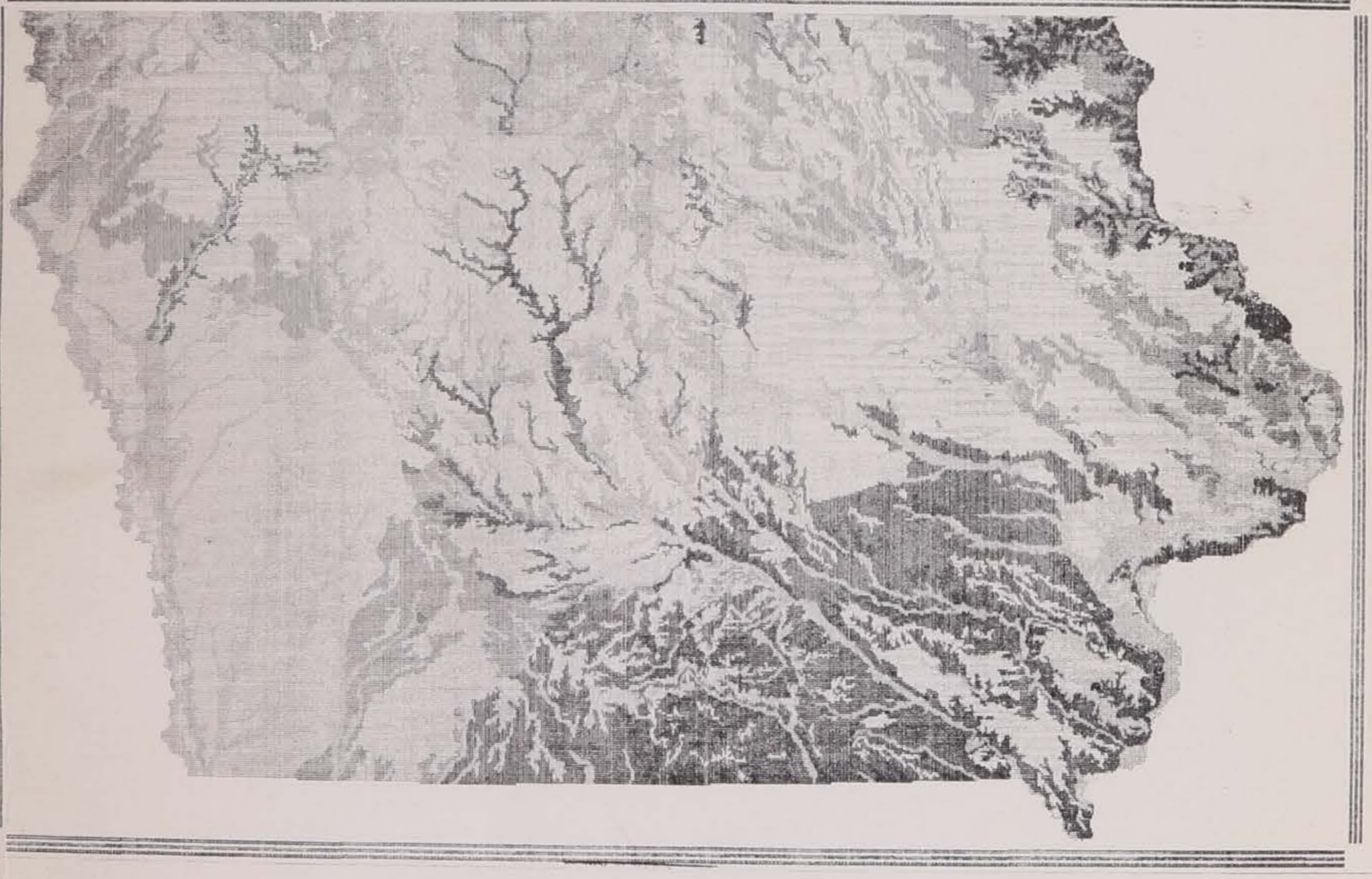
# STATUS REPORT OF THE LAND USE ANALYSIS LABORATORY

for the period

November 1, 1973 through November 1, 1974





Iowa Agriculture and Home Economics Experiment Station
Iowa State University of Science and Technology
Ames, Iowa 50010

November, 1974

# STATUS REPORT OF THE

# LAND USE ANALYSIS LABORATORY

for the period

November 1, 1973 through November 1, 1974

Iowa Agriculture and Home Economics Experiment Station
Iowa State University of Science and Technology
Ames, Iowa 50010
November, 1974

November 14, 1974

John P. Mahlstede, Associate Director
Agriculture and Home Economics Experiment Station
Ames, Iowa

Dear Dr. Mahlstede:

This document presents a status reporting of the Land Use Analysis Laboratory for the period, November 1, 1973, through November 1, 1974. The report includes a review of work products, data preparation, and in progress activities. As a summary of the research conducted with funding from the Agriculture and Home Economics Experiment Station, this document does not represent a reporting of research findings. However, this status report does present documentation of some of the research activities which have been or will be reported in other papers.

As a selected representation of the work of the Land Use Analysis Laboratory, this report reflects the interdisciplinary relationship of the staff and the science with practice research goal.

Respectfully yours,

James B. Sinatra

James B. Sinatra, Director
Land Use Analysis Laboratory

Paul F. Anderson

Glenn H. Beavers

Diane K. Devick

David D. Faxlanger

Timothy L. Shuck

J. Craig Taggart

CONTENTS

## ABOUT THIS REPORT

This publication represents a summary of the activities of the Land Use Analysis Laboratory over a period of approximately one year. This period, comprising portions of two fiscal years and portions of two calendar years, represents a transition period in which the Laboratory has been able to develop from pure and applied research a methodology for the preparation and application of information in a computer information system. Although the research work of the Laboratory is incomplete, there are several portions of work which are available for application.

The Laboratory has been engaged in four research thrusts. (1) The development of various soils information capabilities for the computer information system where data preparation methods, data classifications, and data applications are areas of investigation. (2) The development of extended computer program analysis capability involving classification of spatially correlated data and diversification of information processing methods. (3) The application of experimental data classes to planning problems involving the spatial interrelationship of vegetation-land cover data, soils data (both detailed soils information at three seconds resolution and soil association information at thirty seconds resolution), geologic data classes, and surficial water data classes (both watersheds data at thirty seconds resolution and streams data at ten seconds resolution). (4) The examination of the organization of data units (nominal scale, ordinal scale, and interval scale) in the preparation of a classification of data units before data preparation.

Where possible, this report highlights the available information and tools. However, a significant part of this report discusses ongoing work and continuing methods development. Included in this report are: discussions of computer mapping products prepared in the past year, a listing of the data available for use and the data in preparation, a discussion of programs available for application, a review of reports prepared or in preparation, a review of application projects, and a discussion of future work envisioned by the Laboratory staff.

The research and application accomplishments of the Laboratory would not have been possible without the cooperation, support, and interest of individuals and organizations. These individuals and organizations include: the Iowa State Conservation Commission and in particular Dr. Gene Klonglan, past research supervisor of the wildlife section, and numerous other wildlife research and management biologists; the Story County Board of Supervisors; and the Iowa State University Computation Center. Also included are the following members of the Iowa State University faculty and staff: Dr. Thomas E. Fenton, Associate Professor of Agronomy; Dr. Lyle V. A. Sendlein, Professor of Geophysics; Dr. Robert C. Palmquist, Associate Professor of Geology; Dr. George W. Thomson, Professor of Forestry; Dr. Roger Q. Landers, Professor of Botany; Mr. Steven D. Cecil, Research Associate; Mr. Robert W. Dyas, Professor of Landscape Architecture; Mr. Thomas A. Barton, Professor of Landscape Architecture and Head of the Department; Dr. Merwin D. Dougal, Professor of Civil Engineering and Director of the Iowa State Water Resources Research Institute; Dr. Rolland L. Hardy, Professor of Civil Engineering; Dr. Richard E. Carlson, Assistant Professor of Agricultural Climatology; Dr. Larry D. Wing, Associate Professor of Zoology and Entomology; Dr. Michael K. Petersen, Assistant Professor of Zoology and Entomology; Dr. Robert B. Moorman, Professor of Zoology and Entomology; and Dr. Milton W. Weller, former Professor of Zoology and Entomology (now at the University of Minnesota, St. Paul). Certainly the products of the Laboratory could not have been produced without the twenty-two technical aides who prepared data.

## THE ROLE OF THE LABORATORY

The Land Use Analysis Laboratory, an interdisciplinary research team, has as its general purpose the development of tools for land use planning and management through both pure and applied research. Although the Laboratory is concerned with the conceptual basis of the use of the systems developed in research, the systems themselves are a major part of any study. A fundamental part of the development of an information system is the evaluation of the user's needs for information and the preparation of a data base which will fulfill those needs. Without the examination of the system in application, the Laboratory's research effort would be incomplete.

Both the interdisciplinary nature of the Laboratory's staff and the applied studies nature of the Laboratory's work cause the role of the Laboratory to be diverse. The research work of the Laboratory loses much without demonstrations of application in the user's planning environment. The feedback from this application aspect is invaluable. At the same time, the application of the Laboratory's methods, data, and computer programs is not possible without continuing research. No one member of the Laboratory's staff is involved exclusively in either area of work, though certainly some members are more involved in one area than the other.

The dual nature of the Laboratory's work indicates that the support of the Laboratory should come both from research and from application sources. To a small extent this already occurs when planning users, such as the Story County Board of Supervisors or the East Central Intergovernmental Association, provide funds for an application of the Laboratory's techniques. The research funding that the Laboratory has received from the Iowa Agriculture and Home Economics Experiment Station should not be expected to cover applied work beyond that necessary to the research in progress. It seems feasible at this point to develop funding for the application work of the Laboratory from the users and from other sources which may have a direct interest in the availability of the Laboratory's methodology.

## COMPUTER PRODUCTS

Computer output maps and tables have been produced at the Land Use Analysis Laboratory both for methods development and for methods application. Some computer products are primarily for either methods development or for methods application, but many products serve both goals. Methods development includes testing new data, testing new analysis techniques, and testing new program additions or changes. Methods application includes working with other University groups, local governments, and government agencies, such as the Story County Board of Supervisors and the Story County Conservation Board, to evaluate the usefulness of the methods developed in planning situations.

The methods used in classifying data within a particular data class have a great impact on the use of that data. The computer output maps prepared for the evaluation of data base preparation provide information on interpretive limits of each particular data classification. As a result of the importance of data base preparation, a large number of interpretive maps have been prepared in the evaluation process.

The Laboratory has also been cooperating with the Tennessee Valley Authority in a study demonstrating the exportability of the Laboratory's methods. Data was prepared independently by the Tennessee Valley Authority with minimum instruction by the Laboratory. Their data was then sent to the Laboratory for partial debugging and some demonstration analysis. The resulting computer products were then returned with the data to the Tennessee Valley Authority for evaluation.

The following 42 maps and summary tables are representative of the computer products that have been produced by the Laboratory in the past year. The maps are arranged according to the geographic area they cover: statewide, Story County, and special maps and summary tables. These computer products demonstrate the wide range of resource data resolutions and applications which may be processed by the information system and computer program, MSDAMP, developed by the Laboratory.

# STATEWIDE COMPUTER MAPS

One aspect of the Laboratory's information system is its ability to be used over large areas and in quite diverse locations. This coverage versatility is based on the use of a reference system[1] which does not restrict either the area covered or the location of a study zone. Statewide data represents an example of the coverage versatility. The maps prepared from statewide data are interpretations to answer specific questions or are presentations of information of a broad based type. Although some relatively specific results may be obtained, the data is too general for most local planning purposes.

Data classes represented in the statewide maps and the statewide datafiles are applicable to questions of a regional nature. In fact, the resolution, cartographic complexity, and detail of information are comparable to the natural resource information found in many county studies prepared by engineering firms[2]. However, the ability to vary the factors and the ability to compare several subjective judgments makes the information available in the Laboratory's statewide data classes more useful. In addition, the Laboratory has demonstrated that more detailed information is desirable for local planning (for example, on a county basis). The more general data represented by the statewide maps is applicable to regional (multiple county) planning with the addition of some intermediate resolution data to complement the interpretations.

The statewide maps in this section are representative of large area interpretations. The addition of other statewide data classes now in preparation will make this data more useful and extend the specificity of the interpretations that can be made.

---

[1] Beavers and Shuck, 1974, Research Considerations - A Location Reference System. Land Use Analysis Laboratory, Iowa State University, Ames, Iowa

[2] Associated Engineers Inc., 1969, Green County Iowa, A Comprehensive Plan. Associated Engineers Inc., Fort Dodge, Iowa

Associated Engineers Inc., 1967, Pocahontas County Iowa, Comprehensive Water and Sewer Plan. Associated Engineers Inc., Fort Dodge, Iowa

Stanley Consultants, 1971, Comprehensive Plan, Ringgold County, Iowa Stanley Consultants, Muscatine, Iowa

Veenstra and Kimm, 1972, Fayette County, Iowa, Comprehensive Development Plan. Veenstra and Kimm, West Des Moines, Iowa

## STATE SOIL ASSOCIATIONS - PHYSIOGRAPHIC REGIONS

Physiographic regions determined primarily by slope and topographic form are represented in this map. Darker symbols represent more level landscapes, the lightest symbols represent the rougher landscapes. Within slope and landform groupings there are separations according to surface and near surface geologic material and soil drainage character. There are twenty-four interpretive classes of data which have been derived from eighty-eight input classes of data. This map was produced as a part of a series of interpretive maps based on state soil association data (soil association map of Iowa, scale 1:253,440, prepared by T. E. Fenton, 1974, unpub.). Each of the 227,400 sample points is thirty seconds of arc resolution and represents approximately 157 acres.

STATE SOIL ASSOCIATIONS - POTENTIAL HAZARDS TO AGRICULTURE

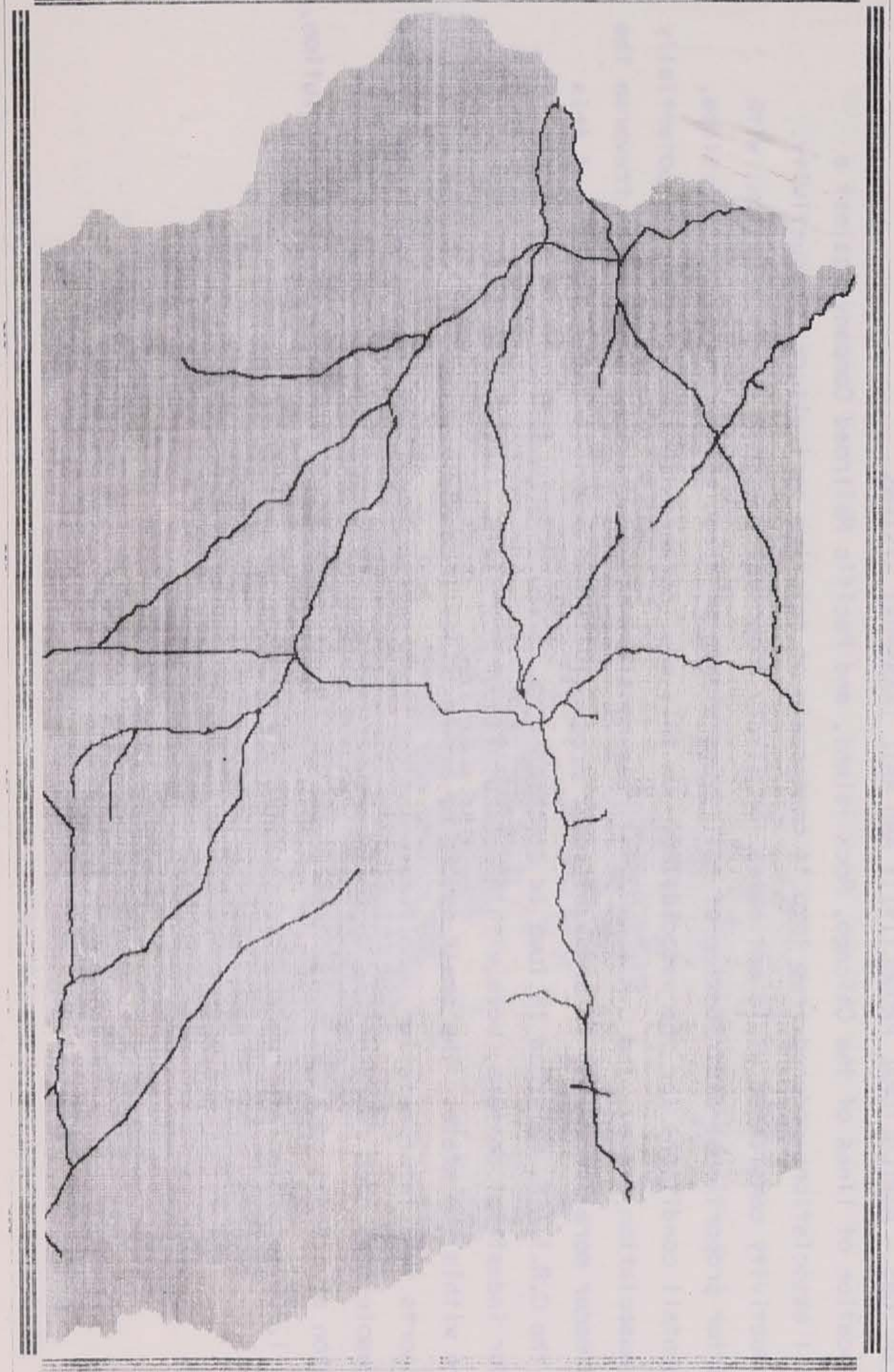
Estimated nature and severity of hazards are indicated on this map. Darker symbols represent areas which can be cultivated intensively that have fewer, less significant hazards. Lighter symbols represent areas with several significant hazards which diminish intensity of agricultural use. Such areas may have lower crop yields and more extensive areas of pasture and timbered land. This map was produced as a part of a series of maps based on state soil association data (soil association map of Iowa, scale 1:253,440, prepared by T. E. Fenton, 1974, unpub.). Each of the 227,400 sample points is thirty seconds of arc resolution and represents approximately 157 acres.

STATE SOIL ASSOCIATIONS - WILDLIFE, RECREATION, AND AESTHETIC POTENTIAL

This map indicates recreational potential. Darker symbols represent areas which have high scenic value and offer a diversity of recreational activities such as hiking, canoeing and hunting. These areas usually are hilly or steep and have large amounts of woodland. Lighter symbols indicate areas with little recreational potential. These areas are usually intensively cultivated and only the occasional marshy areas are available for outdoor recreation. This map was produced as a part of a series of maps based on state soil association data (soil association map of Iowa, scale 1:253,440, prepared by T. E. Fenton, 1974, unpub.). Each of the 227,400 sample points is thirty seconds of arc resolution and represents approximately 157 acres.

STATE RAIL TRANSPORT SYSTEMS - CHICAGO, ROCK ISLAND, AND PACIFIC RAILROAD

The distribution of rail transport facilities (primarily roadbed) is shown for the Chicago, Rock Island, and Pacific Railroad Company. This data class is still in preparation and will provide, when completed, similar information for the other railroad lines of the state. Each of the 11,900 sample points is ten seconds of arc resolution and represents approximately 17 acres; the map resolution is thirty seconds of arc resolution and each symbol represents approximately 157 acres.



STATE SOIL ASSOCIATIONS - AGRICULTURAL PRODUCTIVITY AND RAIL TRANSPORT SYSTEMS

This map shows location of lines of the Chicago, Rock Island, and Pacific Railroad Company against a background of soil associations ordered from 1 to 14 on a scale of relative agricultural productivity. Estimates of productivity considered yield estimates for likely component soils of the association, with assumptions made for proportional distribution of soil types within an association, and of typical slope, drainage, and rainfall conditions for the association. On this map, darker symbols indicate more potentially productive soil association areas. The C.R.I.& P. Railroad consists of several long lines which traverse the state, and which occur more frequently in areas of lower productivity. A possible interpretation of this pattern is that the C.R.I.& P. Railroad in Iowa is oriented more toward through haulage of heavy goods and toward service for industrial centers, both within and outside of the state, than toward agricultural commodity service within the state. The small number of branch lines in areas of high agricultural productivity supports this interpretation. Soil association data consists of 227,400 sample points of thirty seconds of arc resolution, each representing approximately 157 acres. This data is based on maps prepared by Dr. T. E. Fenton at a scale of 1:253,440. Railroad line data was sampled at ten seconds of arc resolution, and each of the 11,900 sample points represents approximately 17 acres.

STATE GEOLOGY - UNITS SEPARATION

Data units of the state geology datafile are represented in this map, and were separated to provide good visual contrast. There are twenty classes shown on the map, but no particular relationship between the shading and the qualities represented by the data is made. Each of the 227,600 sample points is thirty seconds of arc resolution and represents approximately 157 acres.

STATE GEOLOGY - RESOURCE TYPES

The general geological resource types are separated on this map. Six basic separations are provided with sub-separations representing a qualification of the exactness of the resource definition. For example, clay-shale resource is shown as a middle gray symbol with variation representing whether the data unit is a particular formation (darker) or a more general delineation (lighter). The shades represent, from light to dark, 1) no particular resource, 2) sulfate resource, 3) limestone resource, 4) clay-shale resource, 5) sand resource, and 6) coal resource. Each of the 227,600 sample points is thirty seconds of arc resolution and represents approximately 157 acres.

# STORY COUNTY COMPUTER MAPS

Within the past year, new Story County resource data was prepared to replace data not compatible with the current computer program (MSDAMP). Geology, soils, streams, topography, and vegetation data were each prepared at the resolution appropriate to that data source rather than at a single compromise resolution for all data sources[1].

The data prepared for Story County is generally more detailed in resolution than statewide data sets. This permits demonstration of the computer program and analysis techniques on the county planning level. For example, soil association data was prepared for the state at thirty seconds of arc resolution. Because this data is too generalized for most needs at the county level, detailed soils data was prepared for Story County at three seconds of arc resolution.

The Laboratory and the Story County Board of Supervisors are cooperating in methods application[2]. User needs and feedback are being incorporated into the study as a result of a series of meetings with the Supervisors. Additional data was prepared and new interpretations were made in response to requests by the Board of Supervisors.

Resource analysts used the information for geology, soils, vegetation, and wildlife analyses. The maps that follow show either a separation of the basic data, selected data variables for emphasis, or interpretations of the data. Interpretations were made using one data class (for example, soils) as well as using multiple data classes (for example, soils and vegetation). The data is also being used to delineate priority areas for county planning or for further study.

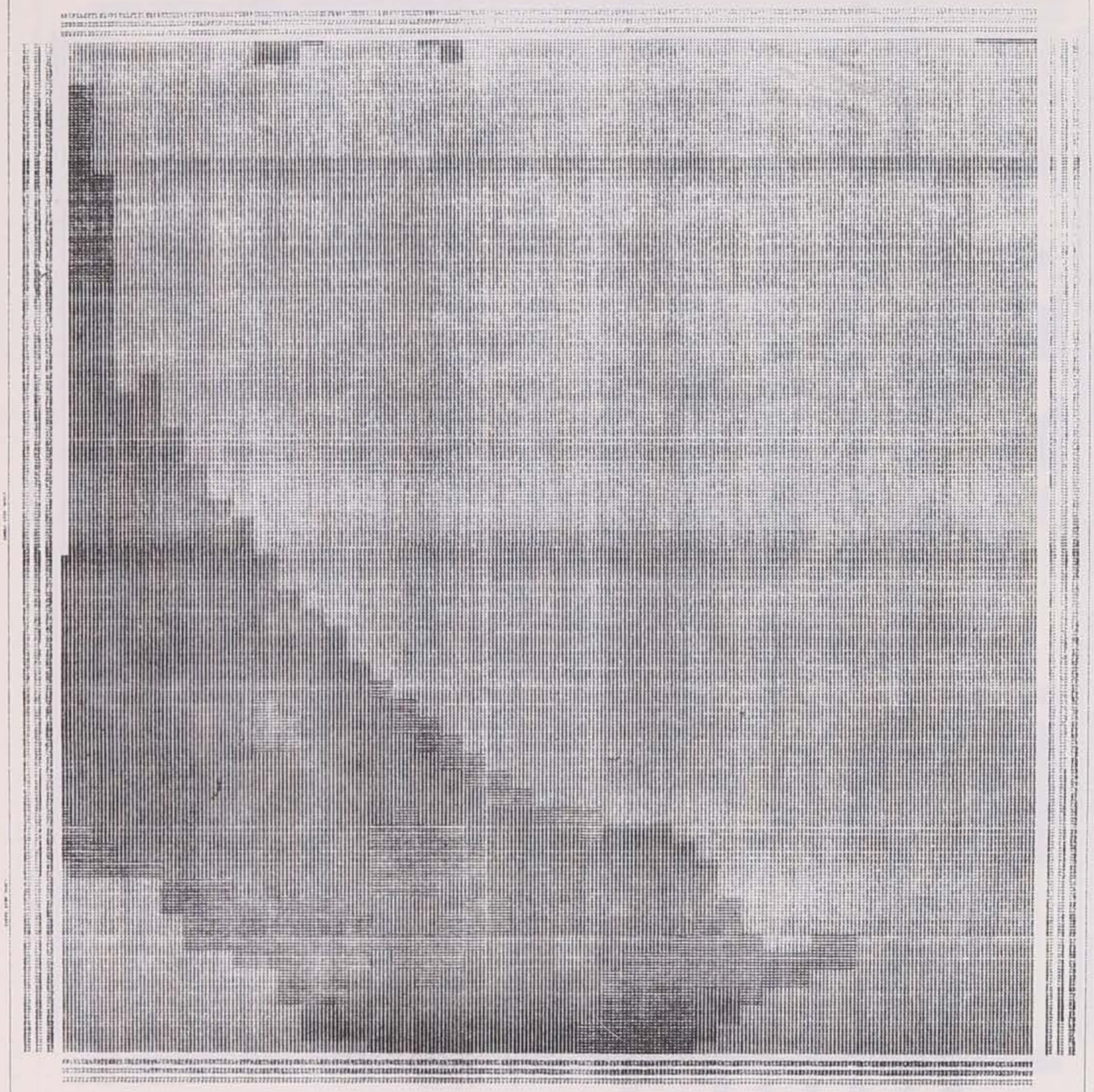
---

[1] See the Datafile Status section of this report for the specific data classes, resolution, and areas of coverage.

[2] See the Projects section of this report for further discussion.

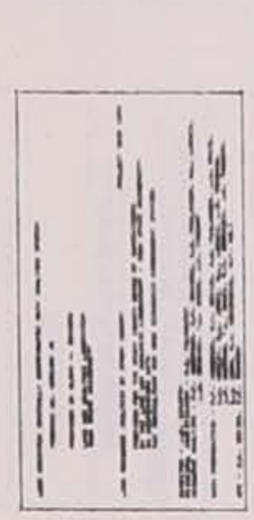
STORY COUNTY GEOLOGY - BEDROCK CONTACT TYPE

The map shows the relative age, type, and distribution of the consolidated rocks exposed at the surface, or immediately underlying unconsolidated surficial deposits. Dark gray symbols indicate the Mississippian age Osage series, gray symbols the Mississippian age Meramec series, and light gray symbols the Pennsylvanian age Cherokee group. This bedrock geology map can be used to determine the extent of bedrock aquifers, the location of potential mineral resources, and the location of potential hazard zones. Each of the 14,100 sample points is thirty seconds of arc resolution and represents approximately 156 acres.



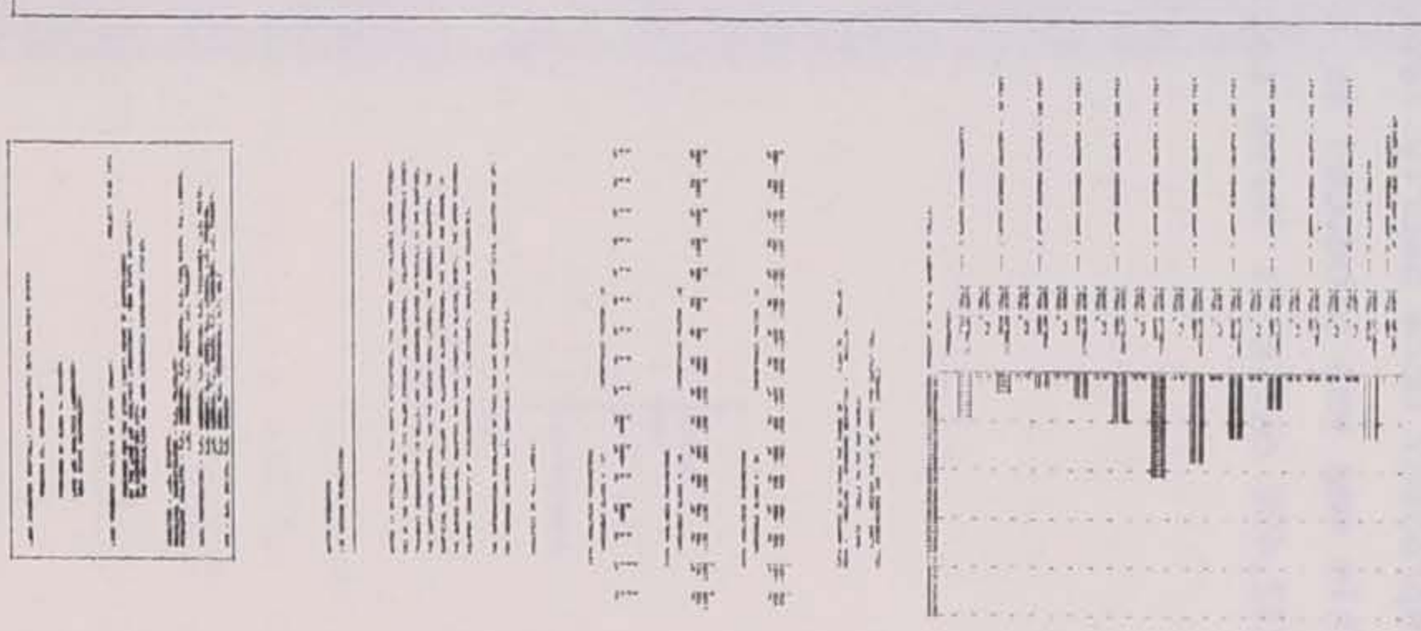
STORY COUNTY GEOLOGY - MINERAL RESOURCES

Mineral resources in Story County include limestone, sand and gravel, coal, and clay-shale. Darker symbols indicate possible coal or clay-shale resources at various depths, gray symbols indicate possible limestone resources, white areas indicate possible sand and gravel resources (with other resources possibly present), and light gray symbols indicate areas where no extensive mineral resource is likely to be present. The map was produced to show only the potential occurence of the resource, not its actual presence, since no field investigations accompanied the preparation of this map. Each of the 14,100 sample points is thirty seconds of arc resolution and represents approximately 156 acres.



