted for withdrawals of more than 2,000 gallons per minute at any one plant site; and (4) the maximum amount the water level can be lowered across the state from its average levels is set at 200 feet.

4. Water Quality, Iowa Coal Region

Work has commenced to obtain baseline water quality data on six drainage basins tributary to the Des Moines River in Iowa's coal region. The objective is to define existing water quality so that the environmental effects of coal mining upon the water resources can be assessed. Water quality will be analyzed for samples collected on an event basis at representative locations in the area of potential coal development.

The results of sampling along Muchakinock Creek in southwestern Mahaska County formed the basis for planning sampling programs along Whitebreast Creek and other Des Moines River tributaries. Samples were collected along Muchakinock Creek during the low flow period of February-March, and during moderate stream flow in August, 1977. With moderate rainfall and runoff to streams along which little past or present mining has occurred, the pH of the stream water increases and the conductivity decreases. In contrast, the water

in Muchakinock Creek becomes more acidic and the conductivity increases, as acid waters from mined areas reach the stream.

5. Borehole Geophysics

Geophysical logs of boreholes provide a valuable source of information on the geologic and hydrologic parameters of Iowa's aquifers. When arrangements can be made, we are running geophysical logs on wells drilled for municipalities, industry and private institutions, especially on wells that are drilled to the deeper aquifers. Borehole logs obtained by the Survey staffs include electric (spontaneous potential-resistivity), caliper (hole diameter) temperature, conductivity and natural gamma logs.

6. Cooperative Applied Soils Research

During the past several years representatives of the Iowa Soil Survey Program from the U.S. Soil Conservation Service, the State Soil Survey staff of Iowa State University Experiment Station, the Iowa and U.S. Geological Surveys, and members of the Soils Engineering Group at Iowa State University have participated in a cooperative integrated program of research. The Geological Survey is providing geologic data to aid in the initial stages of County Soil Surveys, such as:

1. The thickness of unconsolidated material and the topography of the bedrock.
2. The distribution and lithology of rock outcrops,
3. Flood hazard maps,
4. The participation of Geological Survey staff in soil survey field reviews.

In addition, the Geological Survey is carrying on the following specific studies as part of this cooperative research effort:

1. Comparison and correlation of particular soil series with large magnitude floods. This analysis has been very successful to date and results in a very useful planning tool. We have worked with several communities and counties relative to floodplain zoning, flood insurance, and flood damage assessment problems.
2. Quantification of soils engineering information. The number of requests received for soils engineering information is increasing. An active program is underway to quantify cohesion, angle of internal friction, bearing capacity, optimum moisture and density, Atterberg limits, shrinkage properties, etc., for soil profiles and their geologically correlative parent materials. About 50 sites have been investigated to date, and data has been obtained on approximately 120 soil series.
3. Cooperative evaluation of the use of remote sensing in soil surveys.
4. Continuing evaluation of the stratigraphy, mineralogy, hydrology, and geochronology of the unconsolidated materials of the state, including detailed soil-geomorphic studies to model soil-landscape relationships. This year joint detailed studies were conducted in Buchanan, Cherokee, Clayton, Delaware, Des Moines, Dickinson, Dubuque, Fayette, and Marshall Counties.

5. Sand and gravel resources. Soil survey information provides a detailed data base for the location of potential sand and gravel resources.

VII. COMPREHENSIVE STATE WATER PLAN

The Geological Survey staff assigned to the Water Plan Division have concentrated their efforts on the task of developing three comprehensive reports for the Iowa Water Resources Framework Study. These reports were the assigned responsibility of three water plan study task forces chaired by the Geological Survey, namely: Water Availability, Water for Fuel and Energy, and Data Base and Needs. During the reporting period these reports were completed, reviewed and submitted to the Technical Coordinating Committee. Staff of the Survey have worked with this committee to review task force reports prepared by the other State agencies involved in compiling material for the development of the State Water Plan. Summaries of nine task force reports will comprise the final Framework Study Report.