STORY COUNTY GEOLOGY - WATER RESOURCES

Important water resources in Story County include the major streams and aquifers. Gray symbols indicate the upper bedrock aquifer at various depths, light gray symbols indicate the alluvial aquifer and buried channel aquifer, and the white area indicates the upper bedrock aquifer at or near the land surface. The map was produced to locate these resources as a factor in land use decision-making. Each of the 14,100 sample points is thirty seconds of arc resolution and represents approximately 156 acres.

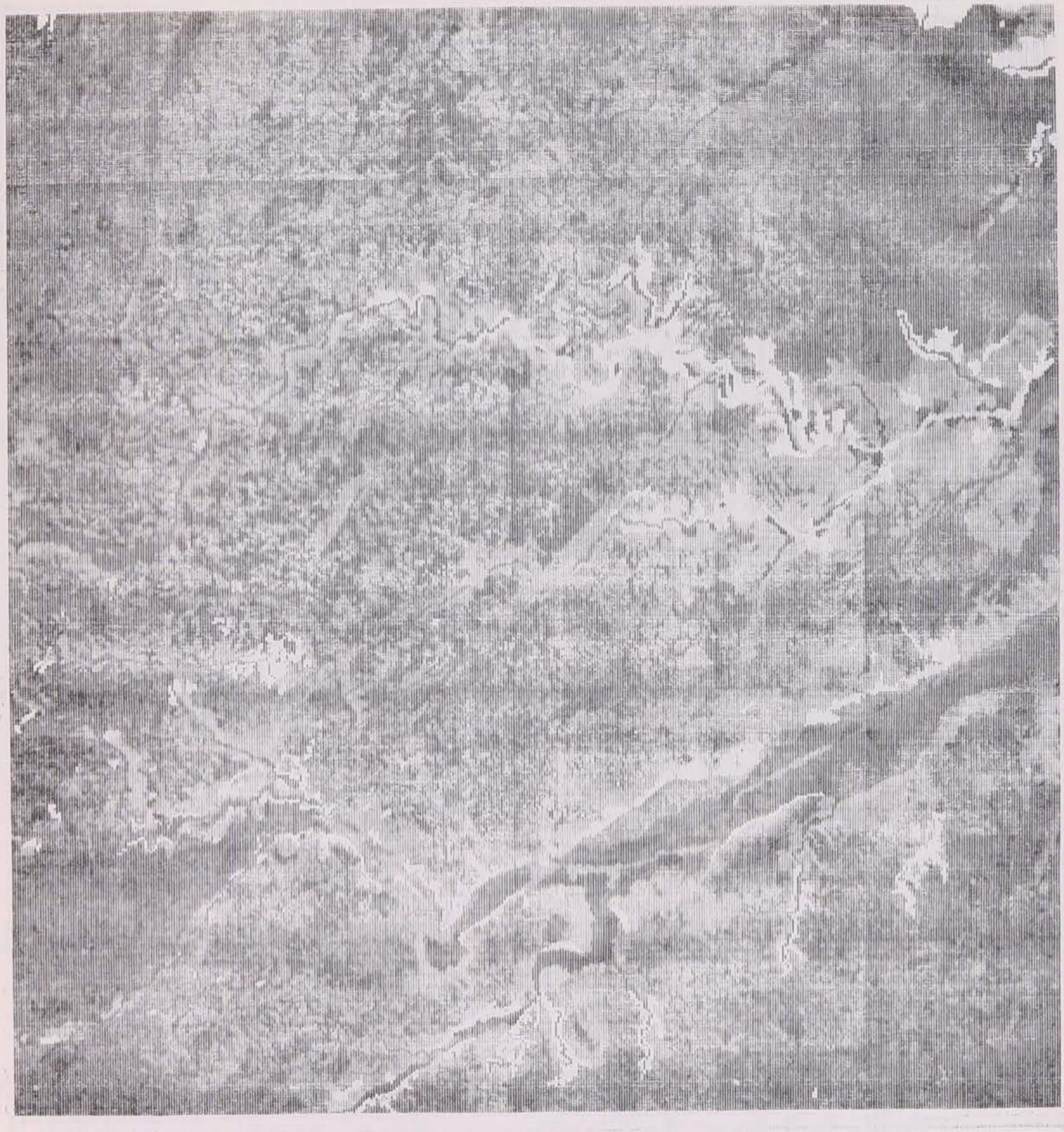


STORY COUNTY SOILS - LANDSCAPE TYPES

This map depicts the distribution of twenty-seven different categories of landforms. Darkest symbols represent more nearly level and poorly drained soils. Lighter symbols indicate steep well drained areas. This map was produced as a part of a series of interpretive maps using soil information. Each of the 232,400 cells is three seconds of arc resolution and represents approximately 1.564 acres.

STORY COUNTY SOILS - AGRICULTURAL SUITABILITY

This map shows the distribution of soils in Story County suitable for intensive agricultural activity. Values are assigned to the map units according to extimated corn suitability ratings based on correlations with soils in similar landscape positions mapped to modern standards in neighboring counties. Darkest symbols indicate the best soils. Highly productive soils are found in extensive areas of the uplands and along the floodplains. Least productive areas, represented by lighter symbols, occur along valley walls, on coarse textured terraces, and on upland windblown deposits. The map was produced as a part of a series of interpretive maps using soils information. Each of the 232,400 cells is three seconds of arc resolution, and represents approximately 1.564 acres.

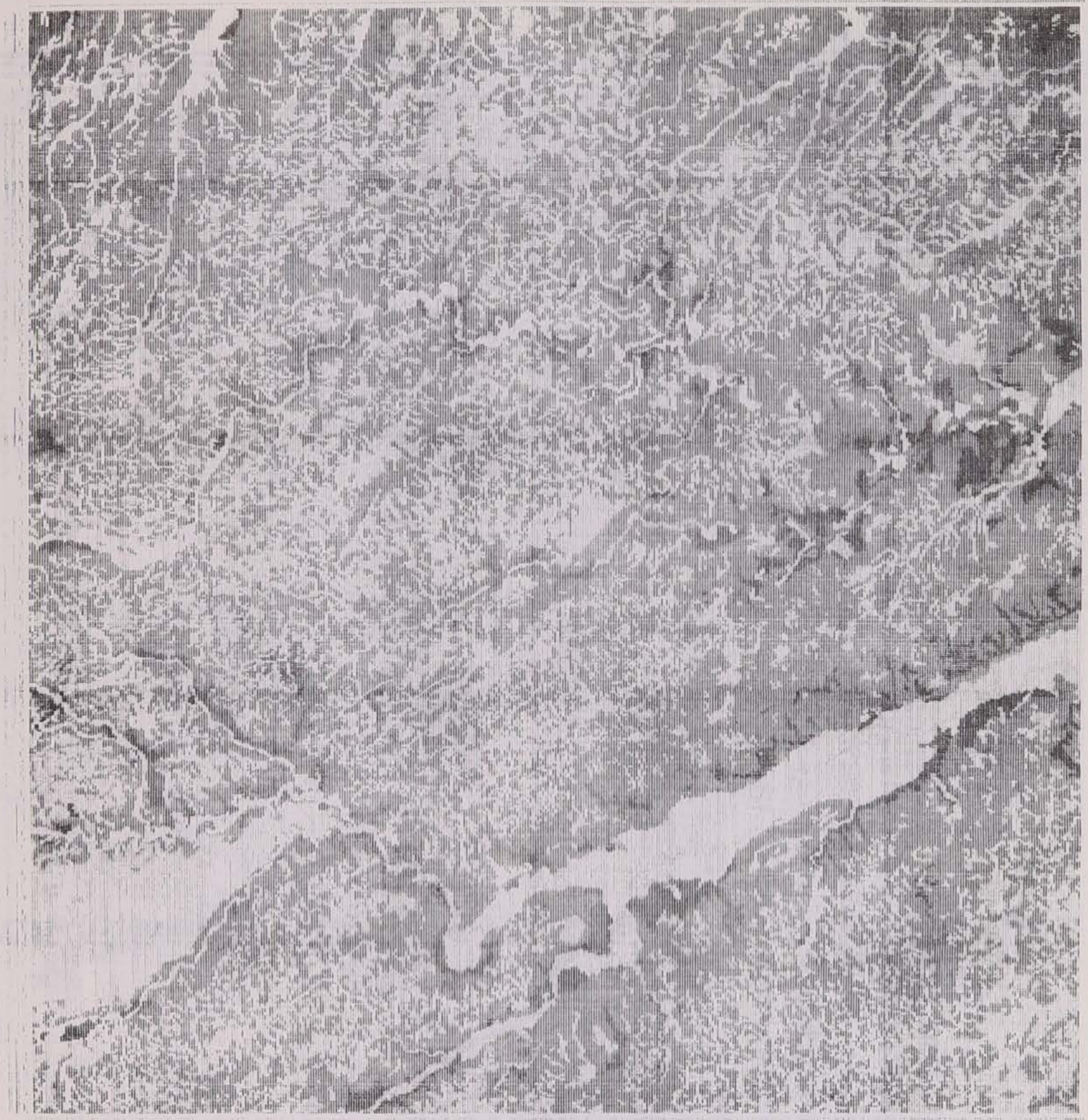


STORY COUNTY SOILS - URBAN SUITABILITY

This map shows the pattern of distribution of soils in Story County suitable for urban development purposes such as residential development and small building construction. Darker symbols indicate soils suitable for development with few hazards and good foundation character. Lighter symbols are subject to such hazards as flooding, sewage disposal limitations, and low bearing capacities. This map was produced as part of a series of interpretive maps using soils information. Each of the 232,400 cells is three seconds of arc resolution and represents approximately 1.564 acres.

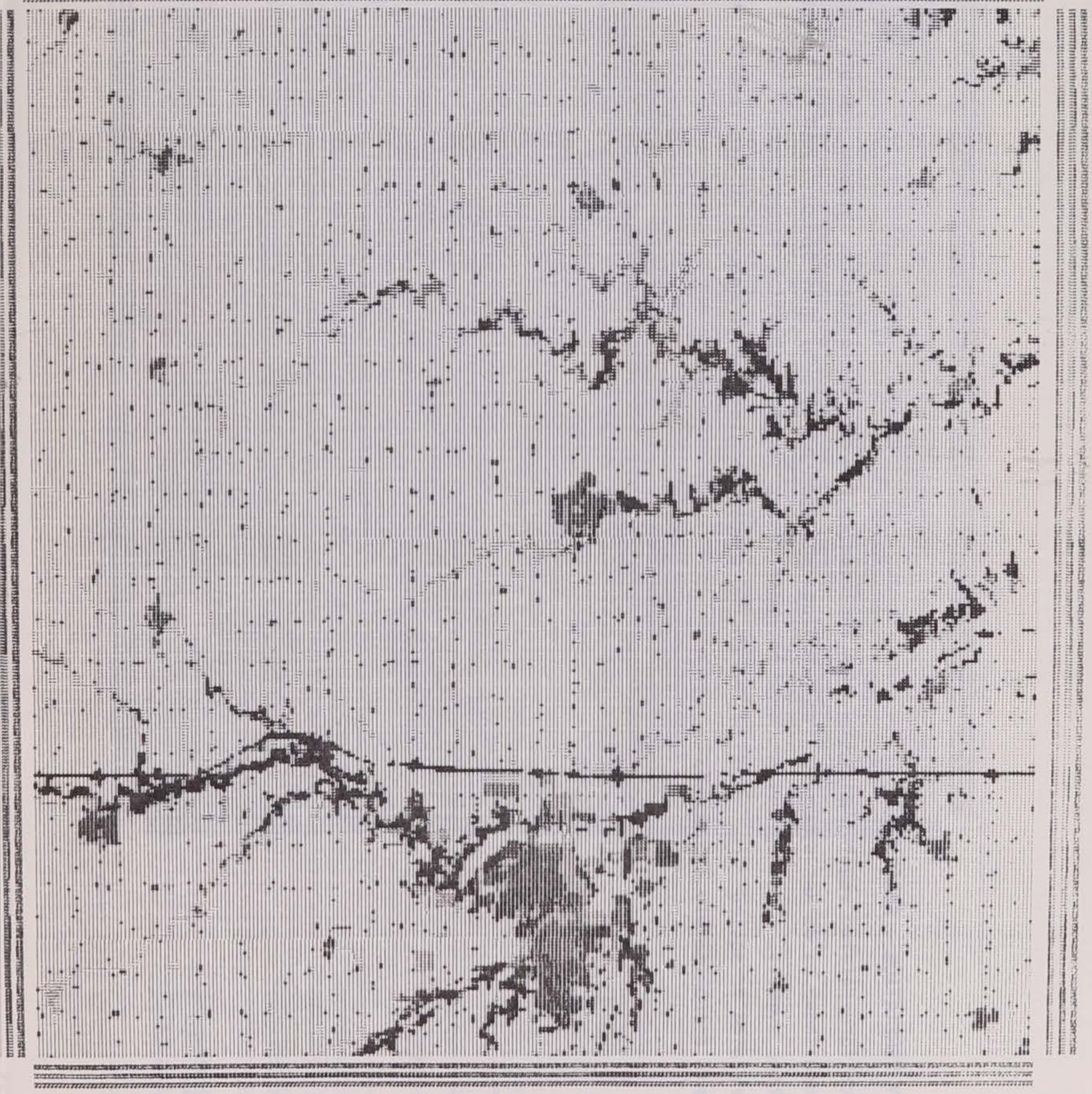
STORY COUNTY SOILS - URBAN AND AGRICULTURAL SUITABILITY

This map indicates the maximum suitability for residential and small building construction with the minimum impact on agricultural production. Darker symbols are on terraces and gently rolling to sloping uplands. Lighter areas are either unsuitable for urban development, or are so highly suitable for agricultural production that development would involve loss of a significant resource. This map was produced as a part of a series of interpretive maps using soil information. Each of the 232,400 cells is three seconds of arc resolution and represents approximately 1.564 acres.



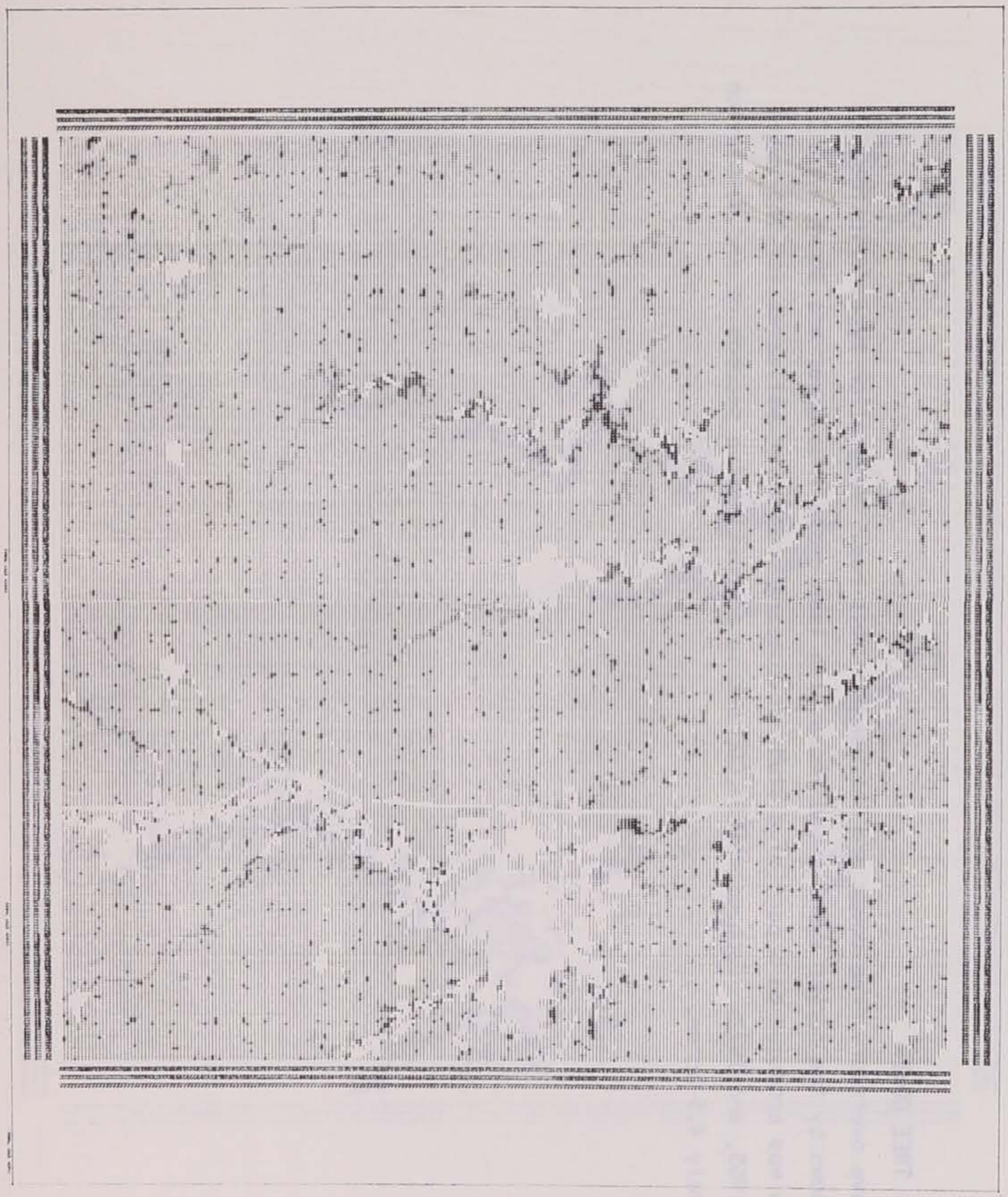
STORY COUNTY VEGETATION - MAJOR TYPES

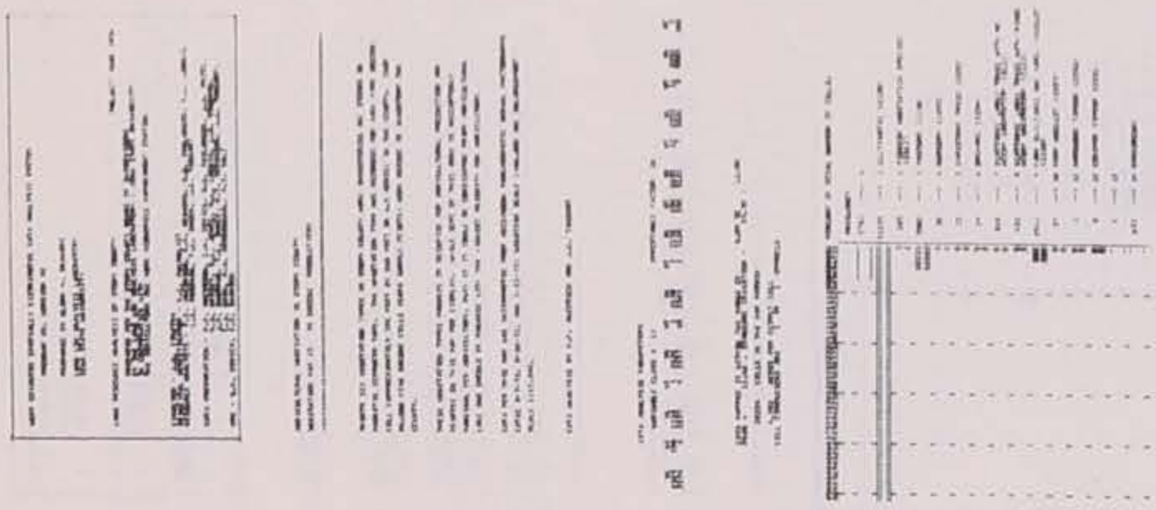
The thirty-six vegetation types inventoried in Story County were grouped into twenty major types for this map. Interstate highways and densly wooded stream valleys are shown by the dark symbols, urban vegetation by dark gray symbols, and cultivated vegetation by light gray symbols. The map was produced to quantify the county's major vegetation types. Each of the 84,000 sample points is five seconds of arc resolution and represents approximately 4.5 acres.



STORY COUNTY VEGETATION - AGRICULTURE

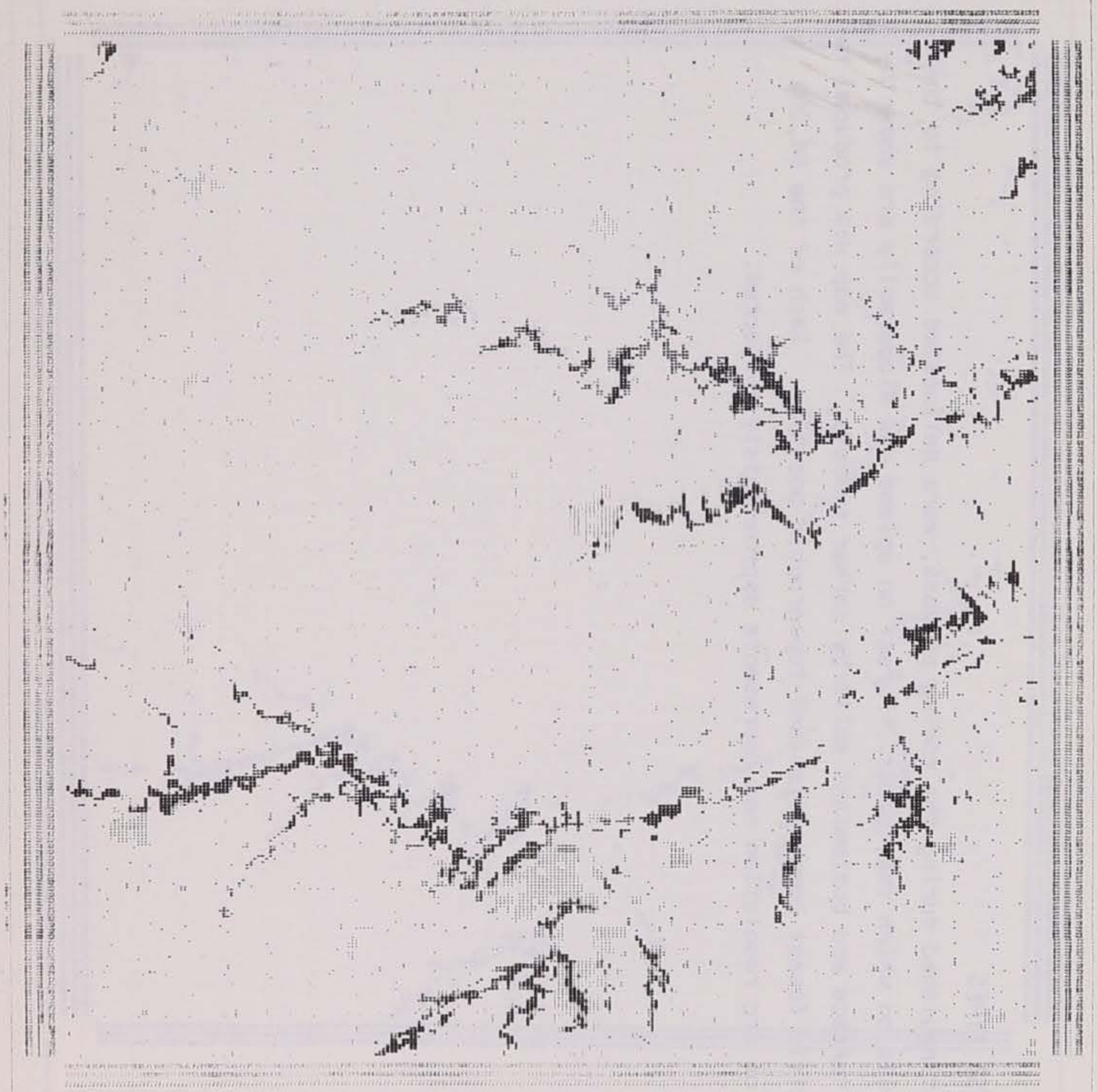
Twelve agriculture-related vegetation types were included in one map for emphasis. Wooded pasture and farmsteads are shown by darker symbols, tree plantings and open pasture by gray symbols, and cultivated land by lighter symbols. The map was produced to quantify and locate vegetation types directly or indirectly related to agriculture. Each of the 84,000 sample points is five seconds of arc resolution and represents approximately 4.5 acres.

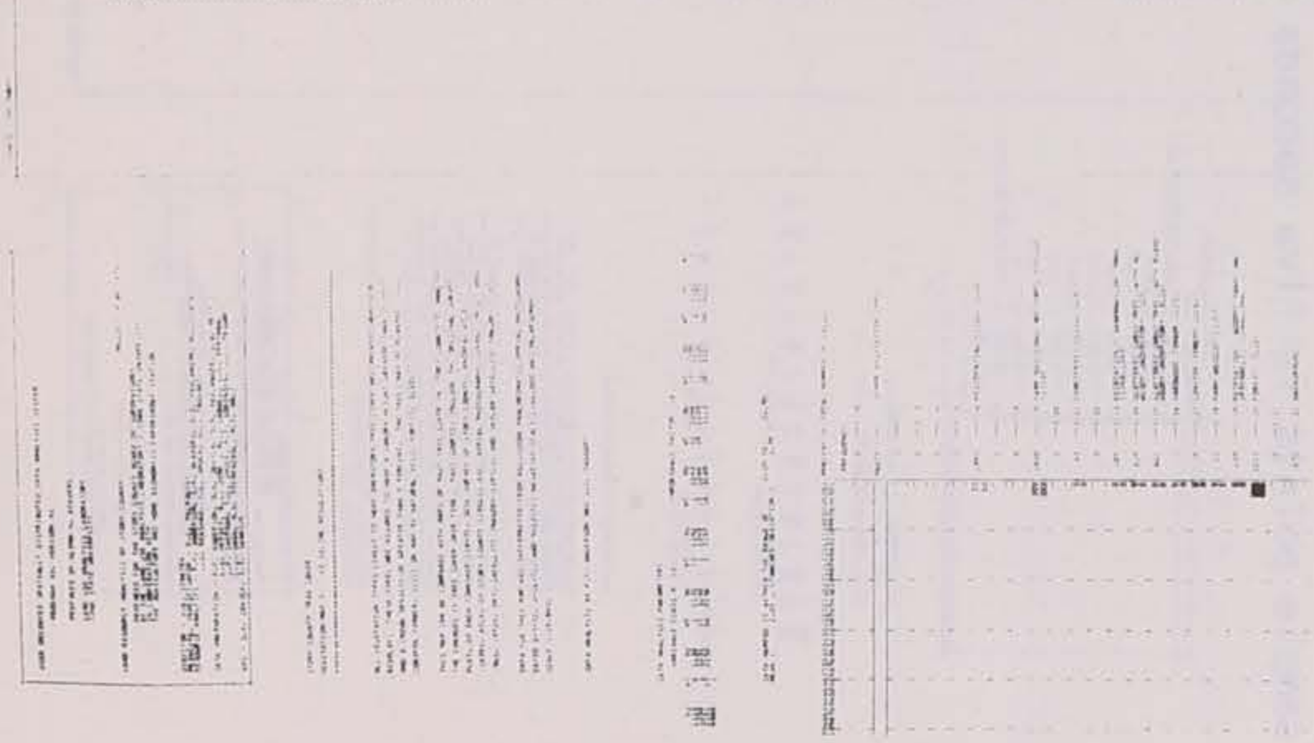




STORY COUNTY VEGETATION - TREE COVER

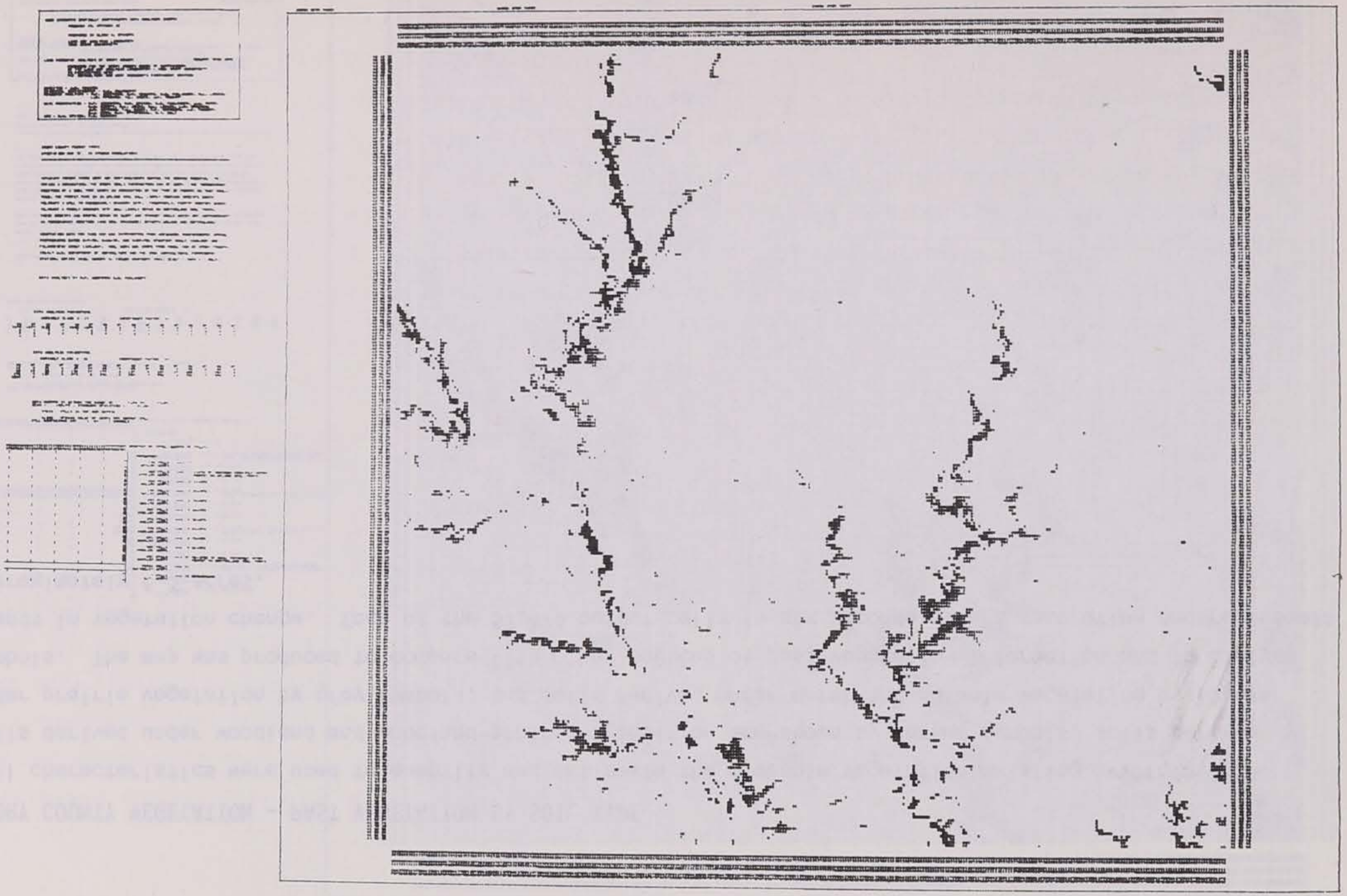
Vegetation types which have overstory tree cover are included in this map. Vegetation types with the densest tree cover are shown by the darker symbols and those with less dense tree cover are shown by lighter symbols. The map was produced as a part of a study to compare tree cover estimates for the years 1875, 1902, 1939, 1953, 1965, and 1972. Each of the 84,000 sample points is five seconds of arc resolution and represents approximately 4.5 acres.





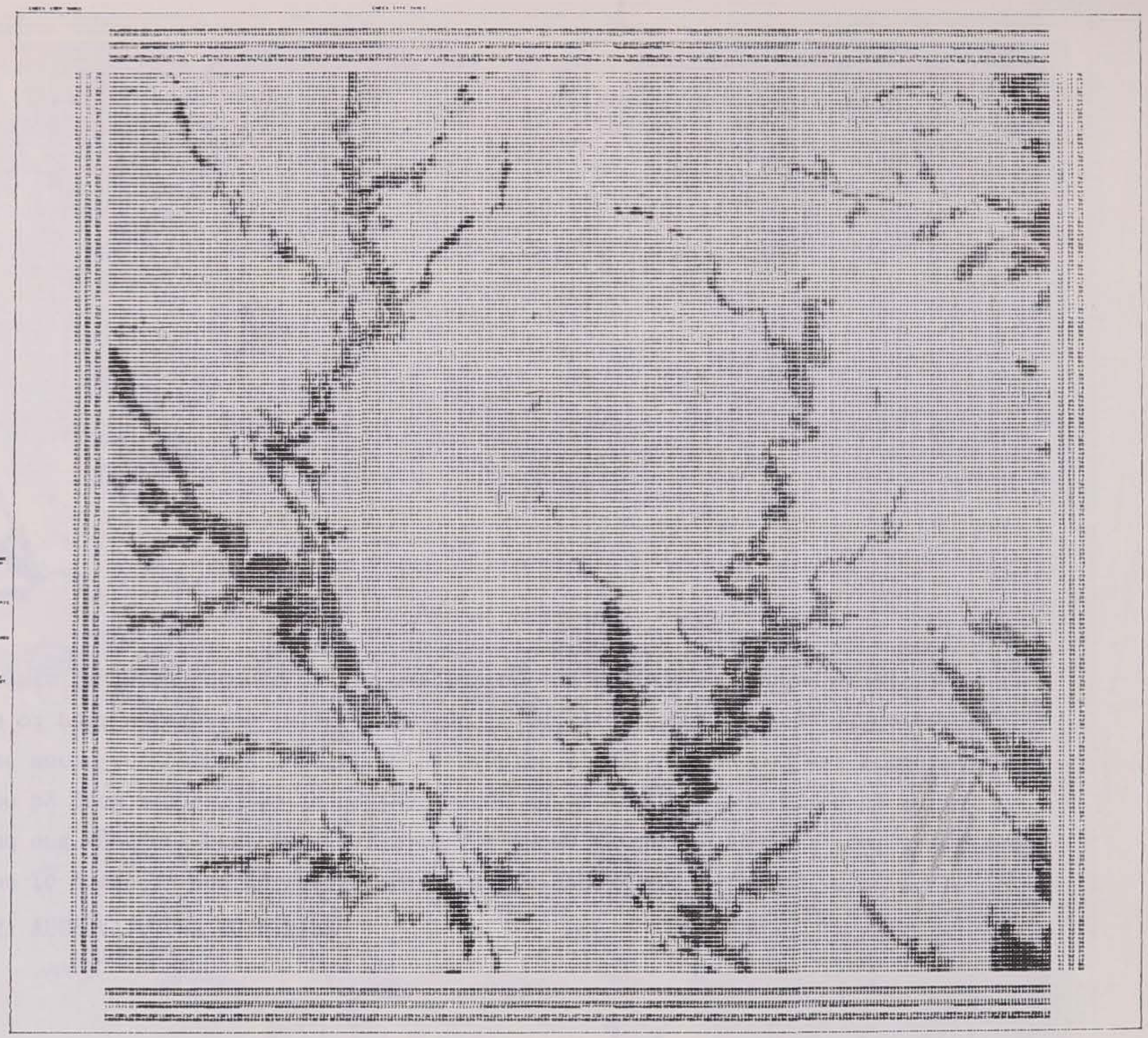
STORY COUNTY VEGETATION - FOREST TYPES

Specific forest types, not distinguished during the coding process, were delineated according to the topographic position of the soils on which they occur. Forest on upland and slope soils are shown by lighter symbols and forest on terrace and bottomland soils by darker symbols. The map was produced to test correlations between specific forest communities and topographic position. Each of the 84,000 sample points is five seconds of arc resolution and represents approximately 4.5 acres.



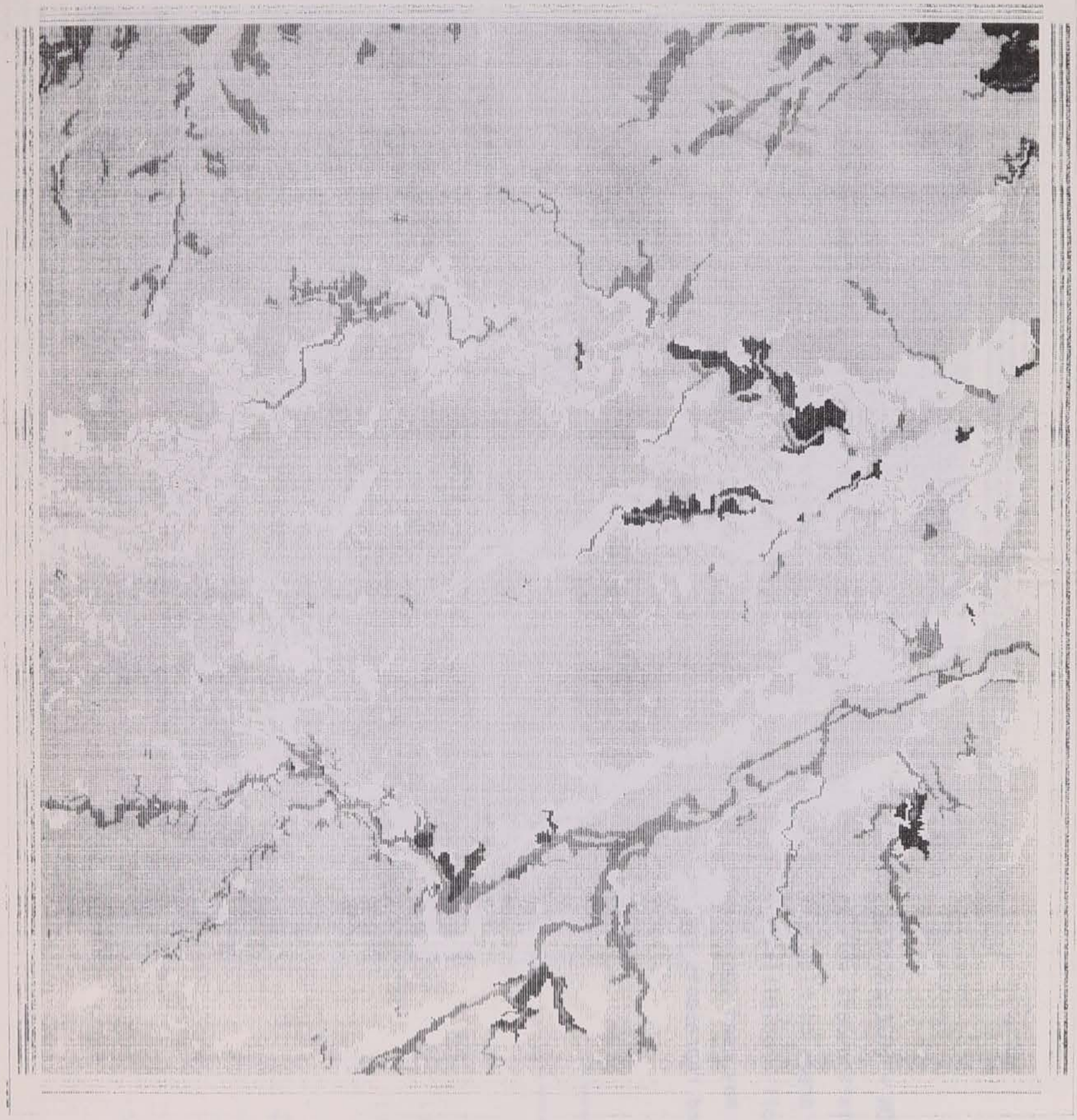
STORY COUNTY VEGETATION - PAST VEGETATION BY SOIL TYPE

Soil characteristics were used to quantify and delineate the probable vegetation existing prior to 1850. Soils derived under woodland and woodland-prairie transition are shown by darker symbols, soils derived under prairie vegetation by gray symbols, and soils derived under marsh and pothole vegetation by lighter symbols. The map was produced to compare with other sources of past vegetation information and to analyze trends in vegetation change. Each of the 57,474 output cells is six seconds of arc resolution and represents approximately 6.3 acres.



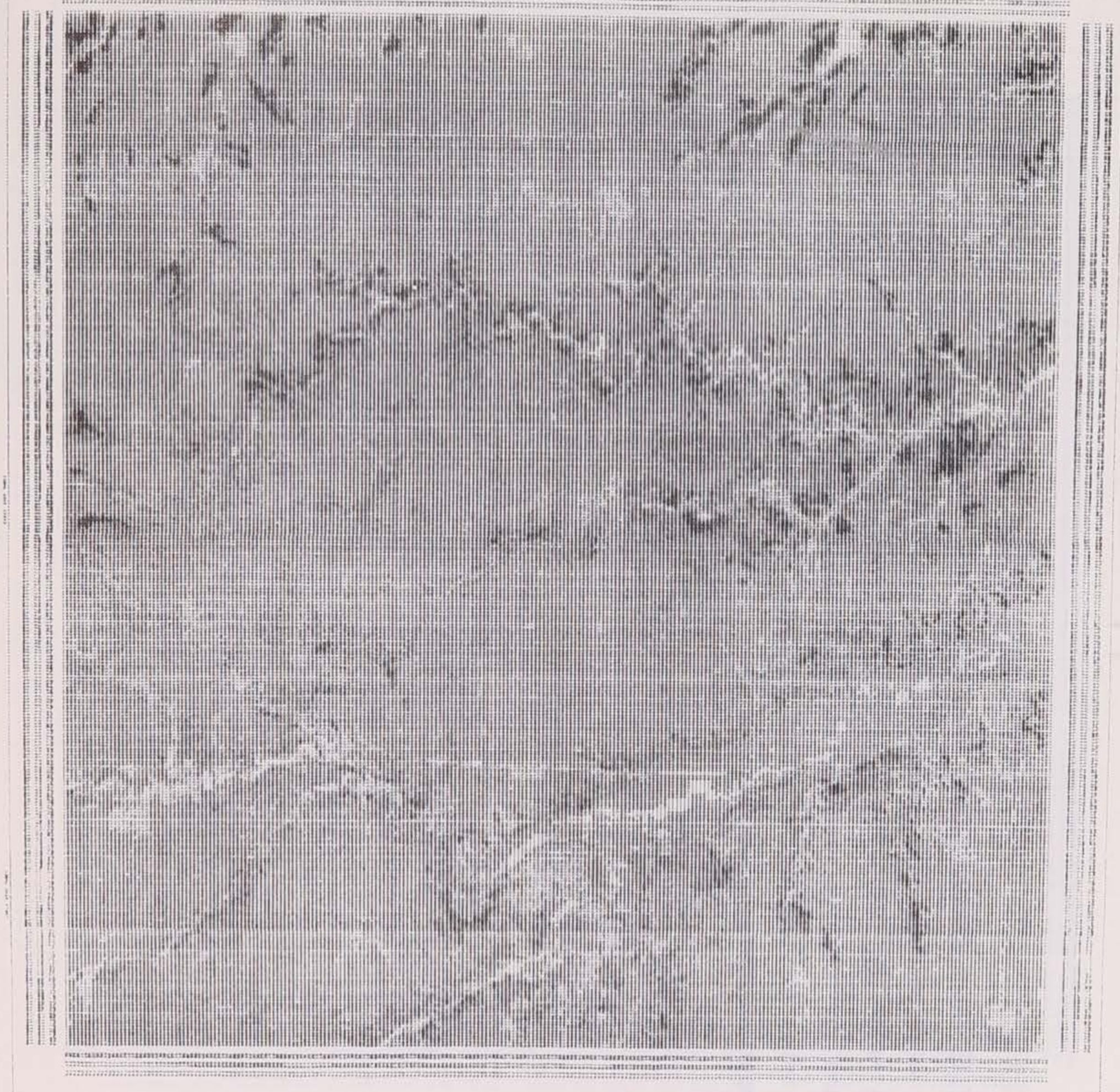
STORY COUNTY VEGETATION - PAST VEGETATION BY SOIL TYPE

Soil characteristics were used to quantify and delineate the probable vegetation existing prior to 1850. Soils developed under woodland and woodland-prairie transition are shown by darker symbols, soils derived under mesic prairie vegetation by gray symbols, soils derived under xeric prairie vegetation by white areas, and soils derived under marsh and pothole vegetation by lighter symbols. The map was produced to compare with other sources of past vegetation information and to analyze trends in vegetation change. Each of the 233,500 sample points is three seconds of arc resolution and represents approximately 1.6 acres.



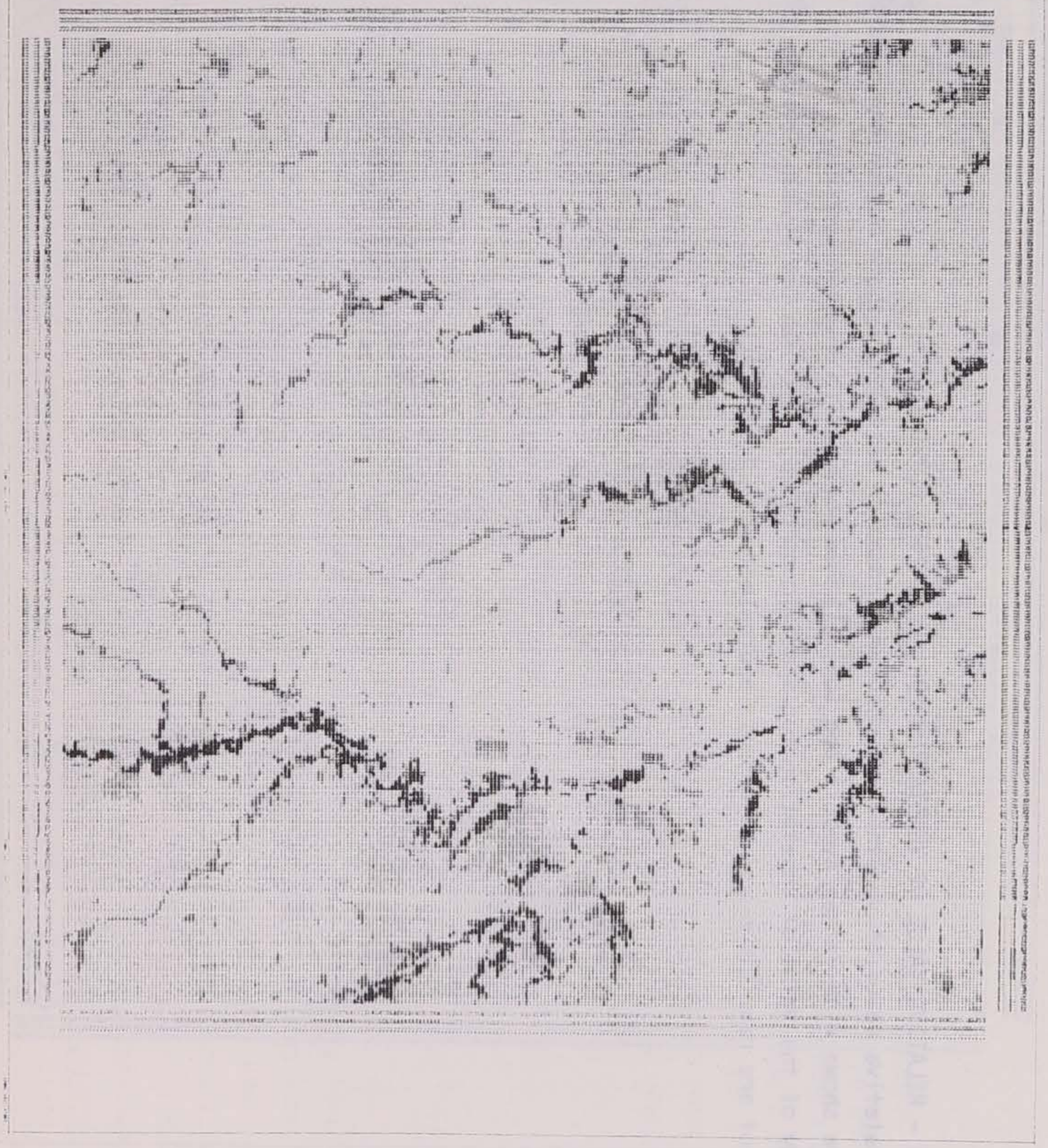
STORY COUNTY VETATION - SOIL EROSION POTENTIAL

Soils data and vegetation data were combined in this map to indicate the relative potential erosion. Darker symbols show areas of high soil erodibility and sparse or seasonal vegetation; lighter symbols show areas of low soil erodibility and dense or permanent vegetation. The map was produced to delineate and rank areas that may need conservation treatment. Each of the 84,700 output cells is five seconds of arc resolution and represents approximately 4.5 acres.



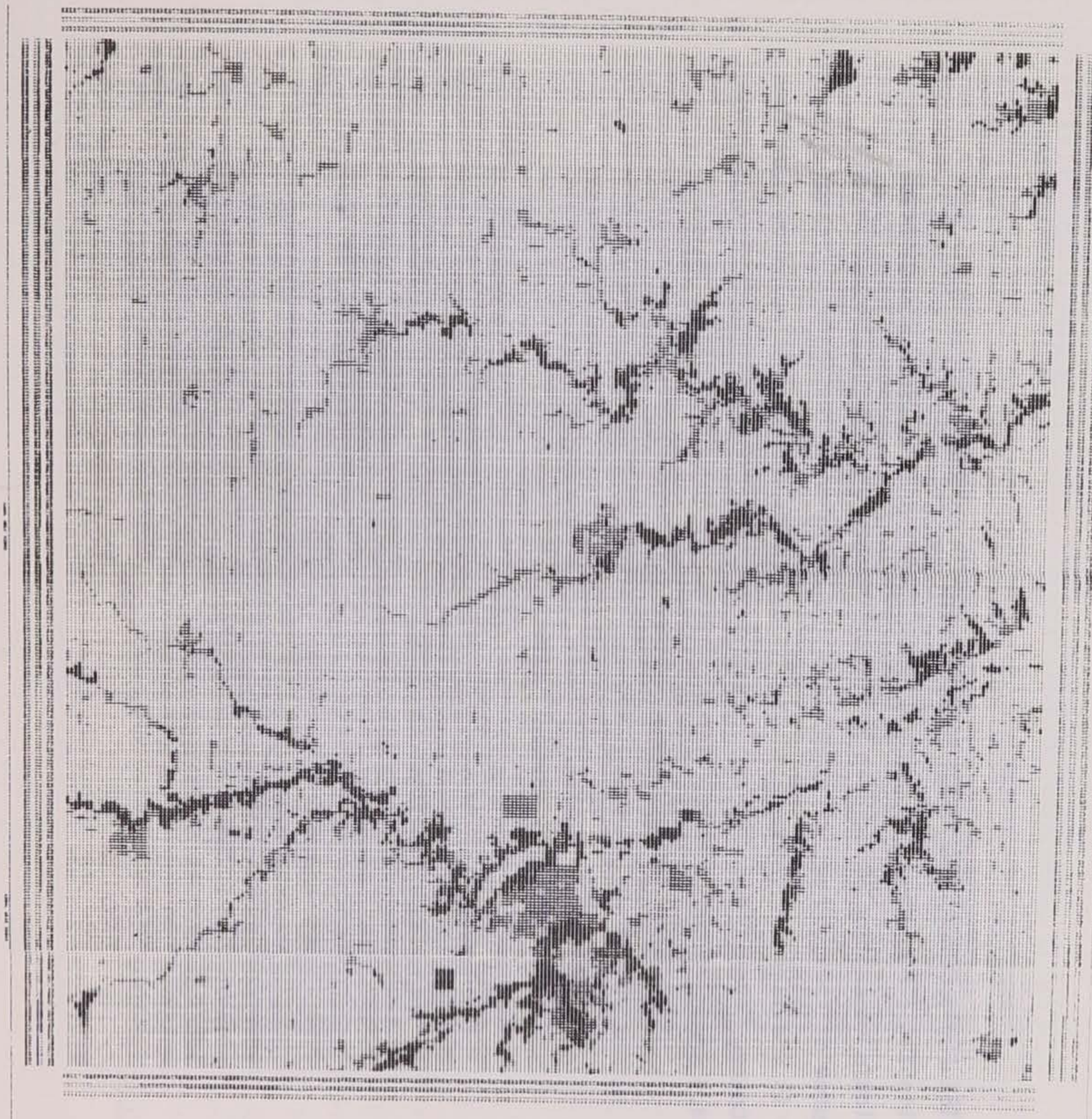
STORY COUNTY VEGETATION - RELATIVE VALUE OF VEGETATION FOR ENGINEERING PURPOSES

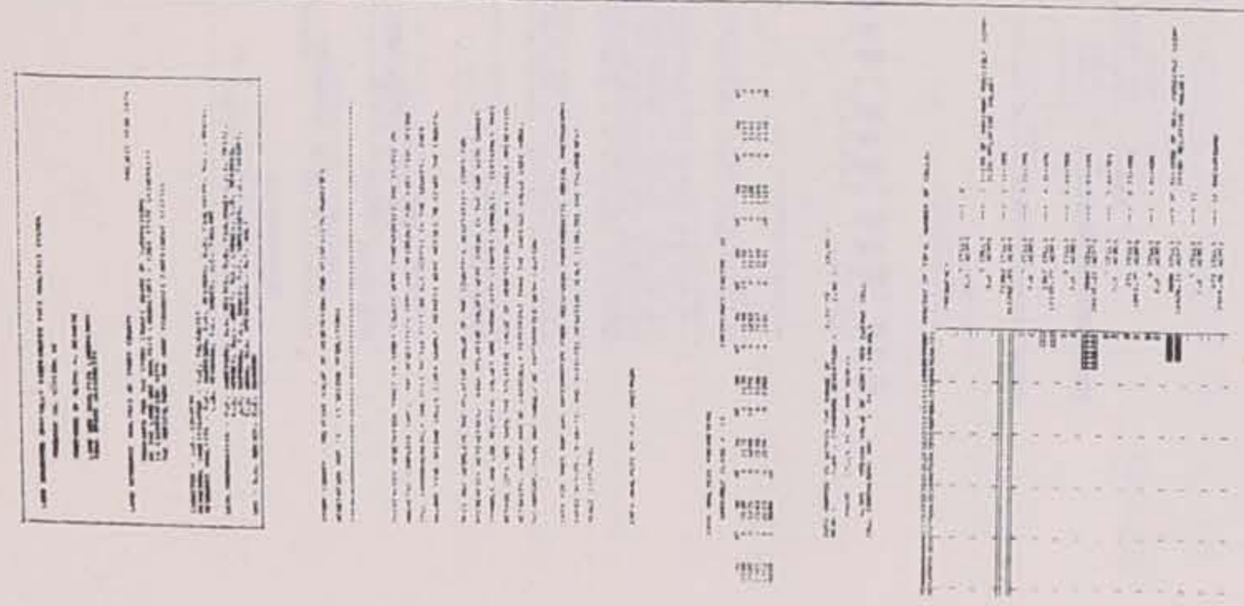
This map displays the relative value of vegetation types for four combined purposes: soil erosion control, runoff water retention, noise attenuation, and air and water pollution control. High relative values are shown with darker symbols and low relative values with lighter symbols. The map is a part of a study of the value of vegetation for specific purposes. Each of the 84,000 sample points is five seconds of arc resolution and represents approximately 4.5 acres.



STORY COUNTY VEGETATION - RELATIVE VALUE OF VEGETATION FOR RECREATION PURPOSES

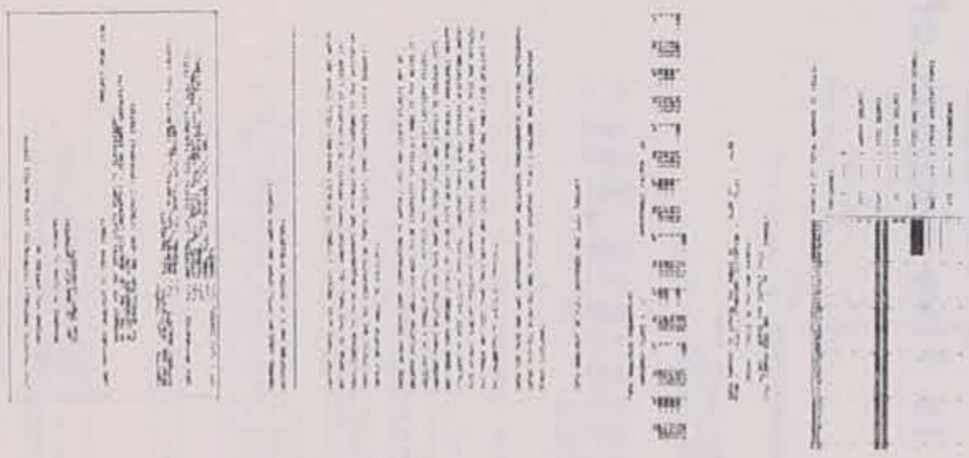
This map displays the relative value of vegetation types for recreation activities, both active and passive. High relative values are shown with darker symbols and low relative values with lighter symbols. The map is a part of a study of the value of vegetation for specific purposes. Each of the 84,000 sample points is five seconds of arc resolution and represents approximately 4.5 acres.





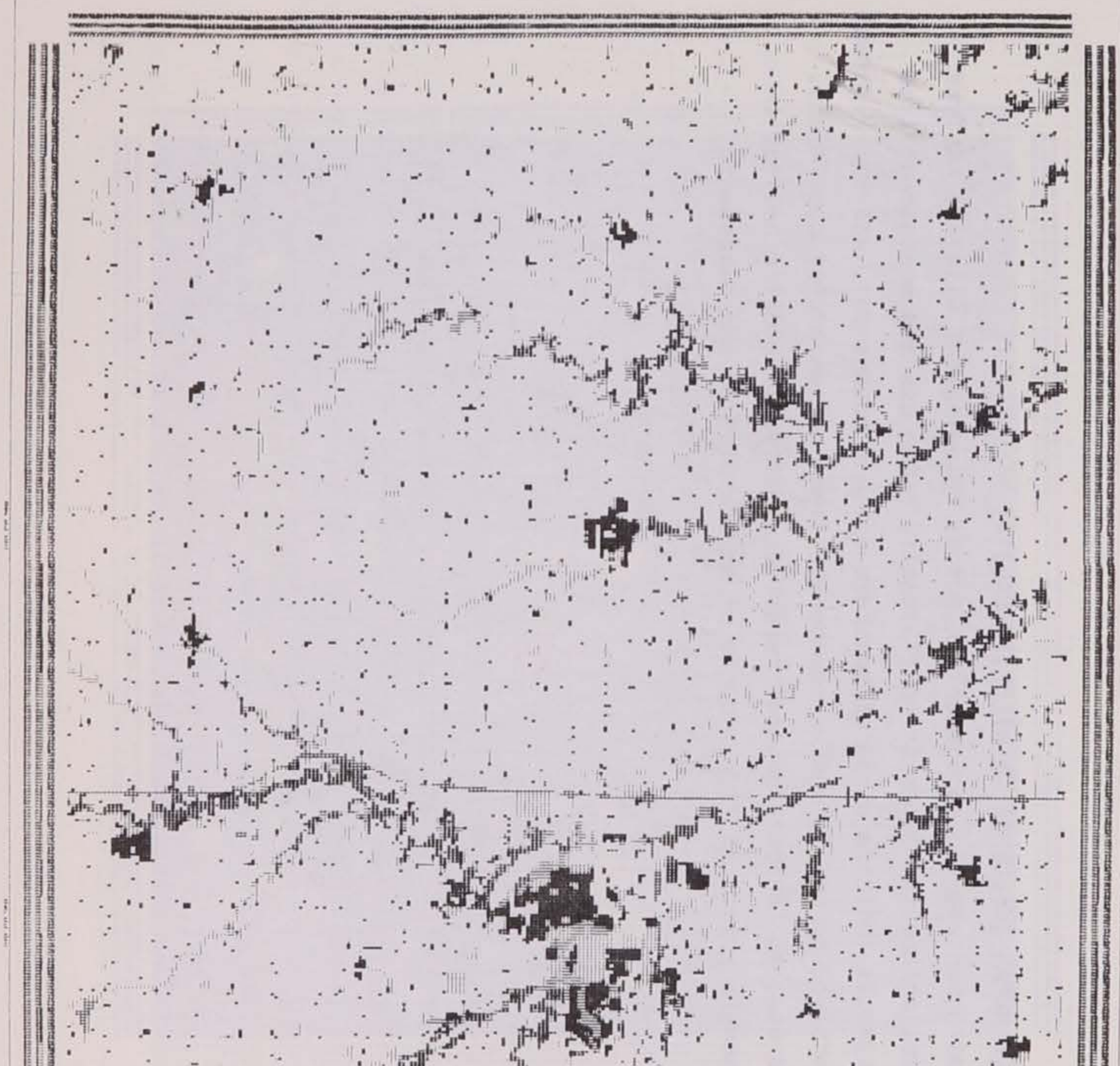
STORY COUNTY WILDLIFE - WILDLIFE FOOD, COVER, AND WATER SOURCES

Vegetation types which are suitable as a source of wildlife food, cover, and/or water are shown on this map. The darkest symbols indicate vegetation which is a potential source of food and cover; the gray symbols designate either a source of food, cover, or water; and the white areas indicate a lack of all these requirements. This map is the first of three maps used to determine the general relative quality of wildlife habitat in Story County. Each of the 84,000 sample points is five seconds of arc resolution and represents approximately 4.5 acres.