The elements of the task force report on Data Base and Needs differ from those of the other reports. The objective with this report is to provide an overview of the state's data collection programs and activities related to water. Two progress reports and a final report were completed, but the bulk of the information is presented in tabular form in the Iowa Water Resources Data System (IWARDS) catalog as a section on data and data collection activities. In addition, the IWARDS catalog includes: an index of state and federal agencies, and state institutions involved in water resources

management and/or data collection, in which their responsibilities, data collection programs, and current activities are summarized; a cross-referenced subject index of the Iowa Legal Code and the Iowa Administrative Code regulations pertinent to water resources; and finally, a subject-indexed bibliography containing over 1,000 entries on Iowa water resources publications.

The development phase of the IWARDS program is nearly completed, and we look forward to an operational phase that will benefit state agencies involved with water resources, and aid in the ultimate development and implementation of a State Water Plan. The scope of services that will be available through the IWARDS program includes:

1. Data Base Management System. IWARDS will provide, and support on the state computer, Data Base Management Software. Any state agency may use this software, to avoid the cost of acquiring or developing their own. It will enable them to do a variety of data processing tasks using a simple command language, rather than having to write special programs.
2. Clearinghouse. IWARDS will serve as a data reference service by maintaining a data index and bibliography, and will serve as a National Water Data Exchange (NAWDEX) Local Assistance Center. IWARDS will assist in the retrieval of data for requestors and will store frequently requested data sets on the state computer so that participants can access them directly. Priorities and procedures for this are to be set by the IWARDS Advisory Committee.

3. Systems Analysis. IWARDS will assist state agencies in evaluating the applicability of the DBMS for their data processing needs, in training of operators, and performing transition tasks. IWARDS will also perform non-routine analysis and display processing for a nominal charge. This processing, analysis and display service will include statistical summaries, cross tabulations, and computer mapping, utilizing available package programs at the University Computer Center in Iowa City.

4. Research. In support of studies performed by state agencies, IWARDS will undertake investigations directly related to EDP techniques and information system issues as appropriate to serve needs identified by the Advisory Committee.

Apart from in-house functions in support of the water plan effort, staff of the Survey have participated further in the following activities:

- Public participation program.
- Provided materials and consultation for revision of task force reports generated by other agencies.
- Assisted in development of the state's response to the "Federal Water Policy Study."
- Reviewed and commented on documents prepared by the Upper Mississippi River Basin Commission and the Missouri River Basin Commission relative to their respective comprehensive planning and inputs into the Water Resources Council's national assessment.
- Provided water planning information to public interest groups and regional planning groups.

VIII. REMOTE SENSING LABORATORY

The Remote Sensing Laboratory (RSL) has continued to provide technical assistance, service, and information to governmental agencies and to the public, and has continued research into new applications of remote sensing techniques to data collection problems. New imagery acquired by RSL reflects the cooperative nature of our program and its orientation towards natural resources issues (fig. 6). The Helena Chemical Company was photographed to provide the Department of Environmental Quality with data on possible herbicide contamination. Selected Missouri River oxbow lakes were imaged to enable the Conservation Commission to evaluate the effect of drought on this wetlands resource. Blackhawk Lake was photographed to provide a basis for making decisions on resource and recreation development. Imagery was obtained in the vicinity of the Duane Arnold Energy Center to monitor any possible vegetation changes that might occur as a consequence of plant operation. Other imagery acquired recently is being used to evaluate sand and gravel resources and to study structural features of Iowa's bedrock.

A measure of the success of the RSL cooperative programs is provided by the fact that agencies that have worked with the RSL are now developing their own independent remote sensing programs. The Conservation Commission is obtaining and interpreting photography of lands under their control. The Corps of Engineers, Rock Island District, routinely obtains imagery of many Iowa rivers for planning and permit purposes. The Corps also is using photography to monitor significant flood events.