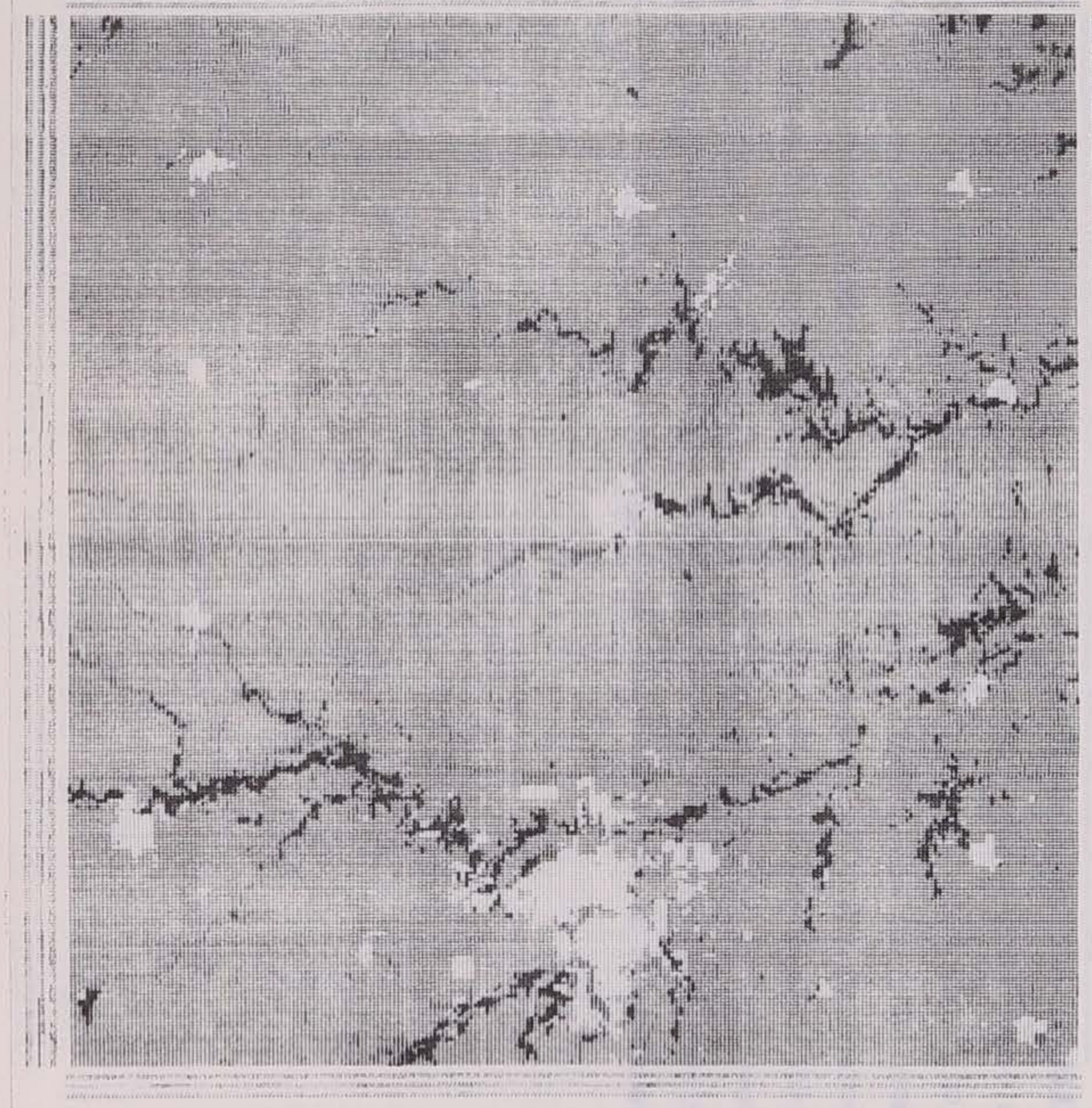
STORY COUNTY WILDLIFE - PERMANENT WILDLIFE COVER TYPES

Only permanent vegetation types (present year-round) are indicated on this map. Appropriate types of permanent vegetation provide wildlife with nesting, shelter, and/or escape cover during periods when seasonal cover is absent. The darkest symbols on the map indicate vegetation types which provide a source of two or more of these needed types of cover; the gray symbols represent types which provide one of the needed cover types; and the lightest symbols indicate vegetation types such as grazed pastures which are permanent, but have no value to wildlife as a source of cover. This map is the second of three maps used to determine the general relative quality of wildlife habitat in Story County. Each of the 84,000 sample points is five seconds of arc resolution and represents approximately 4.5 acres.



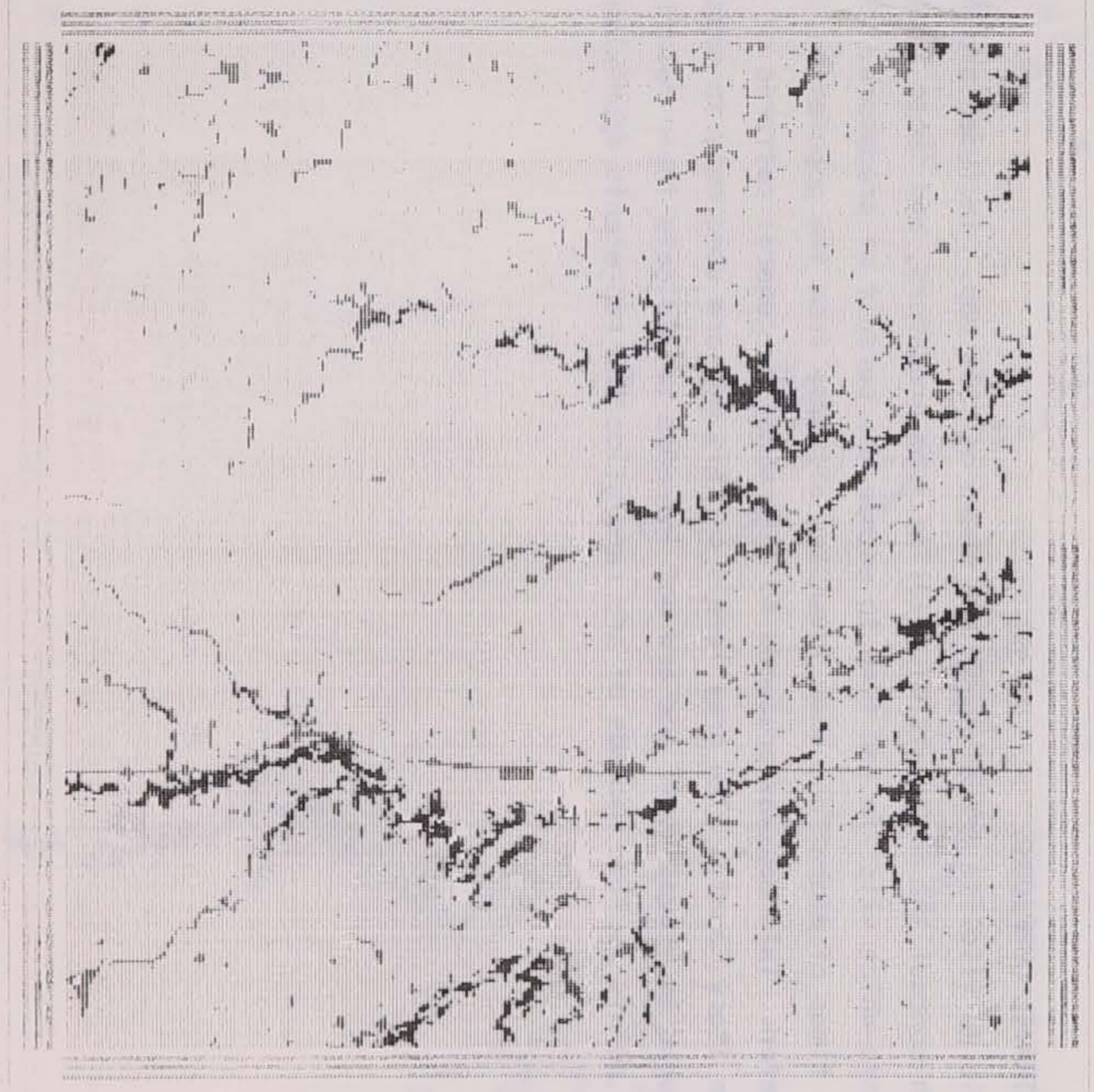
STORY COUNTY WILDLIFE - INTENSITY OF HUMAN INFLUENCE ON WILDLIFE HABITAT

This map represents the intensity of human use and management on actual or potential wildlife habitat. The darkest symbols represent vegetation/habitat types of low intensity human use and management (the most natural condition), the gray symbols indicate areas of moderate use and management, and the lightest symbols indicate areas of both intensive use and intensive management (the most unnatural condition). This map is the third of three maps used to indicate general relative quality of wildlife habitat in Story County. Each of the 84,000 sample points is five seconds of arc resolution and represents approximately 4.5 acres.



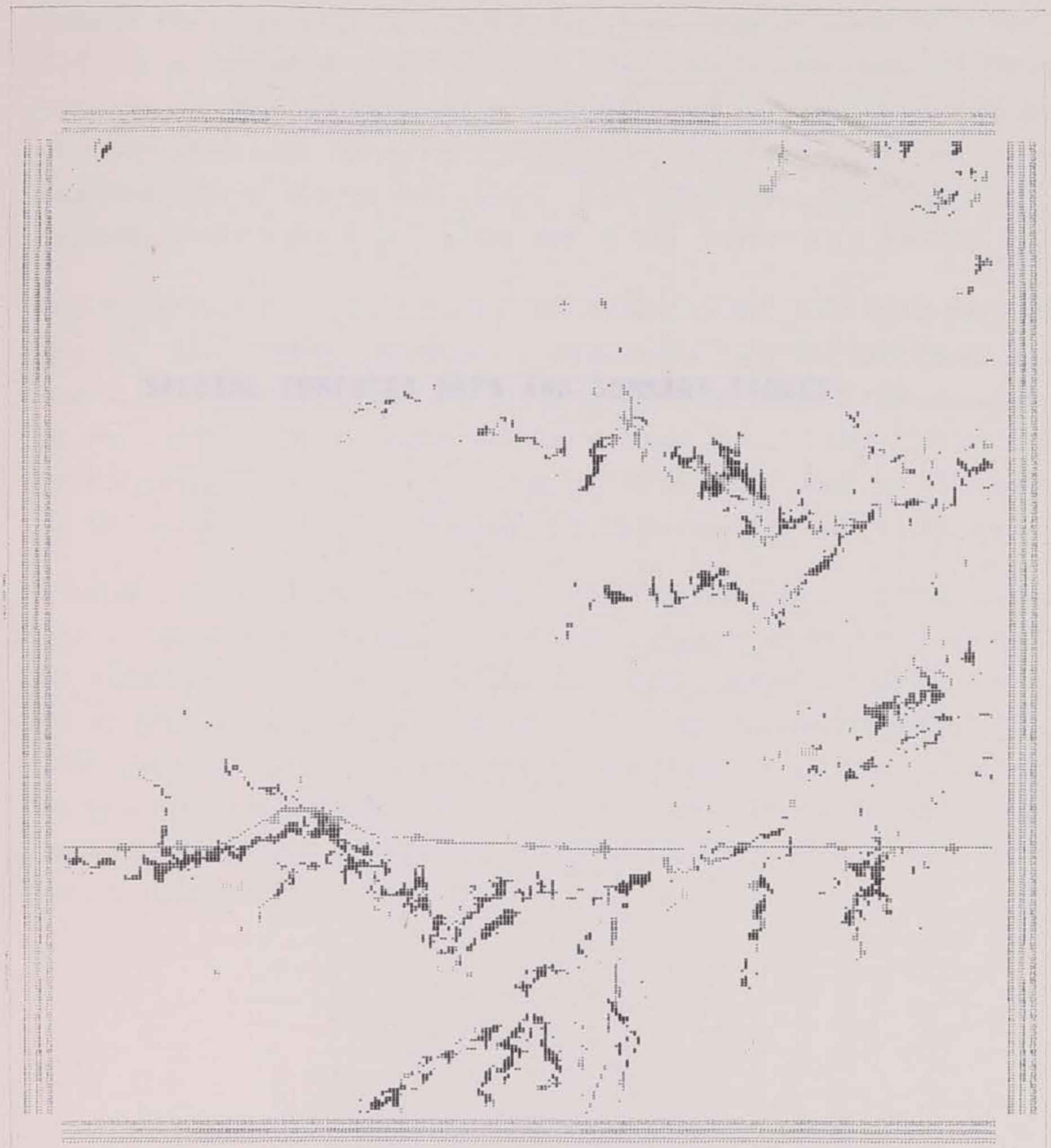
STORY COUNTY WILDLIFE - GENERAL WILDLIFE HABITAT QUALITY

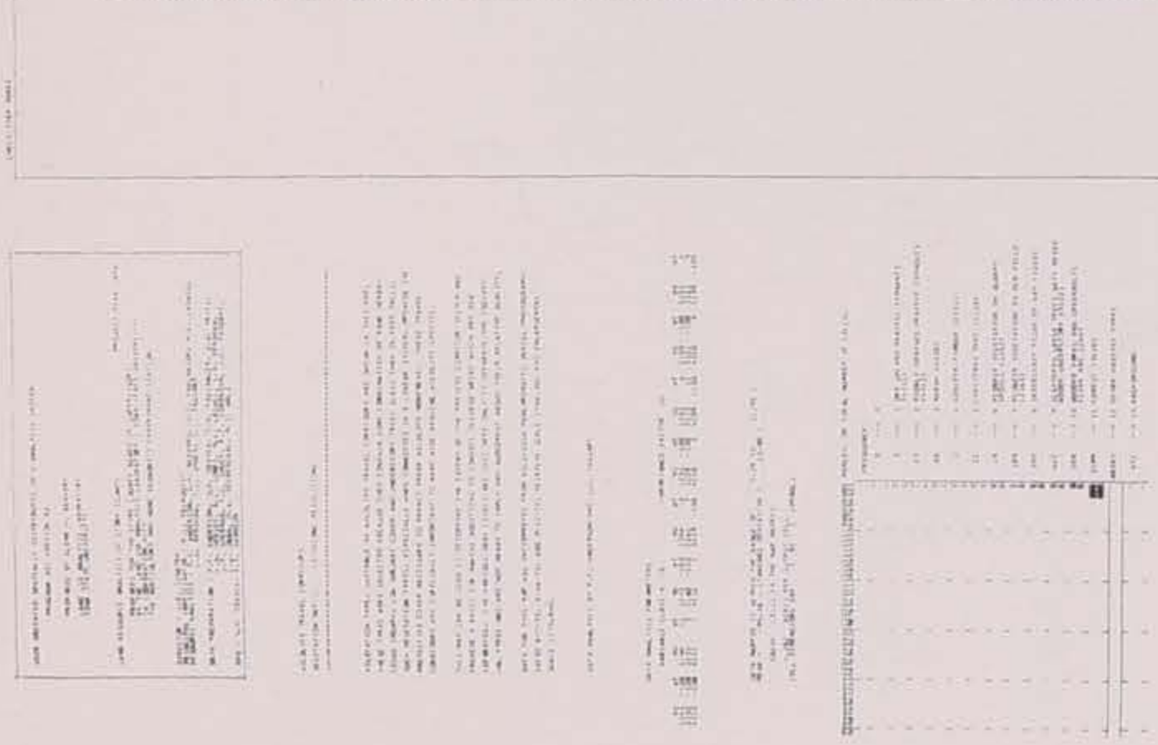
This map indicates the relative value of each vegetation type as habitat for wildlife in general, based on its combined value as a source of food, water, and/or permanent cover and its positive or negative value based on its intensity of human use and management. The darkest symbols indicate vegetation types which have the highest actual or potential value as wildlife habitat; as the symbols become lighter the value of the vegetation type as wildlife habitat becomes less. This map was produced to determine the relative value of vegetation in Story County as wildlife habitat in general (for most species). The specific requirements of any individual species would not necessarily conform to this analysis. Each of the 84,000 sample points is five seconds of arc resolution and represents approximately 4.5 acres.



STORY COUNTY WILDLIFE - WILDLIFE TRAVEL CORRIDORS

Vegetation types which are suitable as wildlife travel cover are shown on this map. Included are those types (such as tall grasses) which conceal the movements of wildlife from predators, and those types (such as low, woody shrubs and brush) into which wildlife can flee to escape the pursuit of predators. Such cover is necessary to wildlife at times of migration, when juveniles disperse from the population, and in their daily search for food and water. This map was produced to determine the general patterns of travel corridors available to wildlife in Story County. The gray levels on this map are used only to separate the various vegetation types included as travel cover and are not intended to indicate their relative value. Each of the 84,000 sample points is five seconds of arc resolution and represents approximately 4.5 acres.





# SPECIAL COMPUTER MAPS AND SUMMARY TABLES

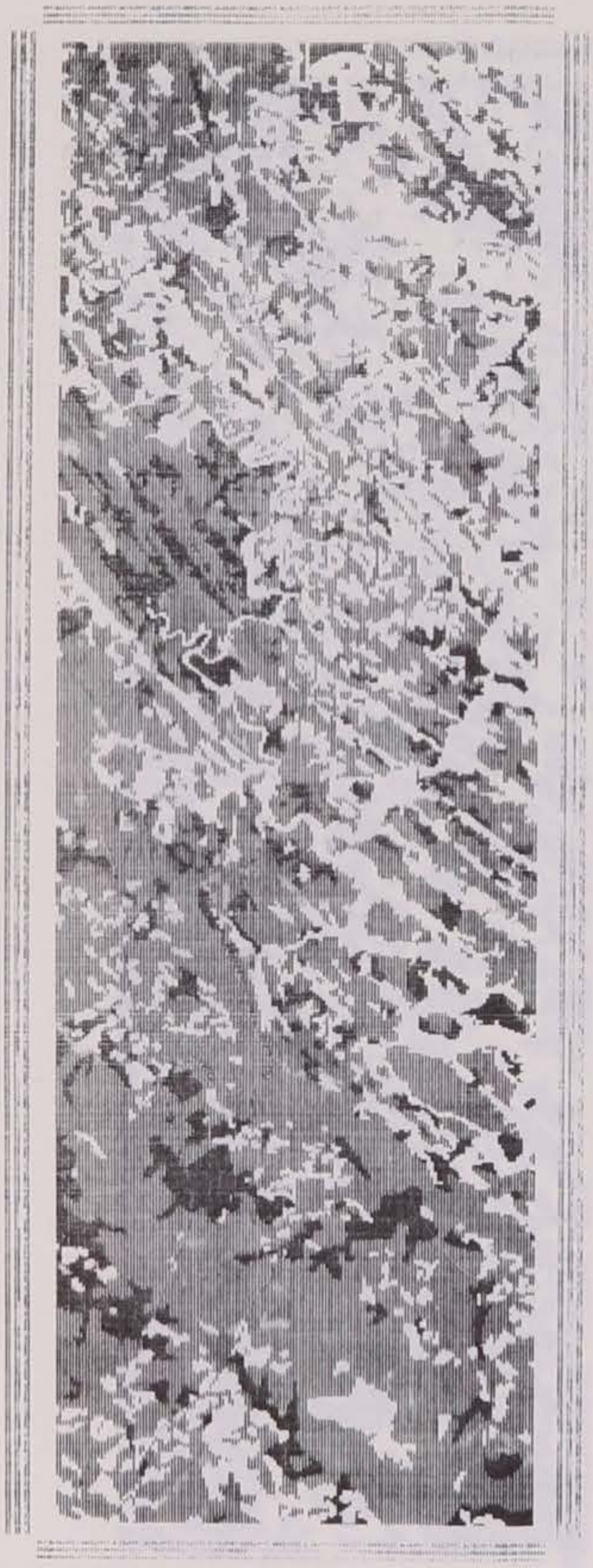
Many of the computer output maps and related computer products do not fit into a particular classification. For example, the maps and table produced for the Tennessee Valley Authority are not associated with any distinct study, but rather were prepared in an evaluation of the exportability of the methods used by the Laboratory. Other important research thrusts are also represented by maps within this section.

One research effort involves the use of specialized data for a multi-county region. This data was prepared to examine the regional setting of a one county study. Use of this data has extended some of the usefulness of the statewide data classes and has allowed the visualization of the relationship of the county to its surrounding area. Most of this data is new and will require additional applications to evaluate its usefulness.

A major concern of the Laboratory is the relationship of resolution to use of information. Several maps have been prepared in the examination of the effects of three processes: 1) generalization of resolution using detailed data, 2) preparation of detailed resolution output from a more generalized data class, and 3) comparison of different resolutions of data from the same data source. Since resolution is one very important measurement of data quality, all three of these evaluations are significant in the Laboratory's work.

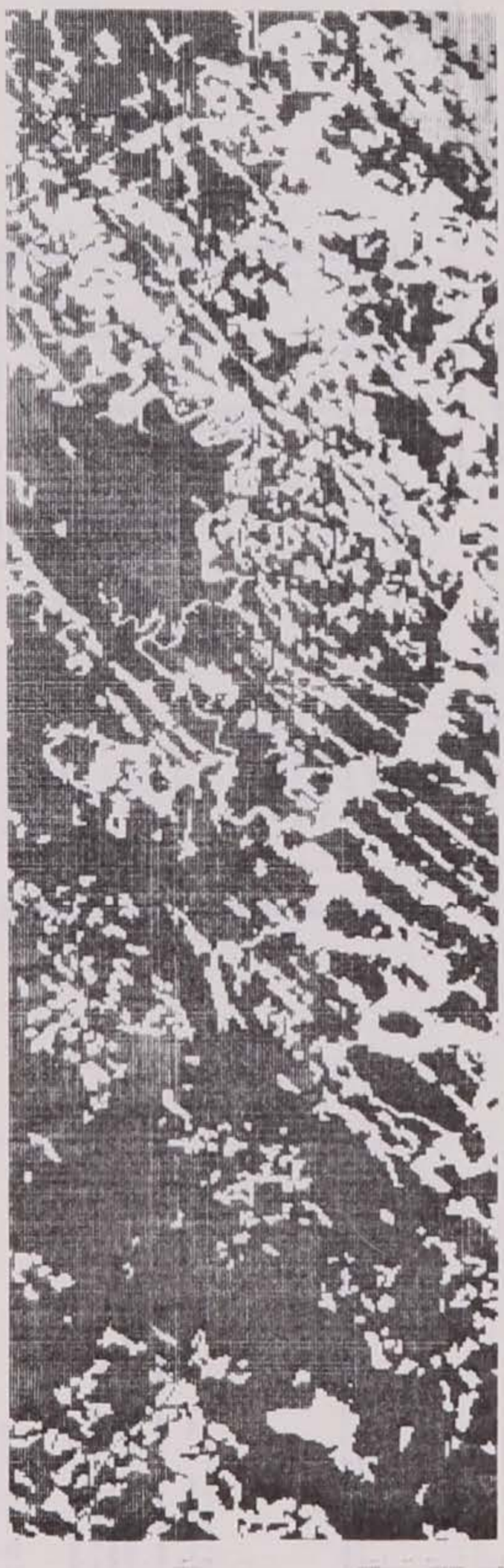
SPECIAL MAP - TENNESSEE VALLEY AUTHORITY-LAND USE IN THE HARRIMAN QUADRANGLE

In a demonstration project to show the exportability of the Laboratory's techniques, the Tennessee Valley Authority prepared a datafile of thirteen major land uses for the north half of the Harriman quadrangle. The map shows a distribution of the land uses by intensity. Lighter symbols represent low intensity uses and darker symbols represent high intensity uses. Each of the 90,000 sample points is six seconds of arc resolution and represents approximately 6.826 acres.



SPECIAL MAP - TENNESSEE VALLEY AUTHORITY-LAND USE IN THE HARRIMAN QUADRANGLE

This second map was prepared as a separation base and represents a unit aggregation from thirteen to four categories: surface water, agriculture, forest, and urban. Each of the maps forms a part of a demonstration of data analysis on data not prepared by the Laboratory. In this case the step shown was the adjustment in categorization available in the weighting method. Each of the 90,000 sample points is six seconds of arc resolution and represents approximately 6.826 acres.



SUMMARY TABLE - TENNESSEE VALLEY AUTHORITY-LAND USE IN THE HARRIMAN QUADRANGLE

One analysis process available in the Laboratory's system is a correlation table. This table combines the previous two maps to show correlations between the four level categorization and the thirteen level categorization. The numbers in the table indicate area in acres.

USER ORIENTED SPATIALLY DISTRIBUTED DATA ANALYSIS SYSTEM
PROGRAM ID. VERSION 4E

PREPARED BY GLENN A. BEARDS
LAND USE ANALYSIS LABORATORY
IOWA STATE UNIVERSITY

HARRISON QUADRANGLE - LAND USE MAP PROJECT YEAR 1974

PREPARED BY THE LAND USE ANALYSIS LABORATORY
IN COOPERATION WITH
THE AGRICULTURE AND HOME ECONOMICS EXPERIMENT STATION
AND
THE TENNESSEE VALLEY AUTHORITY - FORESTRY DIVISION

DATA SUBMITTED BY R.P.GREGORY TVA

THIS IS ONE MEMBER OF A TEST RUN OF DATA PREPARED AT THE FCI LSE WITH USDAMP.
THE PROCESS USED IS - CORRELATION TABLE PROCESS

SEPERATION BASE:

DATA ANALYSIS PARAMETERS
VARIABLE CLASS # 99 IMPORTANCE FACTOR 10

| VV | WT | VV | WT | VV | WT | VV | WT | VV | WT | VV | WT | VV | WT | VV | WT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 8 | 2 | 11 | 3 | 13 | 4 | 9999 | -10 | | | | | | |

| SEPERATION BASE ---> / VARIABLES CORRELATED IN THE TABLE | URBAN AREA LSE | AG. AREA LSE | FOREST COVER | SURFACE WATER |
|---|---|---|---|---|
| --> 1 RESIDENTIAL | 49906. | 0. | 0. | 0. |
| --> 2 COMMERCIAL AND SERVICES | 3166. | 0. | 0. | 0. |
| --> 3 INDUSTRIAL | 4887. | 0. | 0. | 0. |
| --> 4 EXTRACTIVE | 3231. | 7. | 0. | 0. |
| --> 5 TRANSPORTATION | 9125. | 0. | 0. | 0. |
| --> 6 MIXED | 2171. | 0. | 0. | 0. |
| --> 7 OPEN | 3418. | 0. | 0. | 0. |
| --> 8 AGRICULTURE - CROPLAND | 0. | 108446. | 0. | 0. |
| --> 9 AGRICULTURE - OTHER | 0. | 143. | 0. | 0. |
| --> 10 FOREST - DECIDUOUS | 28. | 75. | 252742. | 0. |
| --> 11 FOREST - EVERGREEN | 0. | 14. | 84482. | 0. |
| --> 12 STREAM AND WATER WAY | 0. | 0. | 0. | 212. |
| --> 13 RESERVOIR | 0. | 0. | 0. | 37814. |

97600 CELLS IN THE MAP MATRIX
6.828 MEDIAN VALUE OF ACRES PER OUTPUT CELL
TOTAL NUMBER OF ACRES POSSIBLE IS 666212.19

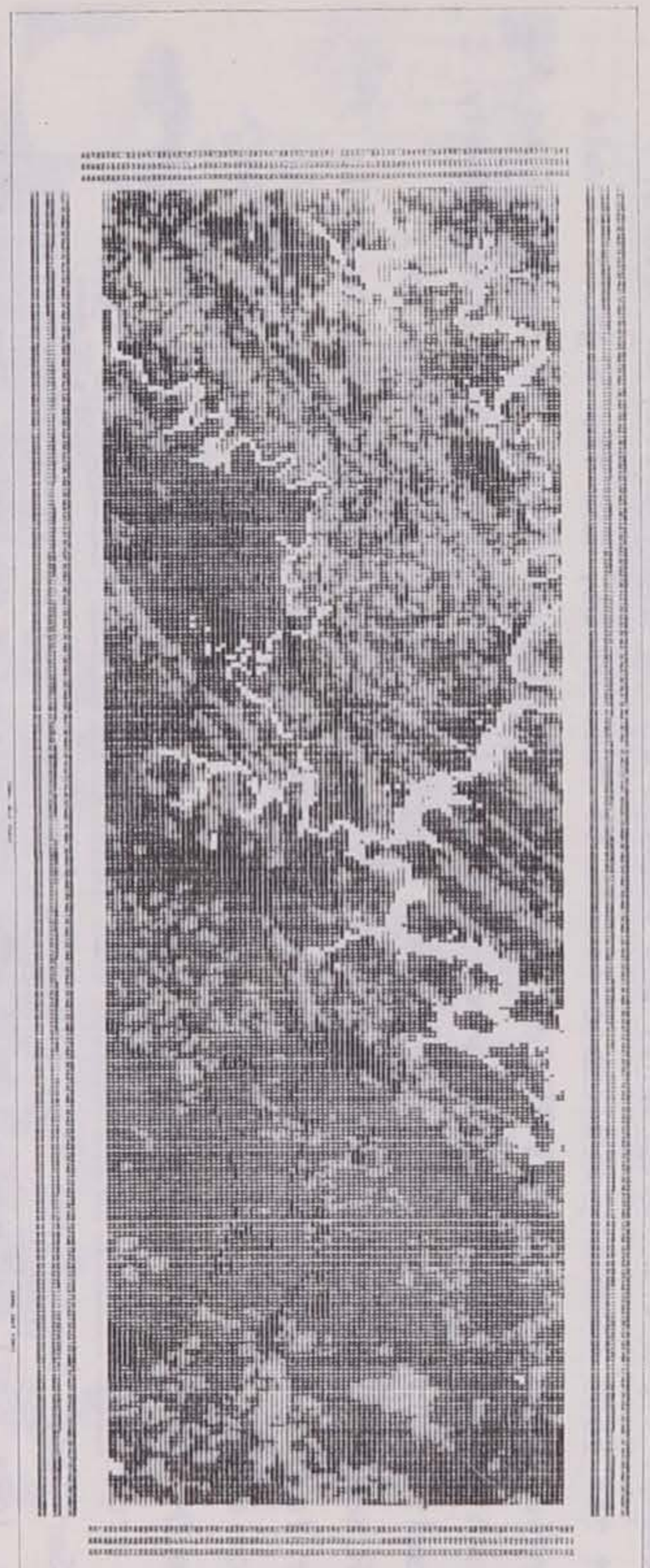
SEPERATION ANALYSIS WEIGHTING SET WHICH IS RUN AGAINST THE SEPERATION BASE:

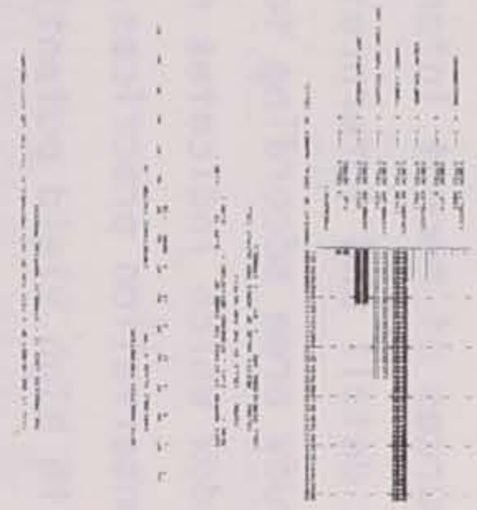
DATA ANALYSIS PARAMETERS
VARIABLE CLASS # 99 IMPORTANCE FACTOR 10

| VV | WT | VV | WT | VV | WT | VV | WT | VV | WT | VV | WT | VV | WT | VV | WT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 2 | 2 | 3 | 3 | 4 | 4 | 5 | 5 | 6 | 6 | 7 | 7 | 8 | 8 |
| 9 | 9 | 10 | 10 | 11 | 11 | 12 | 12 | 13 | 13 | 9999 | -10 | | | | |

SPECIAL MAP - TENNESSEE VALLEY AUTHORITY-LAND USE IN THE HARRIMAN QUADRANGLE

This map represents a sample subset of the data prepared by the Tennessee Valley Authority. The base datafile was prepared at six seconds of arc resolution. The sample subset was derived at ten seconds of arc resolution and mapped. This map used the original thirteen separation categories in preparing the level assignments. Each of the 30,000 cells is ten seconds of arc resolution and represents approximately 18.96 acres.



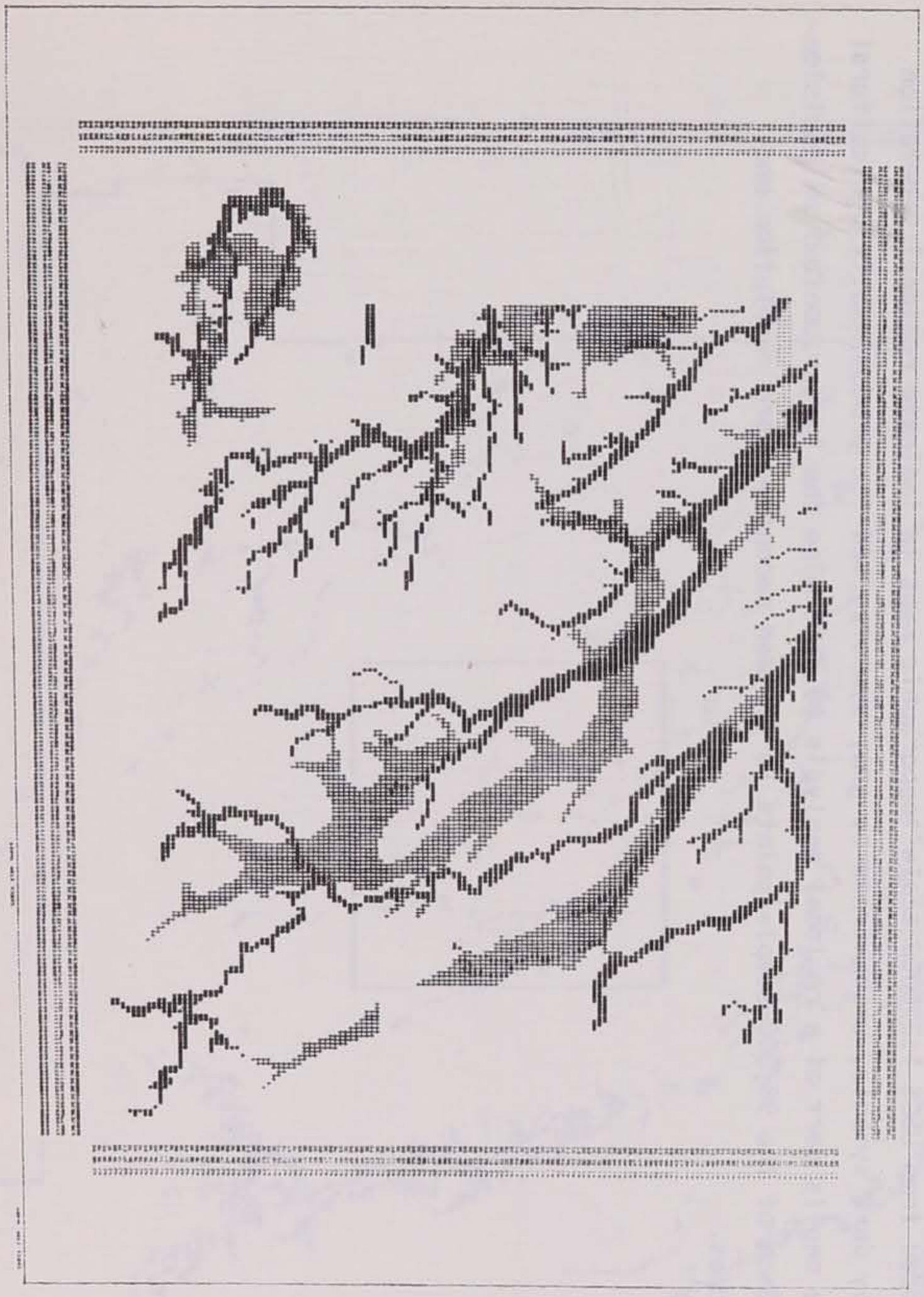


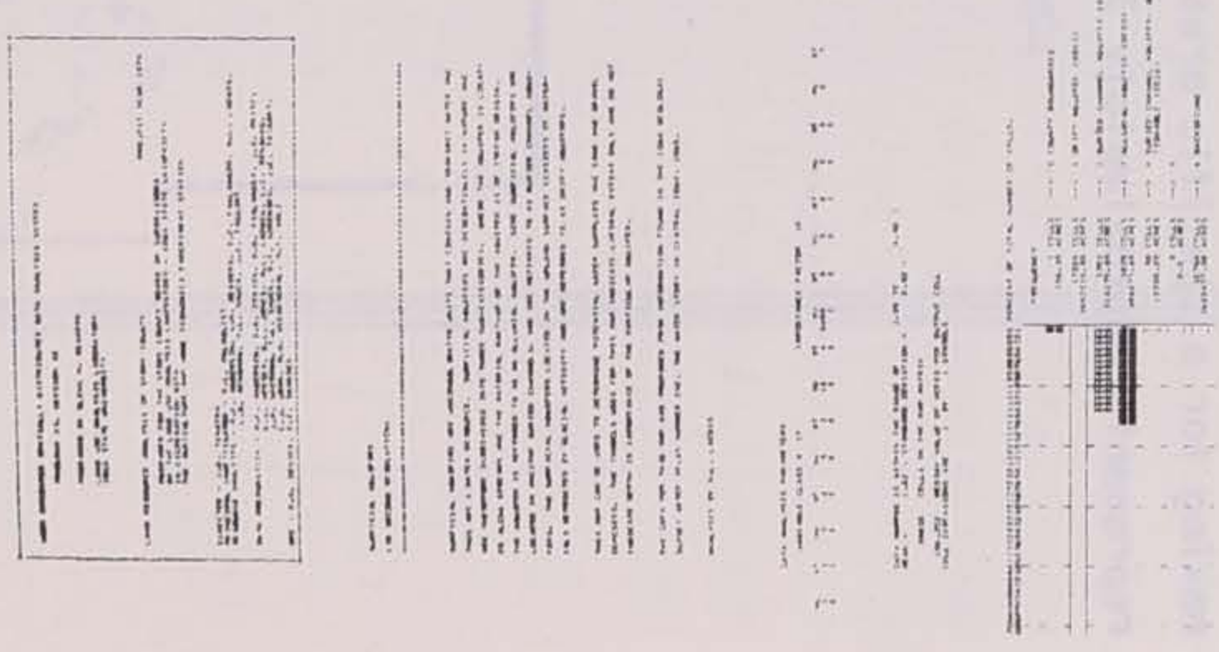
DETAILED STUDY AREA - FAYETTE COUNTY SOILS-CORN SUITABILITY RATING

Studies are underway pertaining to an area of eastern Fayette County between the towns of Arlington and Wadena. The purpose of these studies is to investigate the use of different sources of information at their most appropriate resolution for high levels of detail. The study area was selected because of its great variability in soils, landscape types and topography; and because of the availability of several sources of recent information at the best commonly available levels of resolution, and the highest levels of detail and interpretive potential. This map shows the distribution of soils in a part of the detailed study area according to their corn suitability ratings. A corn suitability rating (CSR) is a productivity index which indicates relative suitability of a soil for row crop production under appropriate soil conservation practices. The CSR scale has a range of 5 to 100, with the highest ratings given to soils with high yield potential (under favorable climatic conditions) which can be continuously row cropped with little erosion. Each symbol on the map represents a class interval of 5 on the CSR scale, with the lightest symbol representing the 0-5 class interval. Darker symbols represent higher CSR values. Estimates of CSRs for this map were taken from Soil Survey Information and Interpretations (Iowa), U.S. Dept. of Agriculture, Soil Conservation Service. The source map, drawn to a scale of 1:15840, is from Advance Report, Part II, Fayette County, Iowa, Soil Survey-Soil Maps USDA-SCS, Lincoln, Nebraska. The map represents an area of 9.66 square miles. Each of the 36,000 sample points is one second of arc resolution and represents approximately 0.172 acres.

REGIONAL GEOLOGY - SURFICIAL AQUIFERS

Surficial aquifers are unconsolidated units that contain and transmit water, and thus are a water resource. Alluvial aquifers are shown by dark symbols, buried channel aquifers by gray symbols, and the drift aquifer by the remaining white area. The map was produced to determine potential water supplies and sand and gravel deposits in ten central Iowa counties. Each of the 24,400 sample points is thirty seconds of arc resolution and represents approximately 156 acres.



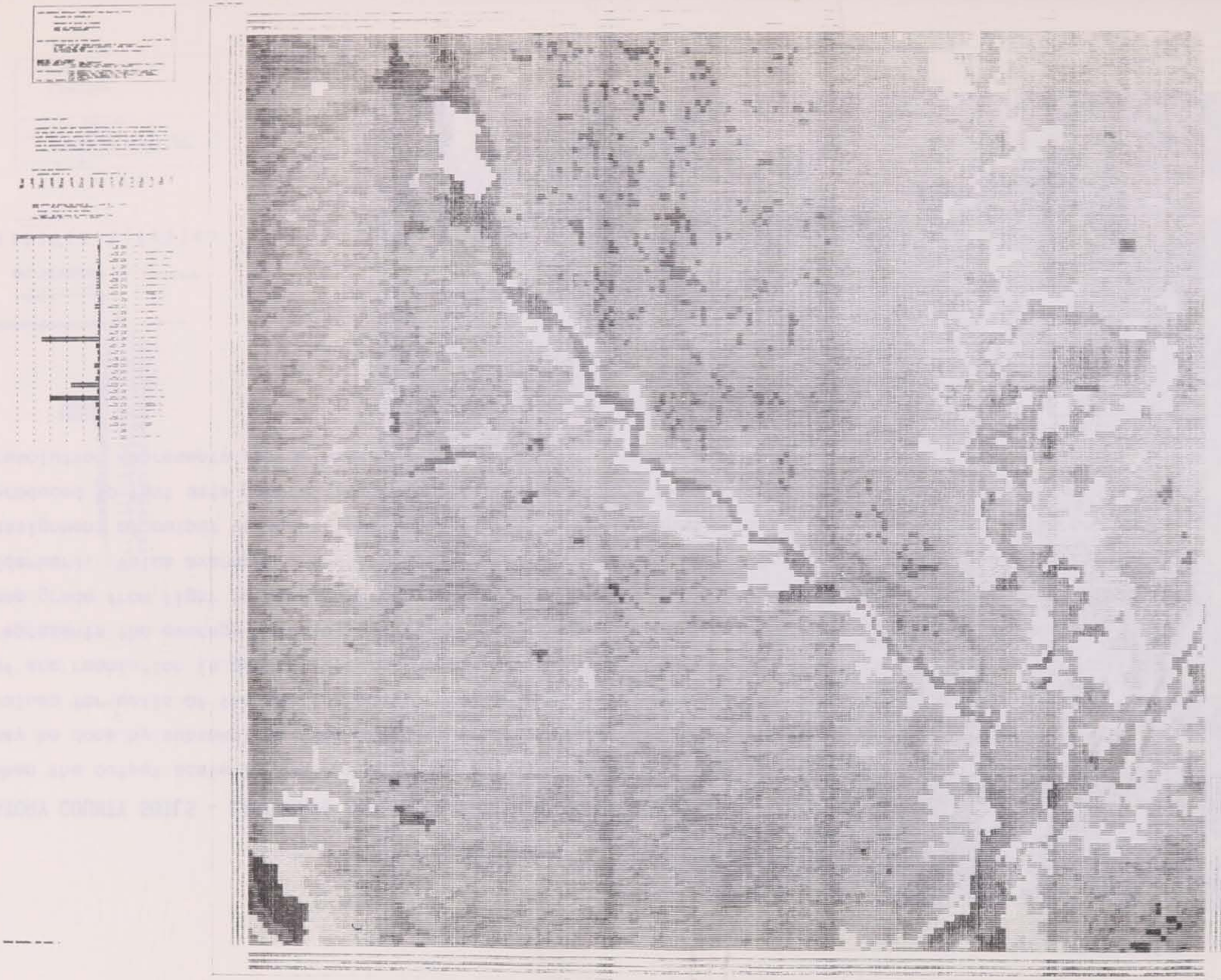


REGIONAL VEGETATION - MAJOR TYPES

Three vegetation types were coded from USGS 1:250000 scale topographic maps to indicate regional vegetation patterns. Woodland is shown by dark symbols, urban areas by gray symbols, and the predominantly agricultural landscape by white areas. The map is part of a regional analysis to determine the larger context of decision-making for a specific area. Each of the 98,000 sample points is fifteen seconds of arc resolution and represents approximately 39 acres.

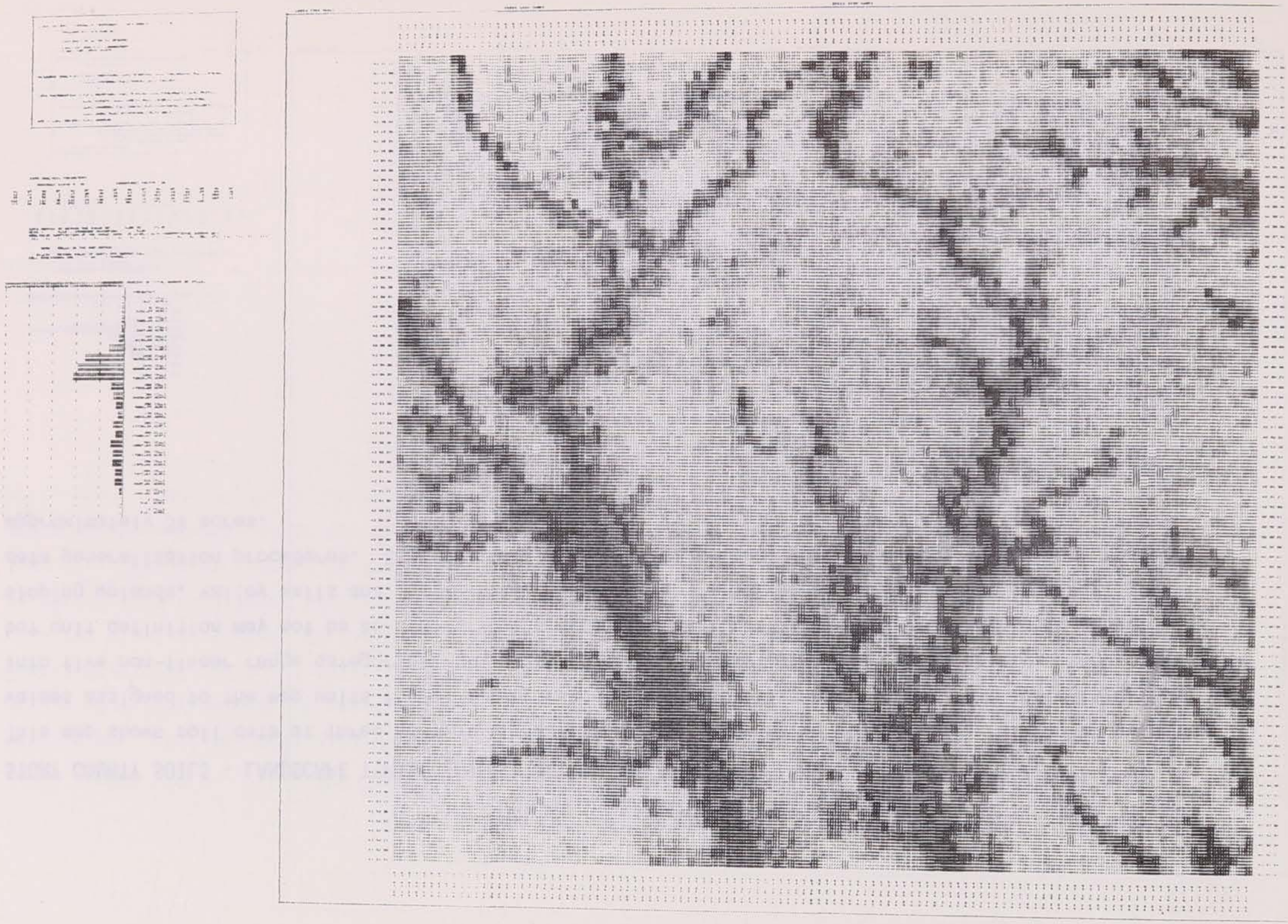
STORY COUNTY SOILS - CELL SIZE RESOLUTION EFFECTS

This map was produced to show the distribution of landscape types for an area in the northwest corner of Story County. Darker symbols represent the more level, more poorly drained land with finer textured soils. The darkest symbols indicate potholes. Light symbols represent sloping, well drained land with coarse textured soils. Each of the 232,500 cells is one second of arc resolution and represents part of one of the 26,000 sample points at three seconds of arc resolution in the data deck. A one second cell represents approximately 1.557 acres. The size of a three second sample point for this map is 0.007 acres per cell smaller than for a county-wide map because the median latitude for the map is located about eight miles to the north of the median latitude line for the whole county. Convergence of meridians has resulted in a 0.45 percent decrease in sample point area over this short distance. It should be noted that decreasing the cell size increases the legibility of the map, but does not increase accuracy beyond the level of map input resolution.



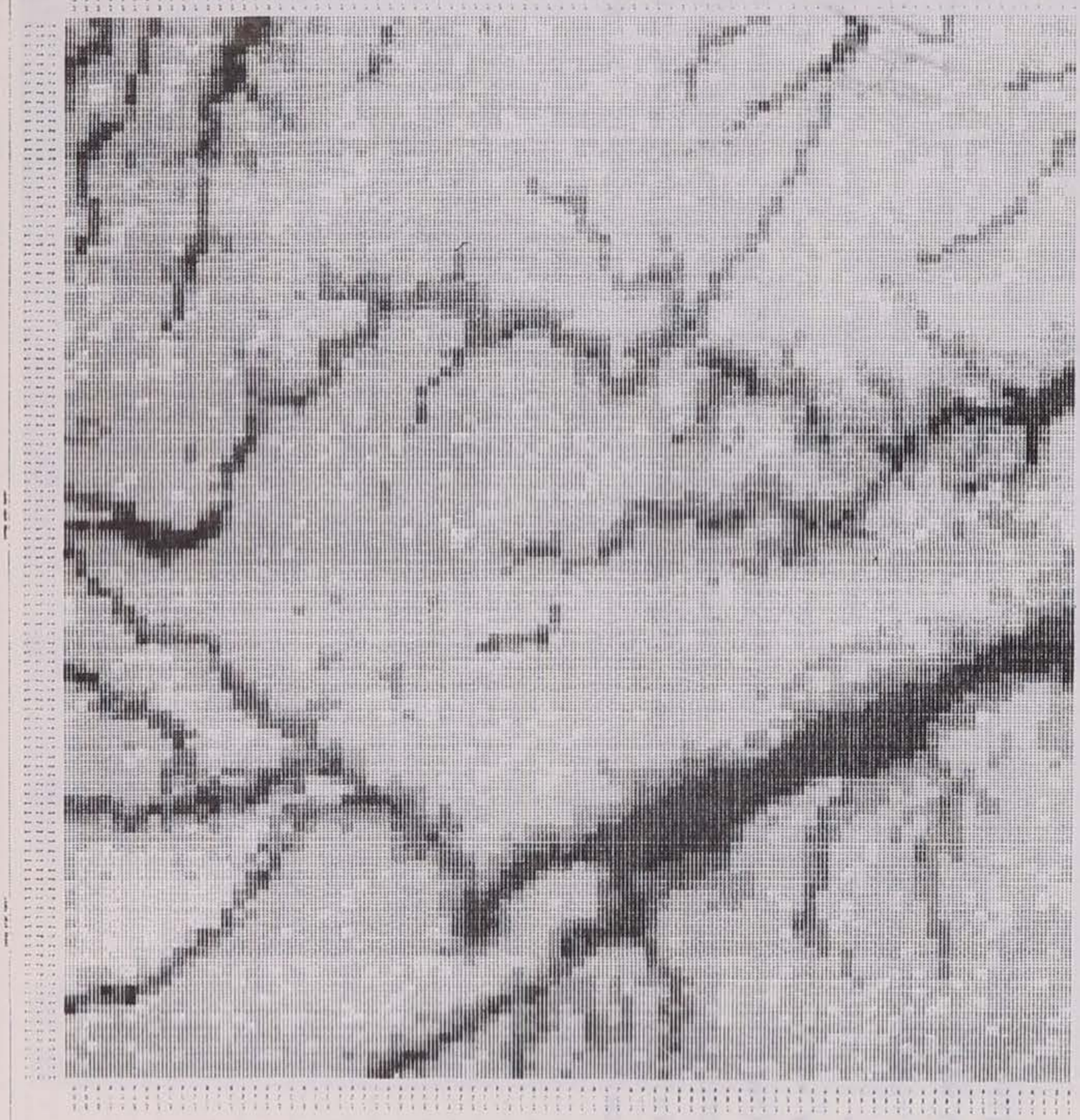
STORY COUNTY SOILS - LANDSCAPE TYPES (GENERALIZATION PROCEDURES)

When the output scale is smaller and less detailed than the input scale, data must be generalized. This may be done by subsampling from the data at the output scale, or by averaging data values to create values for cells of the smaller scale. On this map, soil map information from a data set of three seconds of arc resolution is generalized for output at fifteen seconds of arc resolution. Each output cell represents the average value of twenty-five sample points of the input data. In general, symbols on the map grade from light to dark through a sequence of upland (lighter), valley wall, terrace, and floodplain (darker). Value averages are distributed over a scale of twenty output value ranges. A non-linear assignment of output values allows some discrimination between numerically close values. The map was produced to test data generalization procedures. Each of the 9,300 cells at fifteen seconds of arc resolution represents approximately 39 acres.



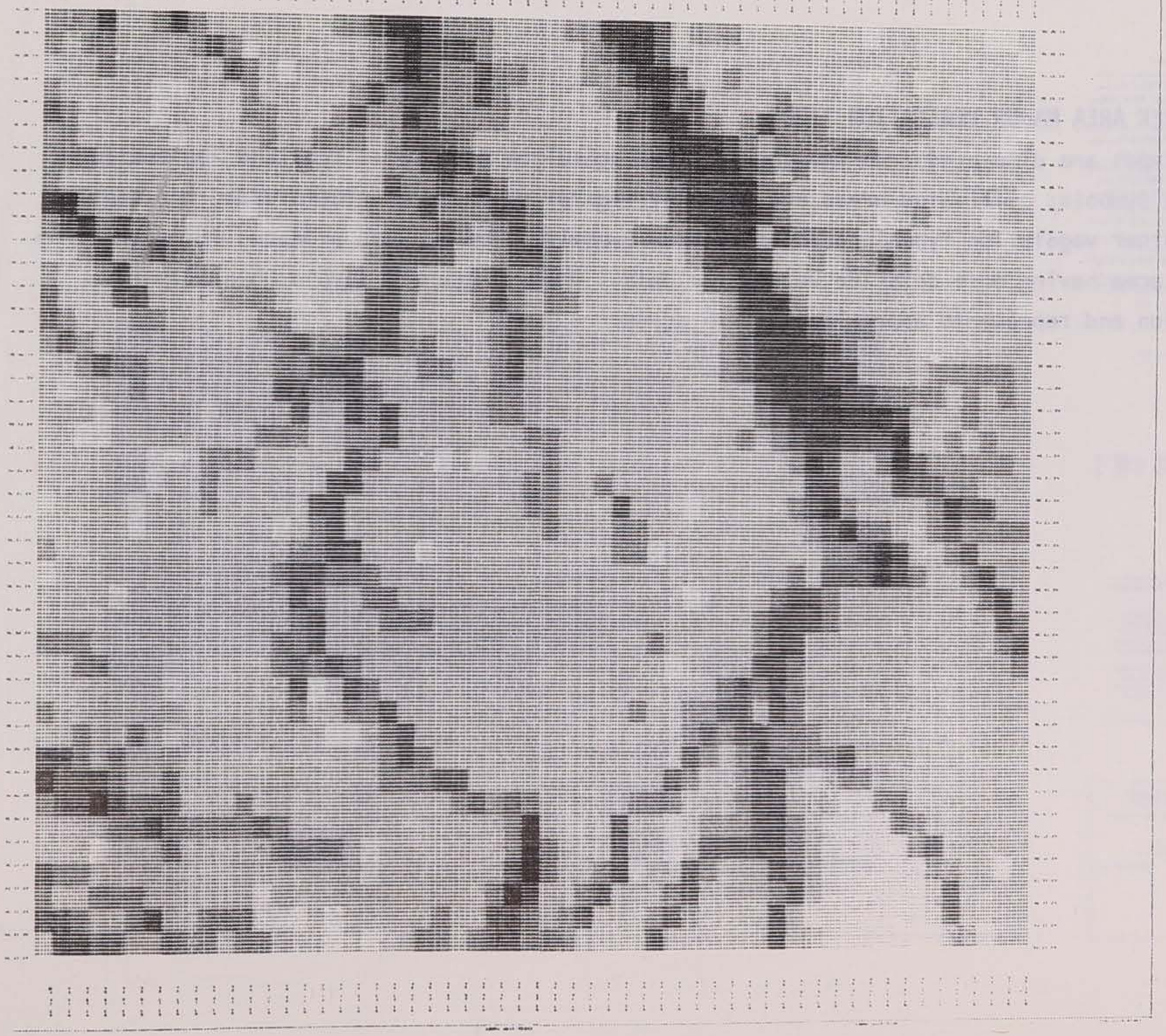
STORY COUNTY SOILS - LANDSCAPE TYPES (GENERALIZATION PROCEDURE)

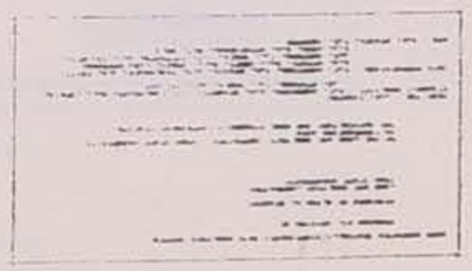
This map shows soil data at three seconds of arc resolution input which has been generalized by averaging values assigned to the map units for output at fifteen seconds of arc resolution. The scale is divided into five non-linear range categories. This map shows more detail than the map at thirty seconds resolution but unit definition may not be as clear. Symbols grade from light for level uplands through gray for sloping uplands, valley walls and terraces, to dark for the floodplains. This map was produced to test data generalization procedures. Each of the 9,300 cells at fifteen seconds of arc resolution represent approximately 39 acres.