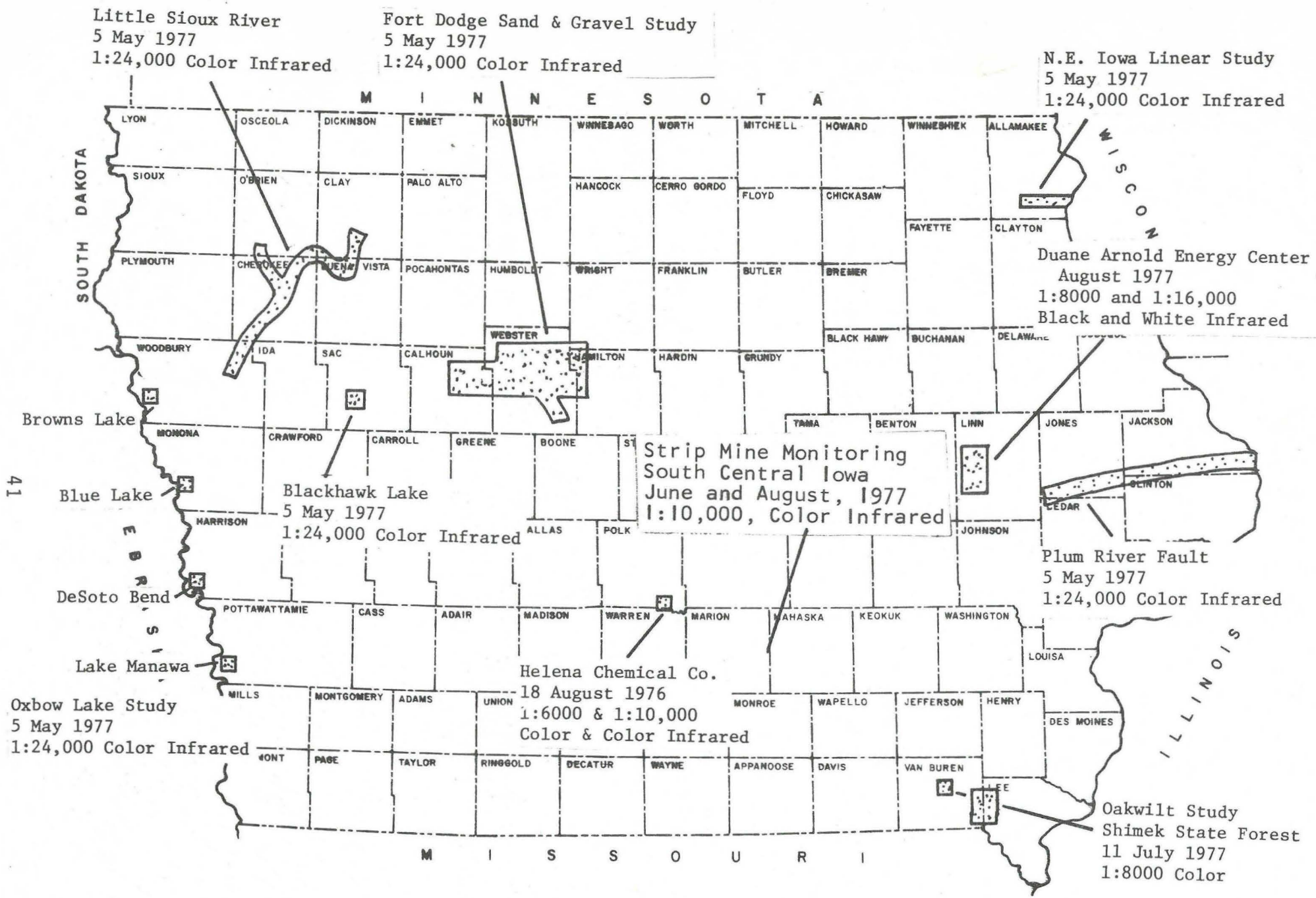


Figure 6. Aerial photography acquired, July 1976-December 1977

To fulfill its responsibility as an information source, RSL has maintained current data on the aerial and space imagery available for Iowa. The Guide to Aerial and Space Imagery of Iowa has been updated and is ready for printing. Additionally, RSL is Iowa's representative in the USGS's Aerial Photographic Summary Record System (APSRs), which is a national inventory of available aerial photography. APSRS receives information on Iowa photography from RSL. In return, APSRS provides RSL with microfilm copies of the entire national inventory.