STORY COUNTY SOILS - LANDSCAPE TYPES (GENERALIZATION PROCEDURE)

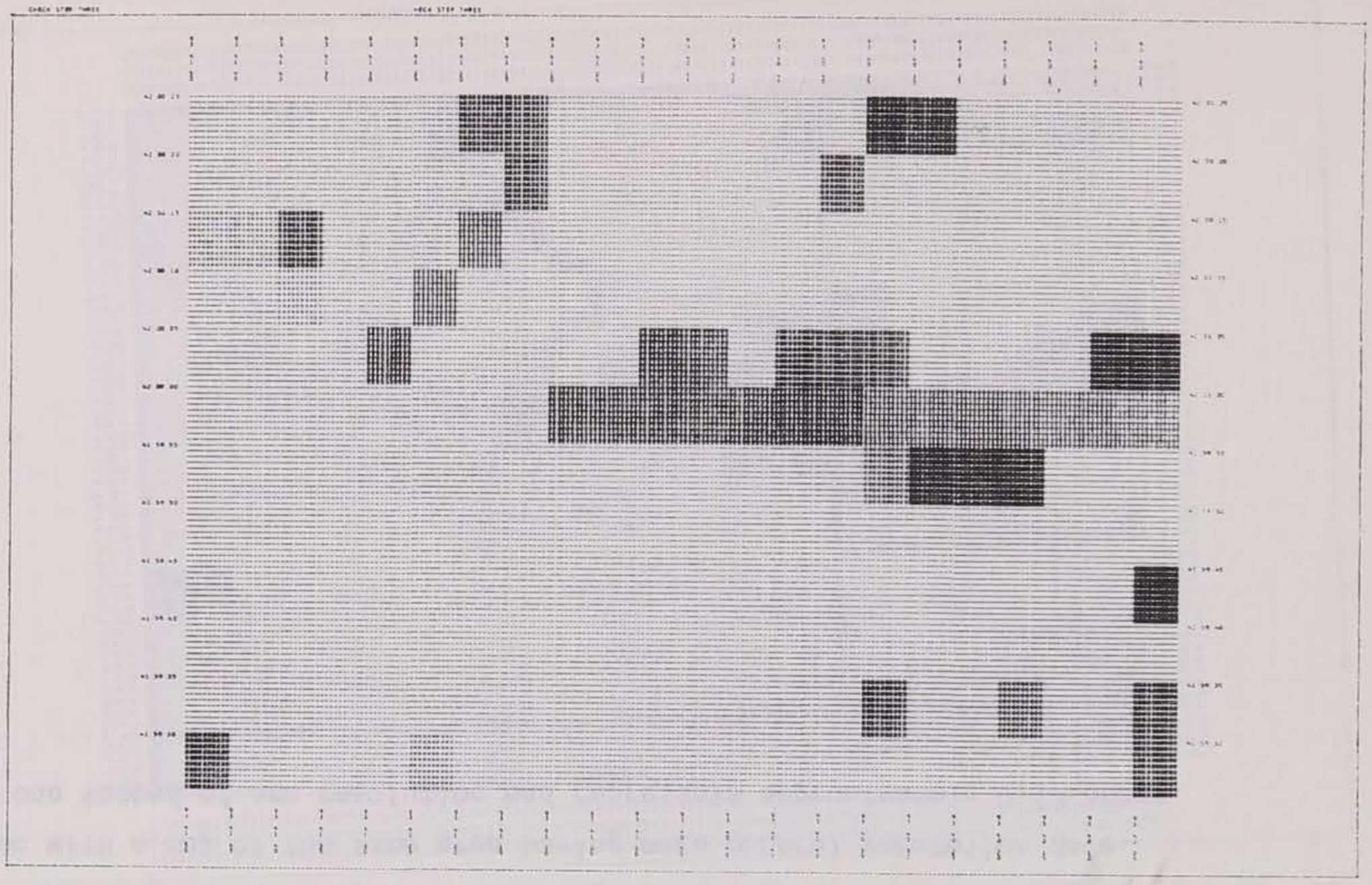
On this map, soil map data which was entered at three seconds of arc resolution has been generalized for output at thirty seconds of arc resolution. Each output cell represents the average value of one-hundred sample points of the input data. Symbols grade from light for poorly drained, level uplands, through gray for sloping uplands, valley walls, and terraces, to dark for floodplains. The output values are separated on a five level non-linear scale. The scale value ranges are the same as for the map generalized into five levels at fifteen seconds. The thirty second resolution sacrifices resolution and detail, but may achieve somewhat better definition of associated units. The map was produced to test data generalization procedures. Each of the 2,350 cells at thirty seconds of arc resolution represent approximately 156 acres.





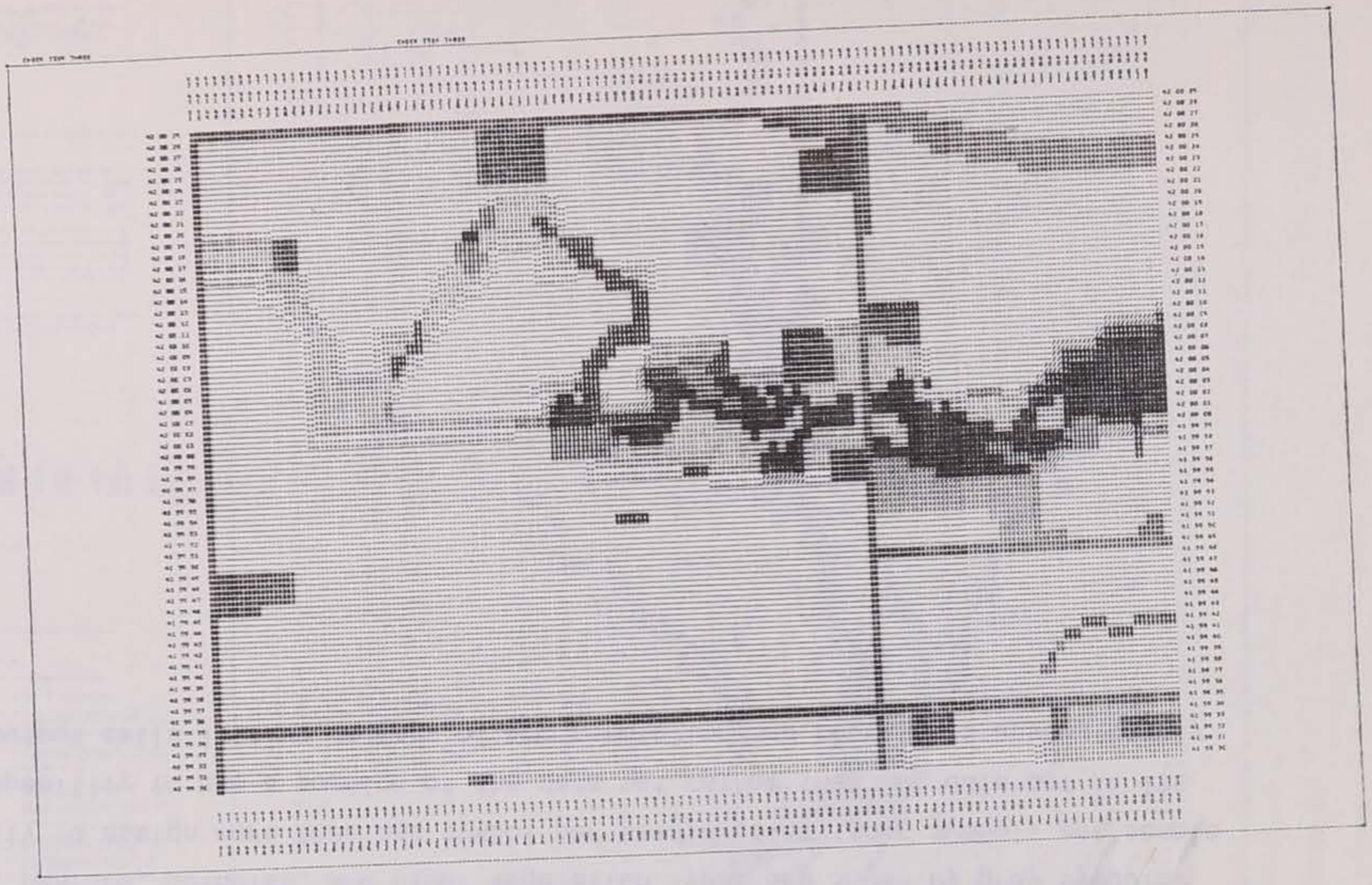
SPECIAL MAP - WORLE CREEK AREA MAJOR VEGETATION TYPES

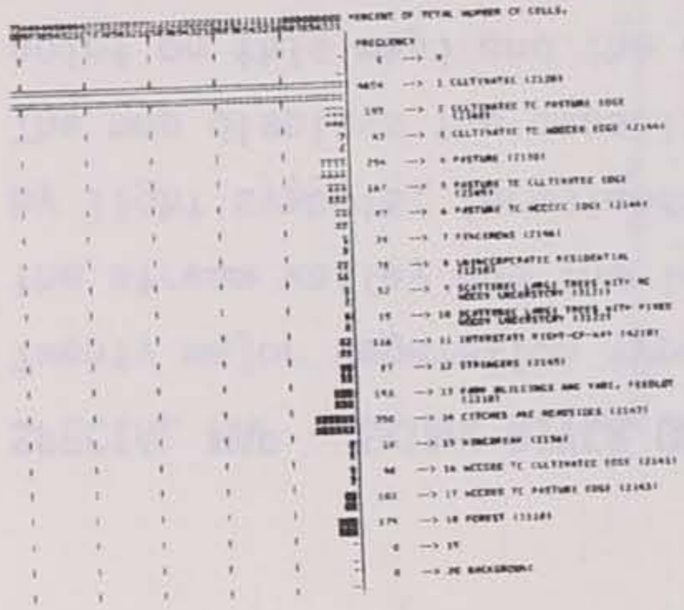
Nine major vegetation types are displayed from the county-wide vegetation data set. Woodland and scattered trees are shown by dark symbols; cultivated areas are shown by lighter symbols; and farmsteads, residential areas, windbreaks and other vegetation types are shown by gray symbols. The map was produced for comparison with a map of the same area having more detailed vegetation data. Each of the 260 sample points is five seconds of arc resolution and represents approximately 4.5 acres.



SPECIAL MAP - WORLE CREEK AREA MAJOR VEGETATION TYPES

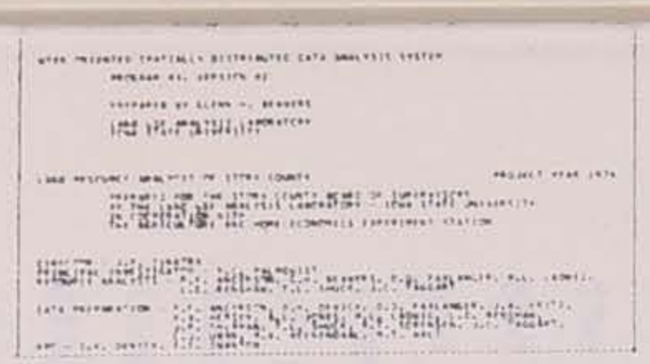
Eighteen major vegetation types are displayed from the detailed vegetation data set. Woodland, scattered trees, and road right-of-way are shown by dark symbols; cultivated and edge vegetation are shown by light symbols; and farmsteads, residential areas, windbreaks, and other vegetation types are shown by gray symbols. The map was produced for comparison with a map of the same area having more general vegetation data. Each of the 6700 sample points is one second of arc resolution and represents approximately 0.17 acres.

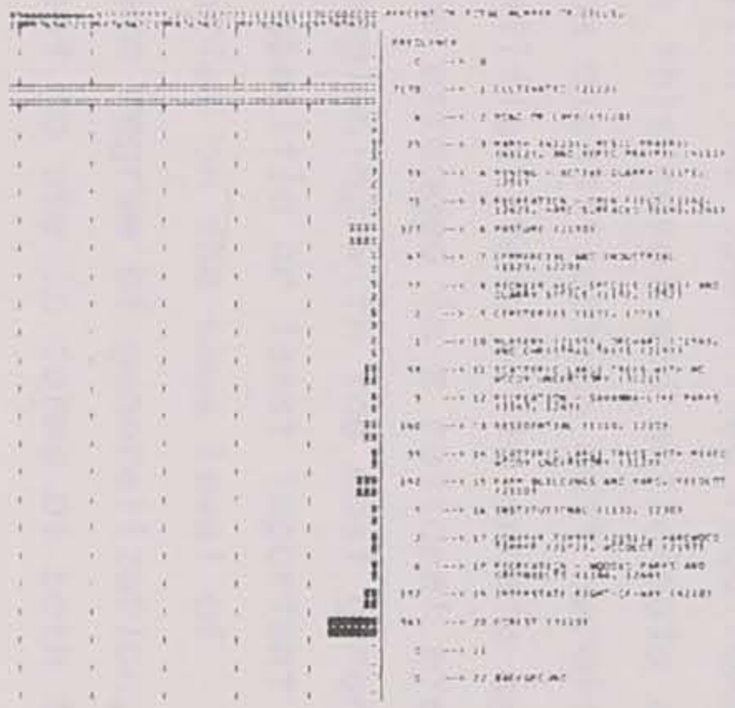


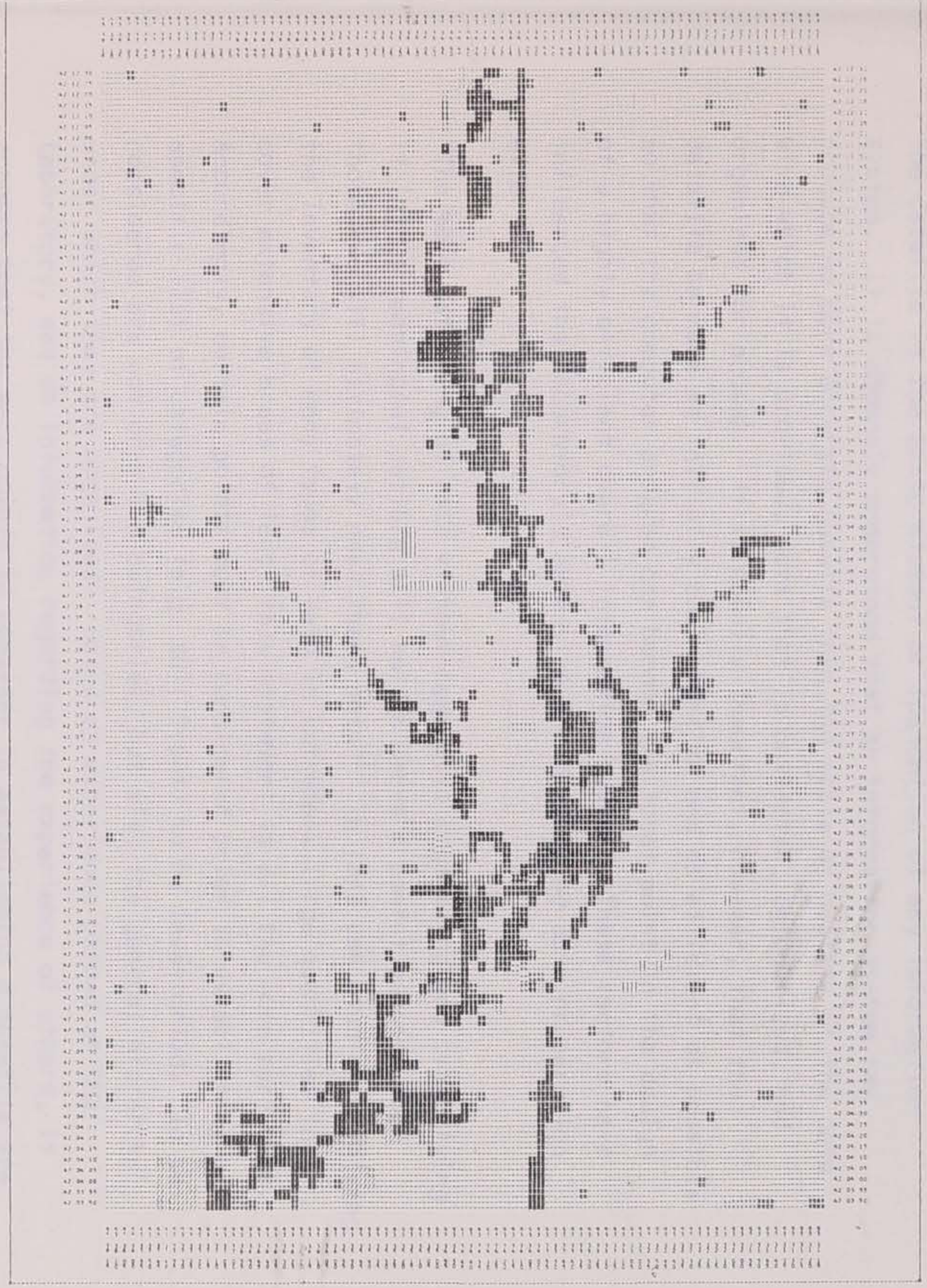


SPECIAL MAP - SKUNK RIVER GREENBELT AREA

Twenty major vegetation types along the Skunk River are shown between Ames and Story City. Woodland in the stream valley and the Interstate 35 right-of-way are shown by dark symbols; cultivated areas are shown by light symbols; farmsteads, pasture, potholes, and other vegetation types are shown by gray symbols. The map displays the capability to assign more than one symbol per sample point (four symbols per sample point on this map) and the capability to use a portion of the data set rather than the data set in its entirety. Each of the 8900 output cells is five seconds of arc resolution and represents approximately 4.5 acres.







## DATAFILE STATUS

The datafile is the basic element or foundation of any information system. It is commonly understood that an information system can produce no more accurate results than the scale or quality of the data with which it is provided; data that is collected, categorized, and organized for access. It is equally important, however, that the datafile be made as initially comprehensive and as efficient as possible so that the computer program can become the focal point in the design of a highly efficient overall information system. These factors have influenced the Laboratory's extensive and continuing data preparation efforts.

"The mere gathering of data without regard to organizing and classifying it into a meaningful pattern will seldom serve a useful purpose for those who will ultimately need these data"[1] In land use studies involving the inventory of many types of data in extremely large quantities that cover extensive areas of land, this statement is all the more pertinent. Accordingly, certain points must be considered prior to establishing a specific list of categories (e.g. soil types) to be inventoried. To be considered are not only the categories, but also the general hierarchy under which they are organized. Based on experience gained at the Laboratory, and on information regarding the experience of others, it appears that the main points to consider in establishing a datafile are (1) the classification must coincide with the identified requirements of the users (land use decision makers in this case) and anticipate an additional wide range of needs, (2) the classification must permit growth and expansion to accomodate newly identified items or to update existing items, (3) the classification should be arranged in a rational hierarchy of natural or inherent relationships beginning with the most general or important and progressing to the most specific or least important (ordinal organization), (4) all categories on the same level of classification should represent the same degree of generalization, and (5) the classification must be efficient to use in terms of both time and money.

---

[1] Burch and Strater, 1974, Information Systems: Theory and Practice. Hamilton Publishing Company, Santa Barbara, California

With regard to the first point, it has been shown that providing for specific detail in the classification scheme allows the maximum possible detail of inventory, which is the best assurance that the information will fill the needs of the user. For example, a vegetation classification which seperates the woodland-cultivated edge into the woodland side of the edge and the cultivated side of the edge allows the decision maker to prepare an analysis which evaluates the edge components as a unit, as seperate units, or as a part of broader categories such as woodland and cultivated respectively. This attribute would be important to a wildlife biologist. Whether specifically anticipated or not, the detail must first be provided for in the classification scheme.

The other four points concern overall organization of the classification system and can be satisfied by an ordinal classification system which arranges the items in over-categories of logical descending order. Each item is identified by a specific number (code) which represents both the specific item and its associated over-category and sub-over-categories arranged in a logical hierarchy of natural relationships. The system can accomodate new items by numerical expansion within an appropriate level and these items can be easily arranged under similar levels of generalization. The categorization is efficient in terms of inventorying data and in terms of computer analysis.

At times it is not possible or practical to arrange the data items into a strict ordinal system, either because the data does not lend itself to such classification (e.g. county delineations and watersheds) or because the data used is commonly known and classified in another manner (e.g. soil types). In such cases a modified ordinal system or a nominal system of classification must be used wherein categories follow each other in no particular logical order and the system is expanded by simply entering new items in unassigned code numbers.

The following table indicates the status of the data classes now on file at the Laboratory along with the resolution of inventory in seconds of arc latitude and longitude (e.g. one second is approximately 0.17 acres). Appendix A is a listing of the data classes with the complete datafile classification, source of information, and specific county coverage available.

| DATA CLASS NUMBER | DATA CLASS NAME | RESOLUTION (SECONDS) | SOURCE PREPARED | DATA CODED | KEY PUNCHED | DEBUGGED/ AVAILABLE | NO. SAMPLE POINTS |
|---|---|---|---|---|---|---|---|
| 0001 | County Divisions | 10 | 99* | 99* | 99* | 99* | 0 |
| 0002 | Watersheds | 30 | 21 | 21 | 21 | 10 | 24,400 |
| 0003 | Geology | 30 | 99 | 99 | 99 | 99 | 227,600 |
| 0004 | Soil Associations | 30 | 99 | 99 | 99 | 99 | 227,400 |
| 0005 | Stream Order | 10 | 10 | 10 | 10 | 10 | 219,900 |
| 0006 | General Vegetation | 15 | 99 | 28 | 28 | 28 | 265,700 |
| 0007 | (Data class not assigned) | | | | | | |
| 0008 | (Data class not assigned) | | | | | | |
| 0009 | Streams (type) - Brush Cr. Area, Fayette County | 1 | p | p | p | p | 126,000 |
| 0010 | Detailed Vegetation - Brush Cr. | 2 | p | p | p | p | 31,500 |
| 0011 | Elevation - Brush Cr. | 2 | p | p | p | p | 31,500 |
| 0012 | Soil Types - Brush Cr. | 1 | p | p | p | p | 126,000 |
| 0013 | Detailed Vegetation - Story County | 5 | 1 | 1 | 1 | 1 | 84,000 |
| 0014 | Detailed Vegetation - Skunk R. Area, Story Co. | 1 | p | p | p | p | 77,200 |
| 0015 | Detailed Vegetation (edge only) - Soper's Mill Area, Story County | 1 | p | p | p | p | 21,600 |
| 0016 | Soil Types - Story County | 3 | 1 | 1 | 1 | 1 | 232,400 |
| 0017 | Surficial Aquifer | 30 | 10 | 10 | 10 | 10 | 24,400 |
| 0018 | Elevation - Story County | 30 | 99 | 21 | 21 | 1 | 2,300 |
| 0019 | Jordan Sandstone | 60 | 10 | 10 | 10 | 10 | 6,100 |
| 0020 | Upper Bedrock Aquifer | 30 | 10 | 10 | 10 | 10 | 24,400 |
| 0021 | Middle Bedrock Aquifer | 60 | 10 | 10 | 10 | 10 | 6,100 |
| 0022 | Lower Bedrock Aquifer | 60 | 10 | 10 | 10 | 10 | 6,100 |
| 0023 | Bedrock Surface Elevation | 30 | 10 | 10 | 10 | 10 | 24,400 |
| 0201 | Major Soils of the North Central United States | 180 | 12† | 12† | 12† | 12† | 225.000 |
| 0301 | Location of Railroad Transportation Routes | 10 | 1Ψ | 1Ψ | 1Ψ | 1Ψ | 11,900 |

* = Unless otherwise noted all figures in the middle four columns represent the number of counties completed.
p = One county, partial coverage
† = Number of states completed
Ψ = Number of railroad lines completed

## PROGRAM DEVELOPMENT

A set of six versions of the Multi-Scale Data Analysis and Mapping Program (MSDAMP) has been developed from the preliminary version of MSDAMP which was applied in the land classification study[1] conducted for the Office for Planning and Programming during the period from 29 June to 30 September, 1973. Each of the six versions provides a different set of processes developed by the Laboratory. The various versions were prepared to provide the potential user with the opportunity to select one which performs the functions needed without superfluous program routines. An additional effect is that the complexity of the program may vary with the complexity of the user's needs.

The original program concept was developed in November, 1972, to solve a specific problem. The problem that was to be solved by this program involved the use of detailed soils data with other data from less detailed sources. It was necessary to develop a process for spatially relating detailed data from a source such as a modern soil survey with much more generalized data from sources such as geologic maps and topographic maps. The agronomists specified that unit areas as small as 0.2 acres needed to be resolved, while the geologists only needed a resolvable unit area of about 150 acres or larger. A single resolution (scale) system provided either a gross generalization of a modern soil survey or a highly redundant storage of general data. Any compromise unit area left all concerned unsatisfied. MSDAMP has provided a process which satisfied all of the representatives of the disciplines involved in the Laboratory.

A secondary benefit relating to the development of the MSDAMP program concept is a large increase in the relative validity of the data being used in analysis. Primarily this is due to the data preparation techniques required to implement the program. Data preparation is now not a judgment process where someone must make decisions as to quantity or relative

---

[1] Land Use Analysis Laboratory (1973), A Land Classification Method For Land Use Planning. Land Use Analysis Laboratory, Iowa State University, Ames, Iowa

importance of minor crenulations in lines and areas. All data is prepared by a systematic sample of the data source at a resolution determined by the quality of the data source. The sample is statistically sound and is easily prepared by semi-skilled technicians. For example, soils data for Story County was prepared in less than four and one half man months; this sample consists of more than two hundred thirty thousand sample points.

The Multi-Scale Data Analysis and Mapping Program consists of a system package of related analysis and mapping programs. The operational relationship between the individual segments of the system is based on a common data source and input form. Because the program is not a single entity, various functions may be removed or separated into distinct program units to reduce computer memory allocation or to increase efficiency if those segments are not to be used. The current version of MSDAMP embodies all of the possible functions developed by the Laboratory to this date. Three other versions, named MSDAMP-M, MSDAMP-U, and MSDAMP-D, perform the minimum analysis functions and various utility functions of increasing complexity respectively. Two more versions named MSDAMP-S and MSDAMP-T provide increased analysis capability with some utility functions. Only the full version of the available functions is named MSDAMP.

The multi-functional structure of this program is based on a main program which acts as an 'executive routine'. This main program does not perform analysis functions. Instead the main program selects the proper sequence of analysis and mapping programs to perform the functions sought by the user. The analysis and mapping programs are called as subroutines to the main program. In any given operational step two or more of these subroutines may be used. This structure will allow not only the subdivision or restructuring of the program but also the adaptation of the program to new functions. The main program controls eight subroutines in the complete system. With all eight subroutines in the system there are six distinct sequences and several combination sequences available to the user.

The symbolic mapping process is the basic function of the program system. This process prepares a map on the line printer using symbols to display one to thirty possible separation categories. The data processed may be of a uniform resolution or may be of various resolutions depending on the

data classes used. The data coverage for any or all of the data classes used may be incomplete in coverage of the area mapped if there is missing data or if no data is available for some portions. Output resolution may be selected independently by the user. All measurements and resolutions are defined in terms of seconds of arc[1]. All area references are based on the geodetic reference system. The data is prepared by the user according to the conventions defined in Research Considerations - Data Sampling and Resolution In Data Preparation[2]. Data prepared by the Laboratory is listed in the Datafile Status section of this report. This data is compatible with any of the six versions of MSDAMP. All six versions contain the symbolic mapping process.

The statistical process is a part of the basic function of the program system. This process is also available in all six versions of MSDAMP. The process prepares a statistical summary of the data processed. Output products include documentation prepared by the user, summary values such as the standard deviation and the mean which were derived in analysis, and a histogram with accompanying legend representing the category quantities obtained in the analysis of data. The output products of this process are also produced whenever a map is produced by the symbolic mapping process. The statistical process is used for previewing the distribution of the categorization process to allow the user to have some opportunity for adjustments in his analysis of the data to obtain the maximum information in a mapping product.

Two utility processes are available to aid the user in preparing the data for use in the analysis steps. These routines will (1) store the data on computer tape and will allow the user to (2) sort data from the general file to create a reduced datafile for use in the immediate process steps. For example, data as well as analysis instructions may be processed by the program in one computer run. In this run the data

---

[1] Beavers and Shuck (1974), Research Considerations - A Location Reference System. Land Use Analysis Laboratory, Iowa State University, Ames, Iowa

[2] Land Use Analysis Laboratory (1974), Research Considerations - Data Sampling and Resolution In Data Preparation. Land Use Analysis Laboratory, Iowa State University, Ames, Iowa -- This report is still in preparation; see the Reports section of this report.

may be stored on computer tape and some analysis steps processed. The data may then be sorted for a reduced length file covering a smaller area for further analysis which may not need the full file. This step can provide a considerable savings in computation costs to the user. These two utility processes are available in four of the versions of MSDAMP: MSDAMP-U, MSDAMP-D, MSDAMP-T, and MSDAMP.

The tabular correlation process provides an extension of the classification capabilities of MSDAMP from thirty levels to six hundred levels. This process provides area quantities (acres) in a table form which represents the spatial correlation of a particular data class with a base map representing the classification base. An example might be the spatial correlation of vegetation types for a county with the major watersheds which are subdivided by soil associations. The output would, in this case, represent soil associations by watersheds as columns and represent the vegetation types by rows. A table produced may have up to thirty rows and up to twenty columns where each number represents the acres of spatial correlation[1]. The table process is available in three versions of MSDAMP: MSDAMP-S, MSDAMP-T, and MSDAMP. These three versions of the MSDAMP program system provide the user with the means to spatially relate large volumes of data and evaluate the spatial correlation of the data. Uses of the functions might include the mapping of a general spatial classification of land, the mapping of a second spatial classification, and the correlation of the quantity distribution of the two classifications[2].

The map storage process provides the capability of storing the results of an analysis step as data for future use. This process is particularly useful when a real set of data may be derived by the interrelationship of two or more previously prepared data classes; for example, deriving a data set of the depths to bedrock from the data class of surface

---

[1] See the Computer Products section of this report for a sample table which will illustrate output prepared by the tabular correlation process.

[2] The user's manual for MSDAMP will provide more complete illustrations of possible uses for the tabular correlation process; see the Reports section of this report.

elevations and the data class of bedrock surface elevations. Other uses might include the comparison of two different evaluations of the same data or the composite classification of various analysis runs. This process is a very real extension of the program system's capability to provide the user with a versatile spatial analysis tool. The map storage process is available in two of the versions of MSDAMP: MSDAMP-D and MSDAMP.

All six versions of MSDAMP are now standardized and may be copyrighted and made available for distribution. The user's manual[1] will be applicable to any of the six versions of the program system. However, some program development research is still in progress. One item of interest is the preparation of program routines to provide the user with an empirical measure of the degree of interspersion of data being mapped, the degree of diversity of the data being mapped, and from these a complexity index. Indices of this sort, when statistically standardized, will aid soil scientists and wildlife planners, both of whom need an empirical index measuring the diversity and complexity of the data with which they prepare recommendations as summaries of study results. For example, the soil scientist may use this index when evaluating detailed soils data against a soil association map to indicate the conditions that are represented.

The program development portion of the Laboratory's research effort will provide the means to interrelate soils data at a representative resolution with other data at its representative resolution without resorting to a hierarchical data organization. The program certainly will allow wider use of soils data, particularly detailed modern soils data, in computer information systems for planning applications.

---

[1] The user's manual for MSDAMP is in preparation and is expected to be available in December, 1974; see the Reports section of this report.

## REPORTS

In the process of making some of the techniques under investigation by the Laboratory available for use, a series of reports which documents these techniques and demonstrates their application is being prepared. For example, a just completed report[1] provides information on the basis for selection, on the method of application, and on demonstrations of application of the reference system used by the Laboratory. Although this report includes some basic documentation of the methods used by the Laboratory, other reports are necessary to present a complete review of the available techniques. Areas of concern in this series of reports are the reference system (as just discussed), the data preparation process, the application mechanics of the program, the theory of the system, and application demonstrations.

Data Preparation Data preparation is the next step beyond the development of a reference system in the process of implementing the Laboratory's information system. A large number of considerations are a part of the data preparation processes used by the Laboratory. Data preparation involves the selection of the information source, the development of the horizontal control, the preparation of a classification of the data units, the selection of a resolution, and the encoding of the machine records. An outline of the report that will document these implementation considerations is given on the succeeding two pages. Approximately fifty pages of preliminary material have been assembled for this report.

---

[1] Beavers and Shuck, 1974, Research Considerations - A Location Reference System. Land Use Analysis Laboratory, Iowa State University, Ames, Iowa

RESEARCH CONSIDERATIONS - DATA SAMPLING AND RESOLUTION IN DATA PREPARATION

I Introduction

A. Objectives

1. Provide the basis for the selection of a sampling method
2. Provide the relationship between resolution and data sampling
3. Provide the relationship between classification and data sampling

B. Review

1. Give an examination of other systems and their data handling characteristics
2. Give examples of other data preparation methods used by other data systems that were examined by the Laboratory

II A Statistical Basis For Data Sampling

A. Systematic sampling methods

1. Necessity for retaining spatial characteristics
2. Spatial sampling methods

B. Discussion of attributes

1. Advantages
2. Limitations

III Development Of Data Classifications

A. Selection of sources

1. Availability of needed data
2. Quality and accessibility

B. Development of a basic nominal scale classification

1. Categorization objective for watersheds data
2. Categorization method for watersheds data

C. Development of a nominal scale classification of specific characteristics

1. Categorization objective for soils data
2. Categorization method for soils data

D. Development of a nominal-ordinal scale classification of characteristics

1. Categorization objective for vegetation-land cover and land use data
2. Categorization method for vegetation-land cover and land use data

IV Selection Of Resolution For Data Representation

A. Demonstrate the relationship of resolution to data sources

1. Give source resolution standards

2. Show the development of horizontal control

B. Give the relationship of resolution to data classification

1. Show the development of resolvable units

2. Show the limitations of complexity

V An Application To Soils Data Preparation

A. Selection of the data source

1. Fayette - modern soil survey

B. Devolopment of data classification

1. Preparation of soils numbers used for classification of the data

C. Selection of resolution

1. Resolvable units

2. Development of horizontal control

D. Preparation of computer compatible records

1. Sampling the data

2. Record information

3. Record images

E. Debugging the data prepared

1. Correcting horizontal control errors

2. Correcting classification errors

F. Preparation of analysis of the data

1. Direct interpretations

2. Indirect interpretations

References ---

Appendices

Program Application Mechanics A report on the application mechanics of implementing the Laboratory's computer program, MSDAMP, is primarily a user's manual. The preliminary writing of this report has centered on the user's manual portions. A user's manual of approximately one hundred and thirty pages, which applies to all six versions of MSDAMP, will be completed this year. However, the full report, which will also document the design theory of this program, will not be available until spring. The manual will cover only the mechanics of using the program. Both the full report and the user's manual will be prepared for distribution.

The succeeding seven pages are a segment of the user's manual which illustrate its form of presentation. In addition to the Introduction and the Process Sequence Control Data Sets chapters, the user's manual will include a chapter on the development of static models which discusses the analysis process, the physical preparation of a static model, and the variations in effects derived in use of multi-data class static models.

# INTRODUCTION

## IMPLEMENTATION

MSDAMP is a user oriented computer program for the static modeling and display of data on spatially distributed land characteristics. A static model, which is a user defined set of criteria for evaluating the data with regard to representing a static set of conditions, is the basis for processing data. The data may represent any user defined characteristic which has as a quality a spatial distribution or specific location. A visual representation of the spatial relationships is prepared with a generic analysis section applying the user's static model (Beavers, 1974). Because of the generically structured analysis section, this program is applicable to a broad range of problems and disciplines.

It is expected that frequently the user will not also be a programmer, therefore, MSDAMP is designed to be implemented with a minimum of programing support. The program language is FORTRAN IV which is widely available at computation service centers. Applications of the program will range widely in sophistication depending on the user's expertise and needs. Although only the operation mechanics of the program is covered in this manual, other aspects of program implementation or data preparation are discussed in Laboratory publications listed in the references. These other publications will help the new user to develop techniques of program application.

MSDAMP in operation will process data sets prepared on cards which contain the user's processing criteria. The spatially distributed data may be furnished on cards or in magnetic storage form (magnetic tape or disk). Output product is prepared on the line printer or stored on tape. Peripheral devices necessary to the use of MSDAMP are the line printer, the card reader, and one to two magnetic tape transports. Each computation center will have defined conventions within its system for providing access to these devices. The program will refer to these devices by specific unit numbers and the user must make the necessary adjustments in the computer system's job control language used by the computation center. The program refers to the card reader as unit '5' and to the line printer as unit '6'. The line printer should be adjusted for eight lines to the inch output for minimum visual distortion of the program's graphic product. The program refers to the primary tape transport as unit '10' and to the secondary tape transport as unit '11'. Disk storage may be substituted for either or both tape units to increase the speed of operations. However, this minor economy is usually offset by higher device use costs.

## FUNCTIONAL DESCRIPTION

The Multi-Scale Data Analysis and Mapping Program consists of a system package of related analysis and mapping programs. The operational relationship between the individual segments of the system is based on a common data source and input form. Because the program is not a single entity, various functions may be removed or seperated into distinct program units to reduce computer memory allocation or to increase efficiency if those segments are not to be used. Excepting a matrix (map matrix) used as a manipulative storage field, the complete program package will require less than 100K of main core in the IBM 360 when using the FORTRAN IV G compiler. Optimization using the FORTRAN IV H compiler requires about 2K to 4K less main core memory. The map matrix may be adjusted according to need and available main core in the computer. However, large amounts of data are handled much more efficiently by a large map matrix.

The multi-functional structure of this program is based on a main program which acts as an 'executive routine'. This main program does not perform analysis functions. Instead the main program selects the proper sequence of analysis and mapping programs to provide the function sought by the user. The analysis and mapping programs are called as subroutines to the main program. In any given operational step two or more of these subroutines may be used. This structure will allow not only the subdivision or restructuring of the program but also the adaptation of the program to new functions.

In addition to controlling the sequence of operations the main program also provides a bypass process for errors encountered during a given run. Errors detected by the computer will be handled normally but errors in the program flow will be handled by the program. One group of errors which will be bypassed are errors in the user's mapping

or analysis instruction-data. A multiple map and analysis run will not abort because one instruction-data set out of several was incorrectly prepared. Errors detected which may affect subsequent maps or analysis will cause a run termination.

The main program controls eight subroutines in the complete system. With all eight subroutines in the system there are six distinct sequences and several combination sequences available to the user.

Subroutine CDSIN - Control Data Set Input
This subroutine is provided for the input of the user's criteria for a particular analysis or mapping step. For example, the user may specify the area bounds, the resolution, the symbology, the title and text and legend, the analysis parameters, the numerical ranges for categorization, a static model for analysis, and the data to be used in the production of a map or table. The instructions are prepared in a control data set and are interpreted for the program by this subroutine. The main program will call CDSIN first in all process sequences.

Subroutine DIPAP - Data Input and Analysis Processing
This subroutine is called by the main program in all process sequences where the spatial distribution of the data is a quality which is important. This subroutine searches the data file on unit '10' for data classes being used and data units within these classes which are within the region of interest. The subroutine also performs all resolution adjustments and analysis criteria evaluations except tabular correlations. In addition, basic statistical data is compiled on the results of the analysis. This subroutine does not produce an output product, rather all results are held in memory and transfered for further processing to other subroutines.

Subroutine MMOUT - Map Matrix Output
Subdivision of the map matrix field into strips which may be printed on the line printer is the primary function of this subroutine. In addition to the sorting and output of the data in the map matrix, this subroutine also prepares and outputs the referencing of locations at the map edges. The flow of this subroutine links these operations by preparing the column numbering, the row numbering, and the symbols for each verticle output strip as a unit. These strips must be assembled to obtain the map product.

Subroutine TTLHO - Title and Text and Legend-Histogram Output
In addition to providing the complete output product for the statistical process, this subroutine provides statistics and documentation output for all map processes and derived storage processes. A fixed structure title block and text are prepared, followed by a histogram developed from the basic statistical data prepared by DIPAP. In the derived storage sequence the textual information is bypassed and only the statistical distribution is presented.

Subroutine SSDRP - Sequential Storage of Data Required for Processing
Two modes of data storage are employed by the program. One is the active array in the map matrix and the second is the base file stored on magnetic tape. One or two tapes may be required for a run depending on the complexity of the data processing. Primary storage is on unit '10' and secondary storage is on unit '11'. A direct file use such as preparing a series of maps will require only one magnetic tape which is assigned to unit '10'. If the process includes the sorting of the base file for a reduced area coverage, then two tapes must be mounted and the base file prepared on unit '11'. This subroutine provides the utility function of preparing the base file on either unit '10' or on unit '11' as selected by the user.

Subroutine LSDIN - Load and Sort Data for Input
In preparing a series of maps it is rare for the entire area of coverage of the data to be needed, rather, there is a particular region of interest. If the complete series of maps is based on one region or if a sufficient number of these maps are based on that region there is a real benefit in being able to prepare a data file from the main file that applies to just that region. This subroutine will sort both particular data classes and particular data units from the classes onto unit '10' from unit '11'. The main file must be on unit '11' or must be loaded on unit '11' by SSDRP before this subroutine is called. The subroutine itself is a non-discriminate sorting routine which checks only the data class and the spatial location of the data units.

Subroutine TBLCP - Tabular Correlation Process
A tabular correlation as prepared by this program consists of the evaluation of spatial correlation in acres. This subroutine evaluates the categorization of data units from a particular data class by a base map. For example, a table of acreages of vegetation classes may be categorized by their spatial correlation with soil associations within a region. TBLCP will prepare a table using a user assigned data class and evaluation criteria against a user defined seperation base map stored in the map matrix. The data evaluated is accumulated in a table. The table will show as columns the seperations of the base map and as rows the evaluated data class. Correlations in values of acres appear in the table output by this subroutine. TBLCP will also output the associated documentation supplied by the user including a text and table legends.

Subroutine MMOTT - Map Matrix Output To Tape
Comparisons of maps prepared from the same data file or use of data derived from the interrelationship of two or more data classes from the data file requires that these maps be stored for further use. This subroutine will create a temporary or perminent data set under a user defined data class label and add that data class to the main data file available on unit '10'. Use of this subroutine does require tapes assigned to both unit '10' and unit '11'. Any data stored previously on unit '11' is destroyed by this subroutine's execution.

# PROCESS SEQUENCE CONTROL DATA SETS

## DEVELOPMENT OF CONTROL DATA SETS

Each of the six process sequences available in the complete MSDAMP system of programs is invoked by the user with a process definition card. This card is followed by the instruction data necessary to control the process. The set of cards including the process definition card is called a control data set. Although all six of the process sequence control data sets will be discussed, the user should be aware that the program available may not be the complete system. However, the delivered program will have accompanying documentation indicating which process sequences are available.

Any number of control data sets and associated land characteristic data sets may be processed in one computer run. Each control data set represents a seperate process and is treated independantly by the program. In many cases two or more control data sets will be run sequentially by the user to achieve a specific result. The number of process steps run by the user is restricted only by what is practical in terms of computer use time and cost. The process sequences are:



Many of the instruction cards used in the control data sets apply to several process sequences. In these cases the user should be aware that each instruction card performs the same function in all process sequences to which it applies. Uniformity of function will reduce the amount of effort required of the user to master the preparation of all six process sequence control data set types. Although the instruction data is standardized, there are no default conditions in the program and each instruction card specified in a process sequence control data set must be provided by the user.

In the discussion of the preparation of each of the process sequence control data sets the examples are drawn from control data sets sued by the Laboratory in various studys. Output from the example control data set is presented to provide the user with a view of the relationship between the control data set and the product.

Examples of control data set preparation forms are also presented as illustrations. These forms, when properly completed, allow the user to have clerical aides prepare the cards of a control data set. Control data sets prepared in this manner should be carefully checked by the user to eliminate errors.

Symbolic Mapping Process.
This process sequence is the basic function of the program system. The process prepares a map on the line printer using symbols to display one to thirty possible seperation categories. The data processed may be of a uniform resolution or may be of various resolutions depending on the data classes used. Output resolution may be selected independently by the user. All measurements and resolutions are defined in terms of seconds of arc (Beavers and Shuck, 1974). All area references are based on the geodetic reference system. The data is prepared by the user according to the conventions defined in Research Considerations - Data Sampling and Resolution In Data Preperation.

The process is defined in the control data set as SMAP PROCESS on the process definition card (figure 1). These words must appear on the first card of a control data set prepared by the user to invoke the symbolic mapping process. The subsequent cards are sets of instructions which define the form of the map. The examples shown for this process sequence control data set will be for a vegetation map of Story County, Iowa. The map will be prepared with an output resolution of five seconds for eighty four thousand cells.

Set output and process parameters for the map matrix: this instruction card (figure 2) is labeled with an integer '1' in card column five. This card must be supplied in the symbolic mapping process control data set.

Card columns eleven through seventeen will contain the decimal number of output cells across the map matrix (the number of columns of cells in the map).

Card columns eighteen through twenty four will contain the decimal number of output cells down the map matrix (the number of rows of cells in the map allowed in the map matrix in one data set pass).

Card columns twenty five through thirty one will contain the decimal number of seconds of resolution per output cell. The output cells in this example represent unit areas which are five seconds of arc on a side or approximately 4.345 acres.

Card columns thirty two through thirty eight will contain the decimal number of data set passes required for the map. This number will affect the value placed in the second field (card columns eighteen through twenty four). The memory space allocated to the map matrix determines the maximum number of cells that may be processed at one time. In the example being used there are eighty four thousand cells in the map; however, the map matrix allows for only forty thousand cells. It will require three data set passes to cover the map area. The number of rows of cells in the map is then adjusted to a multiple of three which will most closely approximate the eighty four thousand cells. The calculations are as follows:

the number of cells in the map is 84,000
the number of cells in the map matrix 40,000
the number of columns in the map is 336

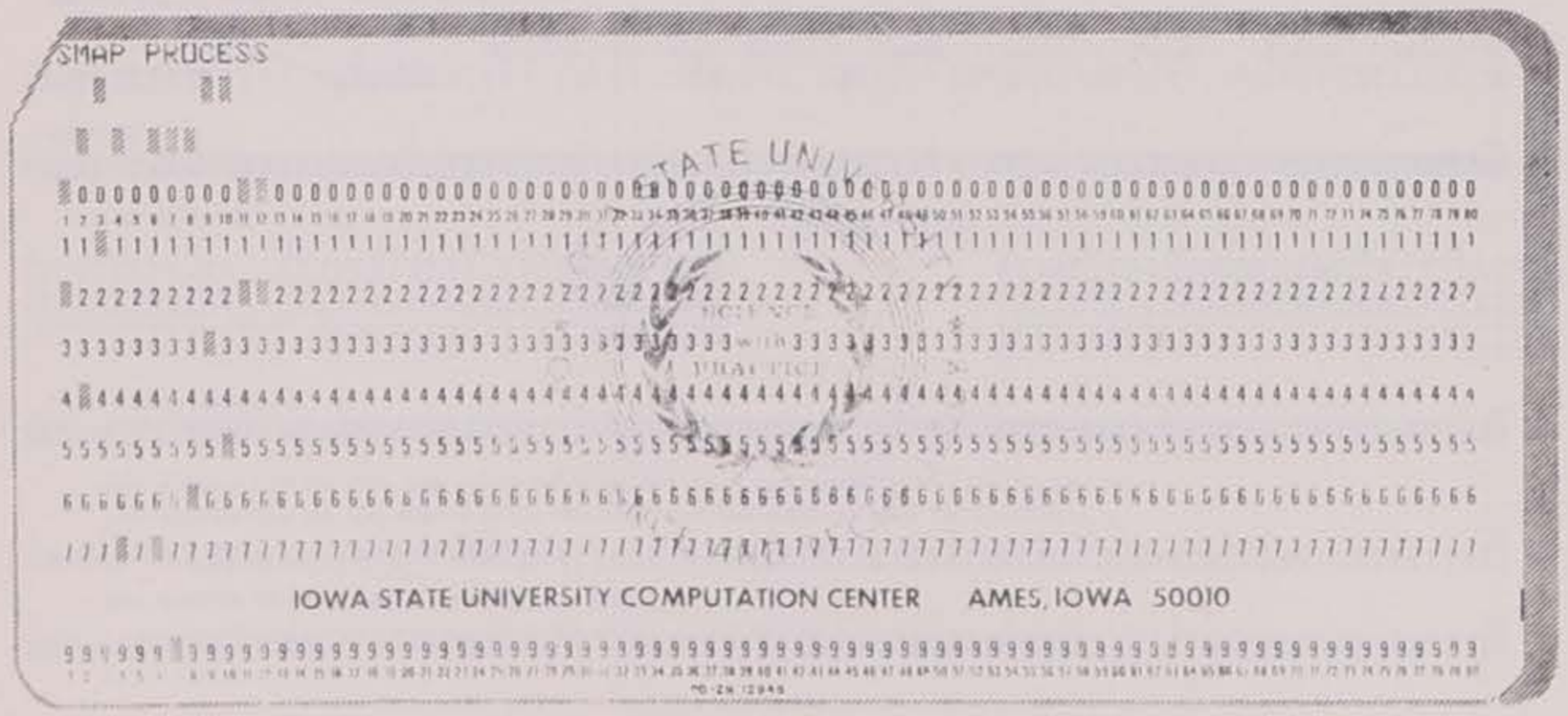
then '3' is the number of data set passes and
the number of rows = (84,000/3)/336 = 83.3

the adjusted number of rows is 84
the number of data set passes is 3

This will produce a map with '336' columns of cells and '252' rows of cells.

Card columns thirty nine through forty five will contain the decimal number of symbols across one output cell. In this example the cell symbol dimensions are one by one symbols. This will allow the enlargement of small maps by having multiple symbols representing one cell width.

Figure #1, Symbolic mapping process definition card.



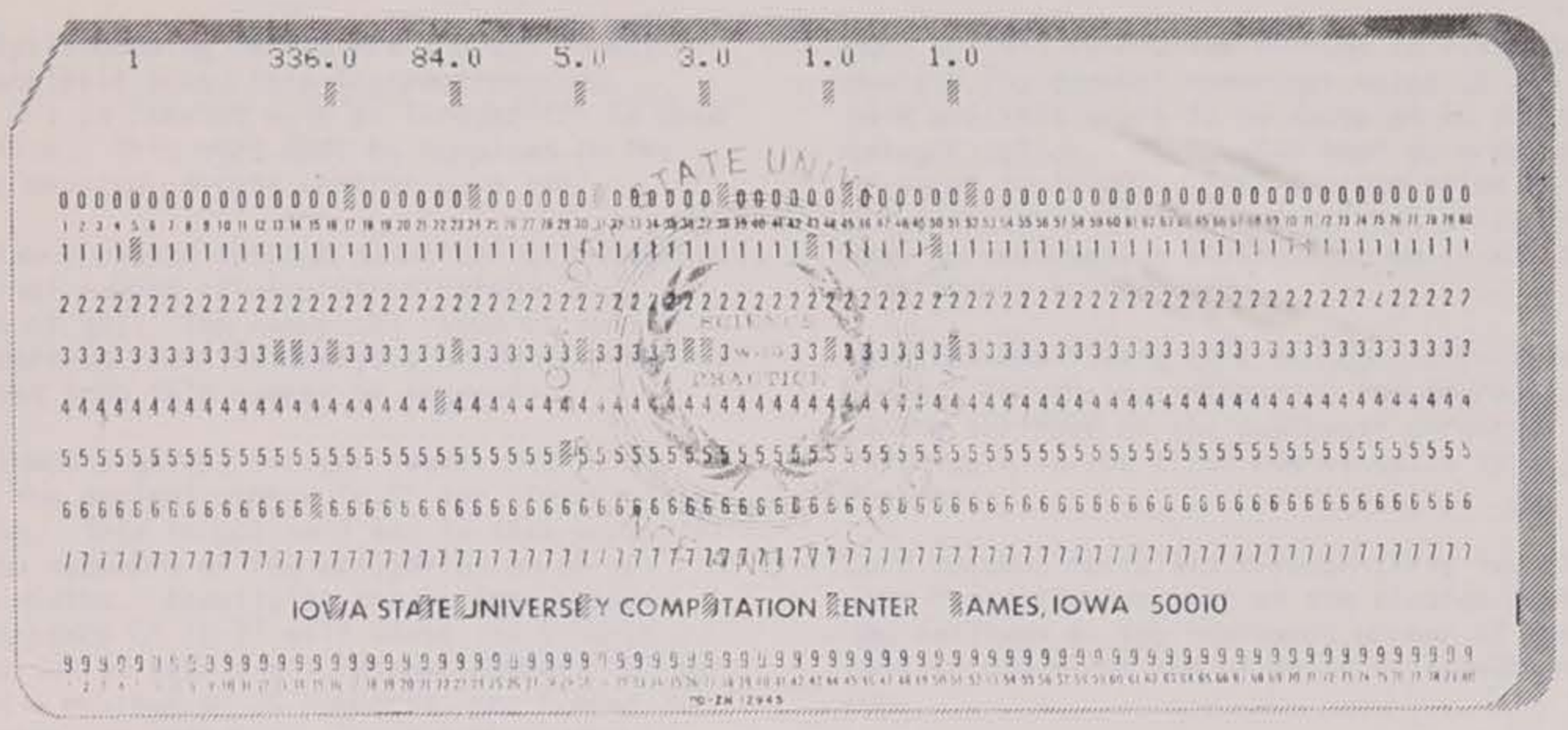



Figure #2, Instruction card for specifying the output and process parameters for the map matrix.

Card columns forty six through fifty two will contain the decimal number of symbols down one output cell. In this example the cell symbol dimensions are one by one symbols. This will allow the enlargement of small maps by having multiple symbols representing one cell hight.

Illustration #1, Control data set preparation form showing output and process parameters for the map matrix.

MAP FORMAT FORM
Land Use Analysis Laborato y

Person submitting form G.H BEAVERS

Page 2 of 6
Date 11/18/74

Output process parameters for the map matrix +

| 1 | cells across | cells down | output resolution | number data sets | symbols across | symbols down | 80 |
|---|---|---|---|---|---|---|---|
| 1 | 336.0 | 84.0 | 5.0 | 5.0 | 1.0 | 1.0 | |

Analysis mapping parameters; location analysis zone +

| 1 | no. range subdiv. | option 9 | max. value map. range | min. value map. range | latitude degrees | latitude minutes | latitude seconds | longitude degrees | longitude minutes | longitude seconds | 80 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | | 0 | 0 | 0 | 90 | 0 | 0 | 0 | 0 | 0 | |

1 Symbology + 80

3

- gray scale levels* +

1 5 10 15 20 25 30 80

*suggested symbology for twenty levels:

1 5 10 15 20 25 30

- . | / : + = > V < I > < V < X H V Z Z Z
- - - I > + I T N N N
+ +

1 Title - Text - Legend + 80

4

- cards prepared from the title page follow the above card (there must be exactly 20 cards for the title)
- cards prepared from the text page(s) follow the title cards (maximum of 50 cards for the text)

1 80

C N O T E X T

- cards prepared from the legend page follow the above card

1 80

E N D L E G E N D

**Set analysis mapping parameters and set location of the analysis zone:** this instruction card (figure 3 ) is labeled with an integer '2' in card column five. This card must be supplied in the symbolic mapping process control data set.

Card columns eleven through seventeen will contain the decimal number of seperation categories (maximum of 30). The numerical range of data scores derived from the analysis steps will be subdivided into this number of segments.

Card columns eighteen through twenty four will contain the decimal number '0.0' for linear range divisions. This is option 9 and in this case will cause the segments of the categories to be of uniform widths. Specifying the decimal number '1.0' in place of '0.0' will cause the program to accept a set of four digit integer numbers (20 per card and a maximum of 30 numbers), one number for each seperation category. These numbers may be used to specify a nonlinear subdivision of the numerical score range. For example, if the total of the numbers is 100 then each number would represent a direct percentage of the total numerical score range. The card or cards with the nonlinear range subdivision numbers must directly follow this instruction card (figure 4 ).

Card columns twenty five through thirty one will contain the decimal numerical value of the maximum data analysis score to be accepted in the mapping categorization. If this value is less than the user supplied maximum possible score derived from the input of the static model, the maximum data analysis score will be adjusted to the value of the user supplied maximum possible score. However, if the maximum data analysis score is greater than the user supplied maximum possible score then no adjustments are made to either value. This relationship is discussed further on page 12.

Card columns thirty two through thirty eight will contain the decimal numerical value of the minimum data analysis score to be accepted in the mapping categorization. This value must be greater than or equal to '0.09'. This minimum value will allow the program to distinguish between cells which have no information entered and cells which were effectively scored zero.

Card columns thirty nine through forty five will contain the decimal number of the degrees portion of the latitude of the southwest corner of the first cell in the first row of cells to appear in the map.

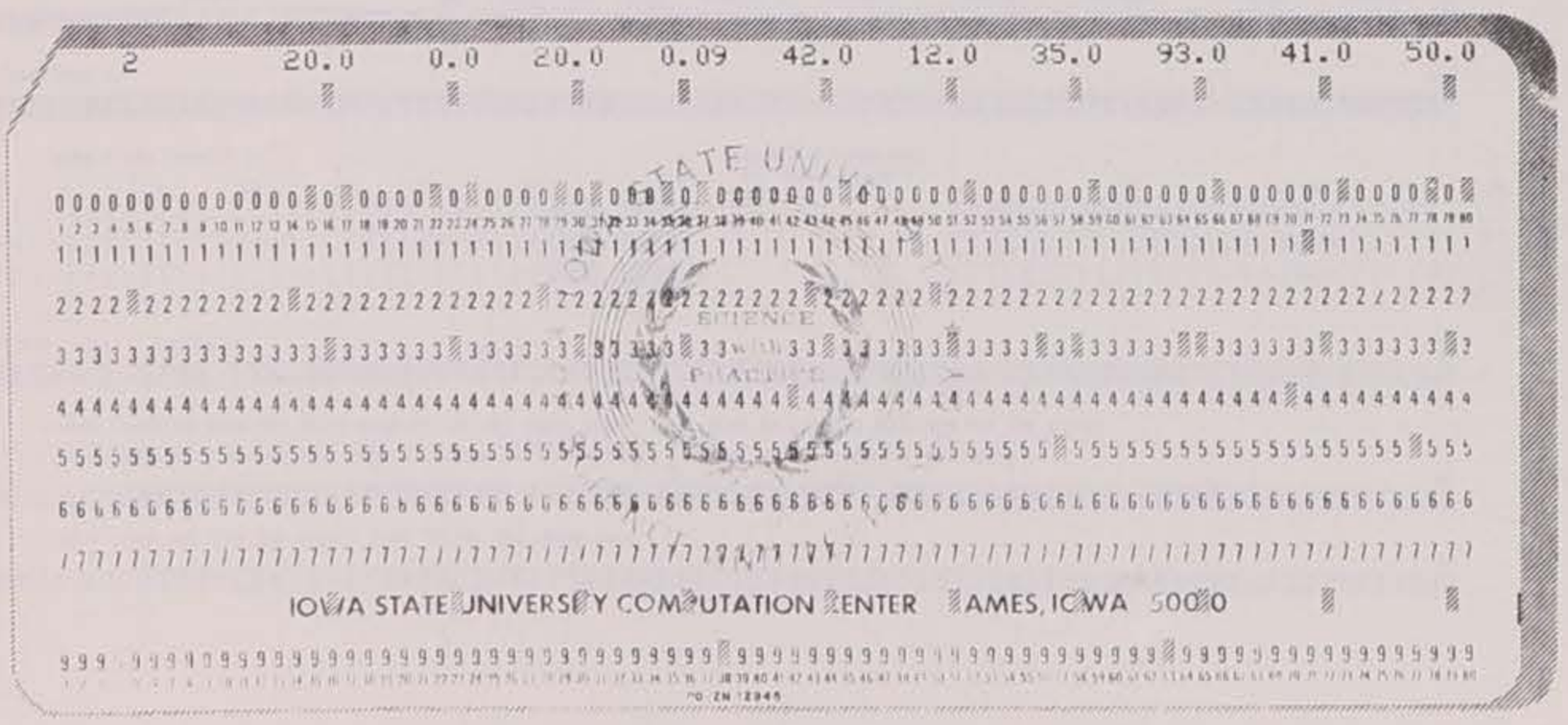
Card columns forty six through fifty two will contain the decimal number of the minutes portion of the latitude of the southwest corner of the first cell in the first row of cells to appear in the map.