In the past, RSL has concentrated on developing and implementing low cost photographic remote sensing techniques tailored to fit a specific agency problem. The prohibitive cost of satellite data processing and the low resolution of the imagery generally precluded the use of this type of data in Iowa. Now, however, processing costs are falling dramatically, and the resolution soon will be increased significantly. A new "technology transfer" program developed by NASA is designed to assist states in acquiring the expertise necessary to utilize this less expensive, higher resolution data. As part of this technology transfer program, RSL and other state agencies are planning a demonstration project to be conducted with assistance from NASA. This project will give state personnel a first-hand opportunity to evaluate and become familiar with natural resources data systems which use digitally processed satellite data. The State needs to keep abreast of new developments in this area of remote sensing, and the NASA program will provide an excellent vehicle.

Major research programs of RSL for the reporting period are:

1. Flood Inundation Mapping. This program was designed to develop a post-crest, color infrared, flood-mapping technique. Testing of the horizontal accuracy of the photographic procedure was completed in 1976, and the results were presented at two professional meetings. A public information circular is being prepared. More importantly, the Rock Island District of the Army Corps of Engineers has incorporated this technique into their flood assessment program. Through the cooperation of the Eros Data Center and the Earth Resources Laboratory, the research is being extended to include the application of digitally processed Landsat data to flood inundation mapping.

2. Oak Wilt Survey. The cooperative study to determine the incidence of oak wilt (Ceratocystis fagacearum) in selected Iowa forests has been completed. The study was conducted by the Iowa Conservation Commission and the Remote Sensing Laboratory, with assistance from the U.S. Forest Service and the Amana Society. Techniques were developed for identifying diseased trees from color aerial photography. The forests studied were Amana (1975), Yellow River State Forest (1975), Stephens State Forest (1976) and Shimek State Forest (1977). Results indicate that oak wilt is not presently a major problem in Iowa, affecting an average of only one in every three hundred oak trees. After five years, a follow-up study will be made to reevaluate the occurrence of the disease and to monitor its spread.

3. Crop Damage Assessment. During the past year RSL has been investigating the application of remote sensing techniques to the monitoring of both flood and drought-produced crop damages. Time-sequential color infrared aerial photography was used to estimate damage to row crops resulting from inundation by flood waters. Hopefully, this technique can be refined and used to replace costly ground inventories.

RSL has also been studying the use of Landsat digital data for predicting the yield of drought-stressed corn. Preliminary research conducted by General Electric Corporation in cooperation with the Iowa State University Extension Service suggests that the yield of drought-stressed corn can be estimated using Landsat reflectance data. A follow-up study planned by RSL was aborted due to cloud cover. Present plans call for an analysis of 1977 growing year data in a joint RSL, Earth Resources Laboratory demonstration project.

4. Migratory Geese Study. RSL and the Conservation Commission continued to refine their photographic geese inventorying procedure during 1976. Eros Data Center provided use of their digital analysis laboratory which made it possible to produce the first computerized count of geese. Thus, an accurate, permanent census record of geese can be derived from aerial photography.

5. Strip Mine Monitoring. RSL continued to acquire repetitive, color infrared aerial photography of active coal strip mines in Iowa. The first mine registered under Iowa's

strip mine reclamation law was imaged before earth moving began, thus providing a record of the original configuration of the site. The use of color infrared photography to monitor mine development, activities, and reclamation has been documented.

6. Sand and Gravel Exploration. Color infrared photography has been obtained near Fort Dodge and BlackHawk Lake and along a portion of the Little Sioux River. RSL will evaluate the utility of this imagery for preliminary sand and gravel exploration. Interpretations of the imagery will be compared to soil maps, earth resistivity measurements, and field sampling data. Previous RSL evaluations of the technique have been very general; this project will provide a more rigorous test.

7. Analysis of Rock Fractures. Large and small scale geologic features loosely classed as lineaments have been mapped in various parts of the world using aerial photography and satellite imagery. These features are interpreted as rock fractures and, as such, may be helpful in interpreting the structure and stratigraphy of an area. Also, these fractures may have important implications for groundwater movement and mineralization. The orientation of segments of many streams in Iowa is controlled by such fractures in the rock, even where thick glacial deposits occur.

A working map of lineaments in Iowa was prepared using Landsat imagery and various topographic maps. More detailed

analyses were made along the Des Moines River, the Yellow River, and the Plum River Fault Zone of east-central Iowa. Tentative conclusions suggest that satellite and aerial imagery, combined with maps and field geologic data, may be useful for developing models of the subsurface geology and structure of Iowa.

8. Land Classification of South-central Iowa from Computer Enhanced Images. This research, sponsored by NASA under contract NAS5-20832, has been completed and the final report sent to NASA.

IX. DRAFTING AND ILLUSTRATING

Illustration and art work services for all divisions of the Geological Survey are provided by the Illustrating and Drafting Division. In addition, contract work has been done for the Iowa Natural Resources Council and the Office for Programming and Planning.

We have purchased a vacuum frame that will enable the use of specialized graphic films. This will eliminate the need for hand preparation of multiple copies of line drawings for use in color illustrations.

The technique of using a vacuum frame is part of a larger process called scribing. Scribing is used by the U.S. Geological Survey and by major companies for map production. If capital improvement funds are appropriated for the necessary renovations in Calvin Hall, we will make the transition to scribing. The results will be:

(1) a reduction in drafting and printing time, (2) lower publication costs, and (3) a higher quality product.

X. LETTERS OF COMMENDATION

The official name of some state geological surveys has been changed in recent years. With such a change, the name usually becomes longer, such as 'Bureau of Geology and Mineral Technology'. The intent is to utilize a name that better describes the actual function of these agencies.

We are proud of the name 'Iowa Geological Survey' as it stands, as we are proud of the long tradition of quality service to the people of Iowa. The excerpts listed below, from letters sent by individuals, might interest the Geological Board. They are representative of the letters of appreciation that we received from time to time, and also of kind words staff receive orally.

From: Stephen E. Himmell, P.E.

French-Reneker-Associates, Inc., Fairfield, Ia.

"I would like to take this opportunity to express my appreciation for the fine service you and the Survey offer. Your information is always clear and concise even for the laymen of the Councils who direct the operation of their various (city) groundwater supplies."

"The towns value your service. In fact I've run into waterworks people who are downright possessive of their IGS letter."

From: John D. Gunter, Asst. Professor
University of Northern Iowa, Cedar Falls, Ia.

"I just received a copy of....Iowa Landforms. Its a beautiful publication and one that was badly needed."

From: Lubon Hiszczynskyj
Associated Engineers, Fort Dodge, Ia.

"I have received all the data and information I need for the design of new wells for the towns of Lohrville, Beaman, Shellsburg, and Lehigh. As usual your information was very complete and thorough for which I express my sincere thanks and admiration."

From: Harold P.Guy, Hydrologist
U.S. Geological Survey, Water Resources Division, Reston, Va.

"The authors, the District Chief, the Iowa Geological Survey, and others involved are to be commended for their role in the preparation and publication of Fluvial Sediment Data for Iowa. I think the book will be a "best seller". The Quality of Water Branch should encourage other Districts to prepare a similar compilation."