Card columns fifty three through fifty nine will contain the decimal number of the seconds portion of the latitude of the southwest corner of the first cell in the first row of cells to appear in the map.

Card columns sixty through sixty six will contain the decimal number of the degrees portion of the longitude of the southwest corner of the first cell in the first row of cells to appear in the map.

Card columns sixty seven through seventy three will contain the decimal number of the minutes portion of the longitude of the southwest corner of the first cell in the first row of cells to appear in the map.

Card columns seventy four through eighty will contain the decimal number of the seconds protion of the longitude of the southwest corner of the first cell in the first row of cells to appear in the map.



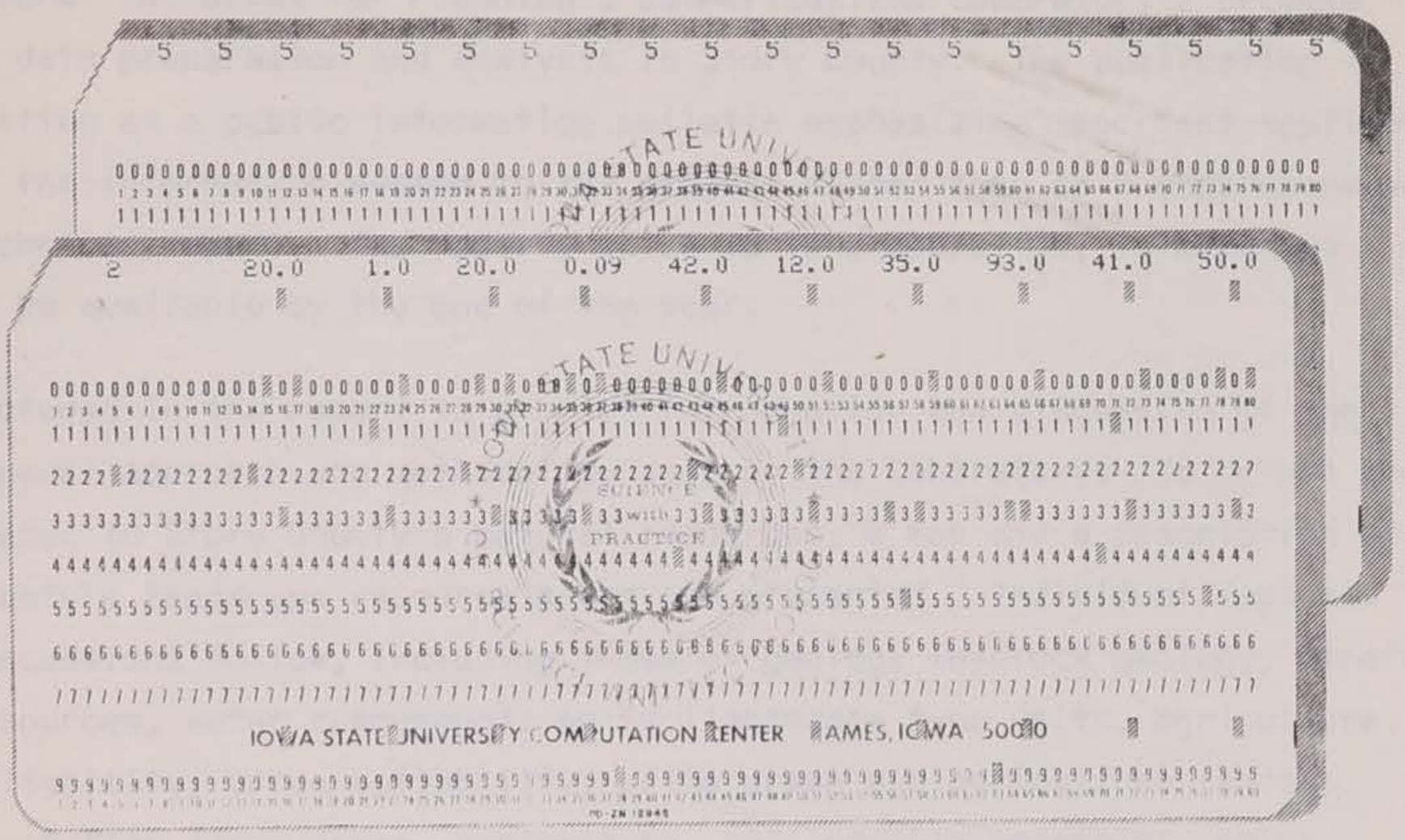



Figure #4, Specifying subdivisions of the mapping range at five percent for each interval.

Illustration #2, Control data set preparation form showing analysis mapping parameters and the location of the analysis zone.

MAP FORMAT FORM
Land Use Analysis Laboratory

Person submitting form G H Beavers

Page 2 of 6
Date 11/28/74

Output process parameters for the map matrix +

| | cells across | cells down | output resolution | number data sets | symbols across | symbols down |
|---|---|---|---|---|---|---|
| 1 | 536.0 | 84.0 | 5.0 | 3.0 | 1.0 | 1.0 |

Analysis mapping parameters; location analysis zone +

| | no. range subdiv. | option 9 | max. value map. range | min. value map. range | latitude degrees | latitude minutes | latitude seconds | longitude degrees | longitude minutes | longitude seconds |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 20.0 | 0.0 | 20.0 | 0.09 | 42.0 | 12.0 | 35.0 | 93.0 | 41.0 | 50.0 |

Symbology +

1 3 80

- gray scale levels* +

1 5 10 15 20 25 30 80

*suggested symbology for twenty levels:

1 5 10 15 20 25 30

- . : / + = > V < ) > < V < X H V Z Z Z
- - - ) > + ) T N N N
+ +

Title - Text - Legend +

1 4 80

- cards prepared from the title page follow the above card (there must be exactly 20 cards for the title)
- cards prepared from the text page(s) follow the title cards (maximum of 50 cards for the text)

1 80
ENDTEXT

- cards prepared from the legend page follow the above card

1 80
ENDLEGEND

Application Demonstration A report, tentatively titled "Story County Natural Resources for Planning", summarizes the Laboratory's process of data preparation and analysis in Story County. The publication is written as a public information bulletin emphasizing important applications of the information system to the project rather than as a comprehensive technical report. The report, which is in preparation, is expected to be available by the end of the year.

Included in the report is a brief introduction and discussion of the general approach and methodology used by the Laboratory. To orient the reader to Story County's natural resources, a map and a description of the county's landscape resource areas are presented. Individual maps and discussions follow, including those of geology (bedrock geology, mineral resources, water resources); soils (landscape type units, agriculture suitability, urban suitability, prime urban and agriculture lands); vegetation (tree cover, agriculture, soil erosion potential, noise attenuation); and wildlife (permanent cover, general habitat quality, travel corridors). Priority areas for county resource planning are then delineated on a final map. A summary and a glossary conclude the report.

Four pages of the report in preliminary form follow. Two maps are shown on separate pages, each following their corresponding explanations. Included for each map is a general discussion of what the map shows, the quantity of each resource variable or separation category in the county, the distribution of the resource variables in the county, the significance of the resource in general and the significance of each resource variable, and the planning limitations presented by the information. Concepts in the discussion are illustrated by a sketch or a diagram. A portion of the map is enlarged at the bottom of the page, arranged with a vertical aerial photograph and an oblique photograph of the same area to help correlate map symbols with natural features on the landscape. A legend identifies each map symbol and the area in acres represented by each symbol.

# Vegetation: tree cover

TTERNS - Story County's tree cover includes areas dense woodland (greater than 25 percent crown ver), scattered large trees (5 to 25 percent crown ver), trees in urban areas, on farmsteads, in meteries, and in parks and recreation areas. Thus, th natural and planted trees are considered part the county's tree cover. Major native woodland pes in Story County include oak-hickory, maple- nden, and elm-ash-willow plant communities. The k-hickory community is found on isolated, dry upland tes as well as west- or south-facing slopes. Bur, ite, red, and black oaks dominate this community ong with shagbark and bitternut hickories. Ameri- n linden (basswood) and sugar maple are found with her maples in the maple-linden woodland community moist north- and east-facing slopes. The elm- h-willow floodplain community occurs along water urses and commonly includes boxelder, silver maple, nerican elm, slippery elm, green ash, white ash, ckberry, black walnut, black willow, cottonwood, d sycamore.

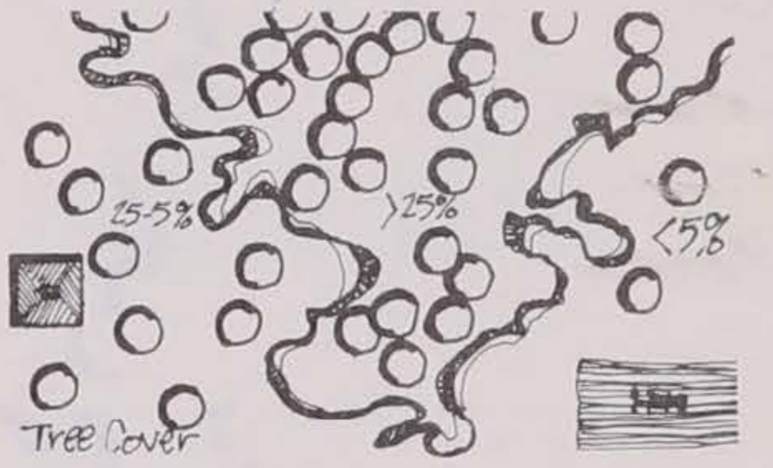
UANTITY - Tree cover, both planted and natural, ccurs on 9 percent (31,830 acres) of the county's and area. It includes about 9570 acres of dense oodland, 8290 acres of windbreaks and tree cover on armsteads, 6050 acres of tree cover in residential reas, 6260 acres of scattered large trees, 1370 cres of wooded and savanna-like parks, 190 acres of ooded cemeteries, and 100 acres of hardwood timber nd farm woodlots.

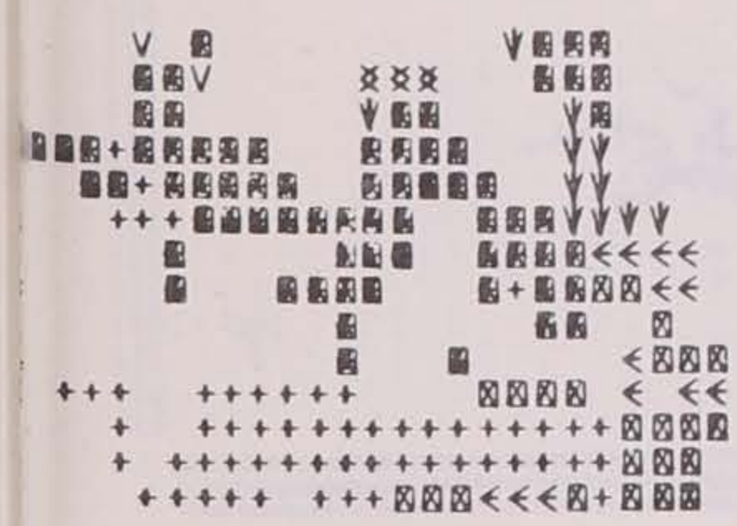
ISTRIBUTION - Most of the dense woodland and scat- ered large trees occur in or near the stream valleys n the south and west portions of the county. Resi- ential tree cover, along with farmsteads, is cattered throughout the county and concentrated in nd near Ames and Nevada. The Skunk River valley etween Ames and Story City contains approximately ne-fourth of the county's dense woodland (greater han 25 percent crown cover); and East Indian Creek, quaw Creek, other creek valleys, and the south- ast corner of the county also contain large stands of dense woodland.

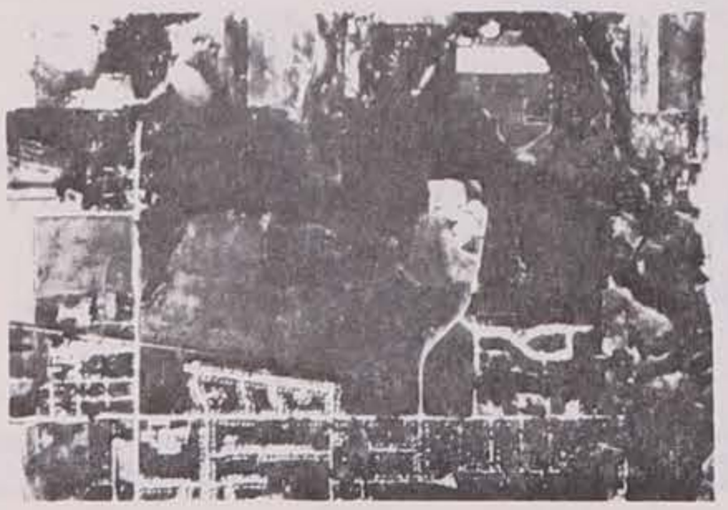
SIGNIFICANCE - Tree cover, especially in and near stream valleys, offers visual relief in a county dominated by cropland. It is this dense tree cover, occupying 2.6 percent (9570 acres) of the county, which can be considered woodland containing primarily native species. Vegetation types containing native species are highly stable due to their diversity. These native plants provide not only biological diversity but the setting for many recreation activities; soil erosion control; and food, cover, and travel corridors for wildlife. Another third of Story County's tree cover occurs in residential areas, while the remaining third is scattered on farms and in cemeteries. These trees are usually planted and include both native and naturalized species. Of the estimated 10 percent original tree cover in Story County, somewhat less than one-third of that remains today. However, tree cover has increased in density recently, especially along the Skunk River south of Ames and in the Indian Creek valley. This may be due in part to the filling in of woodland areas after the Dutch elm disease killed a large number of one of the county's most common tree species. Tree stands tend to be quite old in some areas because tree planting is not directly encouraged (as it has been in the past) and natural regeneration of woodland has been decreased by Dutch elm disease, wind damage, and grazing by livestock. A general decrease in the area covered by woodland since 1900 can be expected to continue unless more public and private action (like the recent land acquisitions by the Story County Conservation Board) protects the existing resource.

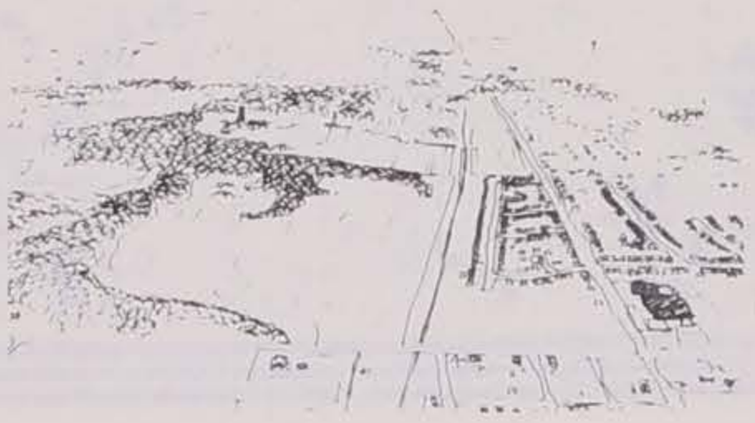
LIMITATIONS - Areas that are now wooded, especially along the Skunk River and Indian Creek valleys, should not be cleared for cultivation, grazed too heavily, or cleared for urbanization. Large trees are difficult to replace and should be protected during any construction. In fact, tree planting should be encouraged to reinforce existing woodland areas and make nearby towns, such as Nevada, Ames, Story City, Huxley, Cambridge, and Maxwell, part of the wooded valleys. Though planting guidelines exist for Ames, more study would be needed before a specific program of planting could be recommended for the county. Transportation corridors through woodland areas should be planned and planted to minimize the visual impact. Recreation uses are generally compatible with existing tree cover and many types of recreation are attracted to woodland areas. But heavy foot or vehicle traffic may cause soil compaction which can injure trees or prevent their regeneration.

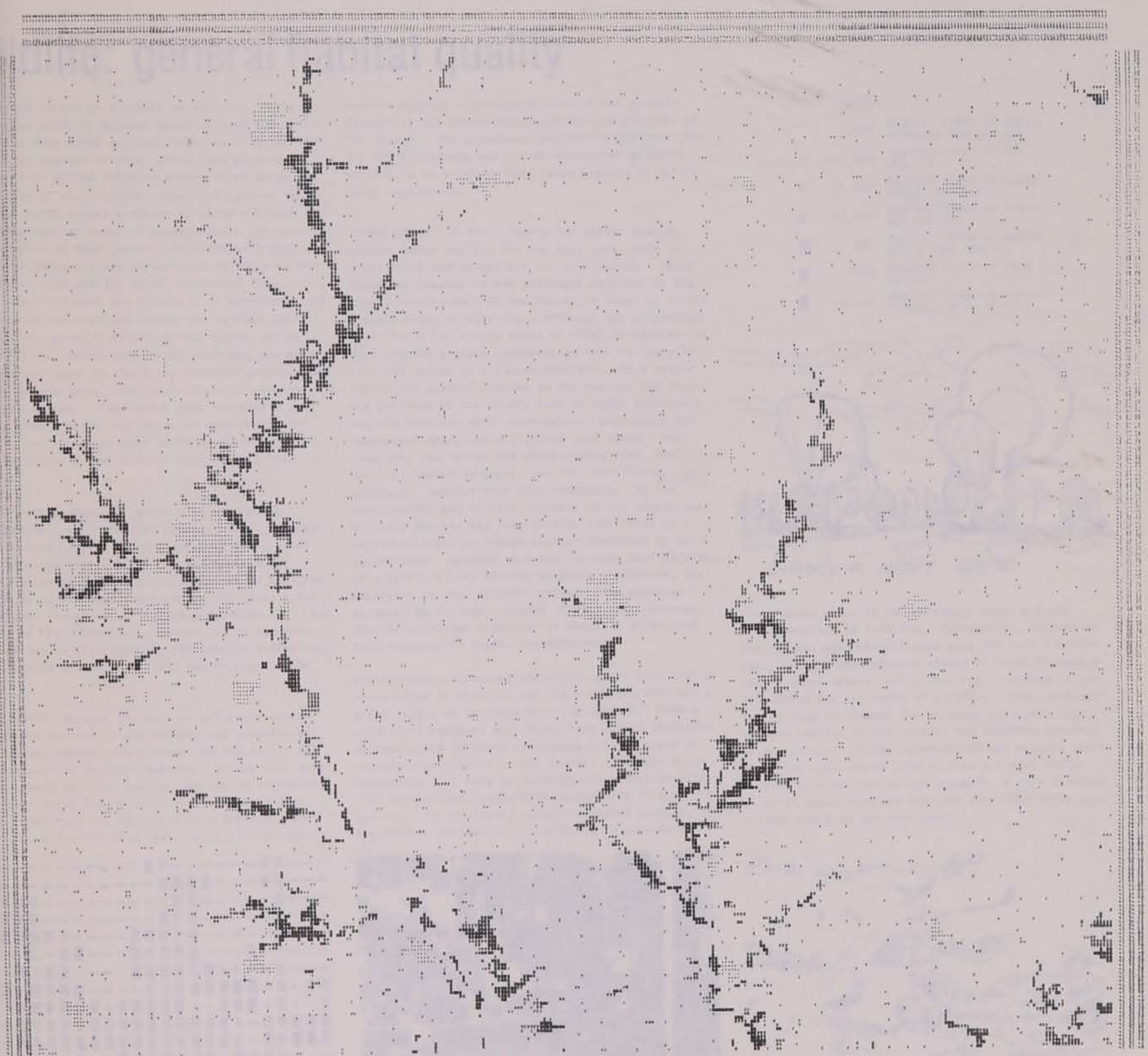
| ACRES | |
|---|---|
| 333,100 | OTHER VEGETATION TYPES |
| 6,050 | RESIDENTIAL |
| 8,290 | FARM BUILDINGS AND YARD |
| 190 | CEMETERIES |
| 460 | RECREATION - SAVANNA LIKE PARKS |
| 3,560 | SCATTERED LARGE TREES WITH NO WOODY UNDERSTORY |
| 2,700 | SCATTERED LARGE TREES WITH MIXED WOODY UNDERSTORY |
| 4 | HARDWOOD TIMBER |
| 100 | FARM WOODLOT |
| 910 | RECREATION - WOODED PARKS AND GREENBELTS |
| 9,570 | WOODLAND |









# Wildlife: general habitat quality

DELINEATION--Based on a numerical analysis, each of the various wildlife habitat types defined for this study have been rated on their value to wildlife (in general) as sources of food, water, and permanent cover as well as the relative intensity of human use and management they receive. Seven categories reflect the total relative values of these habitats and range from habitat types of exceptionally low quality (poor sources of food, water, and cover with high intensity of human use and management) to those of exceptionally high quality (good sources of food, water, and cover with low intensity of management and use). Among the high and exceptionally high quality habitats are pioneer species in old fields and on quarry spoils, stream associated woodland, and marshes. Habitat types in the three moderate quality categories are pastures, interstate right-of-way, and residential areas. Cultivated land received a low quality rating while such areas as industrial/commercial, quarries, and hard surfaced recreation facilities appear as habitats of exceptionally low quality.

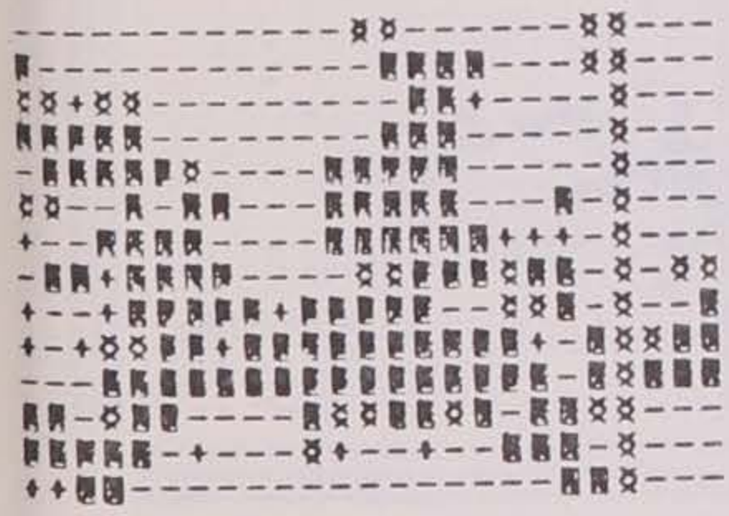
QUANTITY--Only about 4 percent of the County (13,650 acres) is in habitat types of high or exceptionally high quality (good sources of food, water and cover with little human use and management). Approximately 10 percent or 36,840 acres of the land is made up of habitats contained in the three moderate quality categories. The great majority (86 per percent or 314,950 acres), however, is in habitat types of low or exceptionally low quality reflecting the intensive agricultural land use in much of the County.

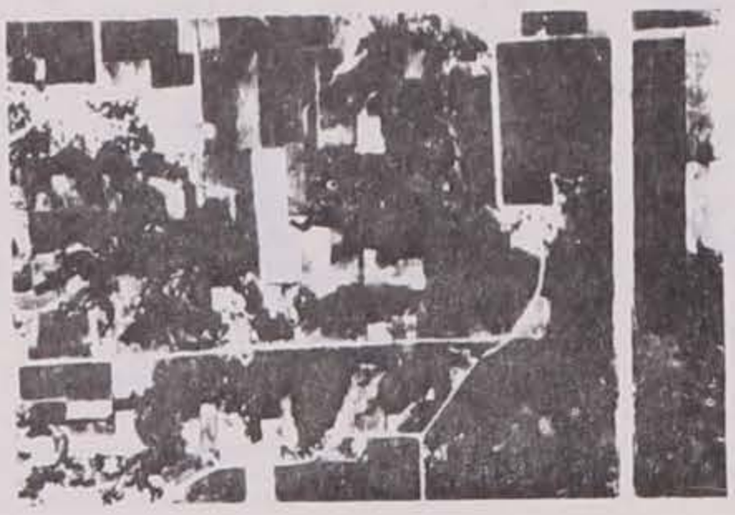
DISTRIBUTION--Because the marshes and major wooded streams are located in the western and southern portions of the County, these areas contain nearly all the best quality wildlife habitat. Within this part of the county the high quality habitat is reasonably well distributed but is often fragmented and scattered. Some parts of this area also contain large blocks of cultivated land that, in itself, is low quality habitat. Cultivated land is the primary feature in the northcentral and eastern portions of the County. The principal contrasting habitats here are the farmsteads and stream associated pastures which help to break up this large expanse of agricultural vegetation.

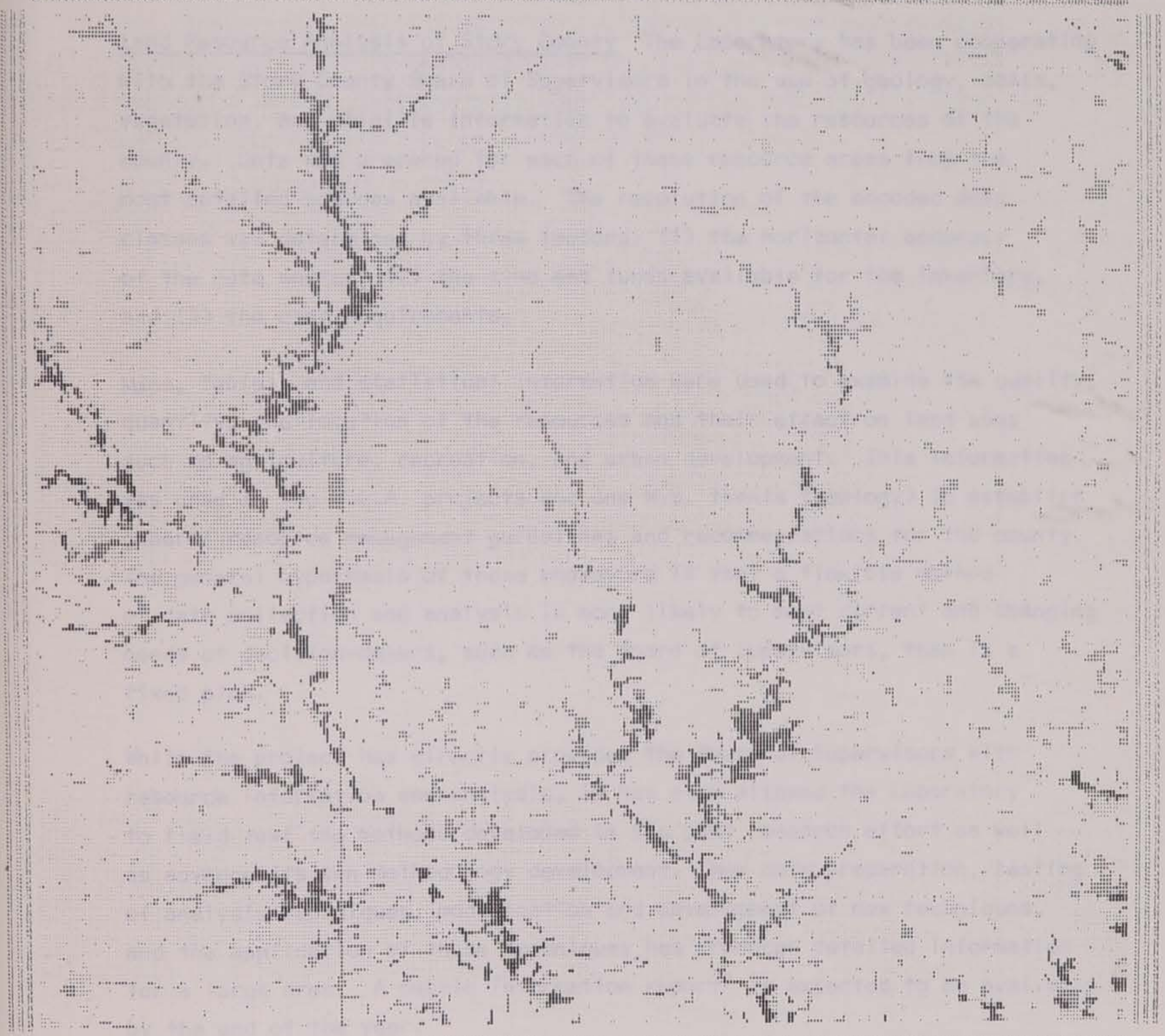
SIGNIFICANCE--In Story County the better quality habitat types remain, for the most part, only in areas which are unsuitable for cultivation. These areas are located in two principal portions of the County leaving much of the County in types of little overall value to wildlife. Although the cultivated land itself has little value as wildlife habitat, it does provide a great abundance of food to the wildlife who reside in adjacent habitats. As a result, the better quality habitat in the western and southern portions of the County take on added importance because they are well interspersed (well mixed arrangement) among the cultivated land there. Such important species as the white-tailed deer, fox squirrel, bobwhite quail, red fox, and raccoon, particularly, benefit from this situation. In the northcentral and eastern portions of the County the wildlife habitat has been greatly simplified by a landscape which is almost totally dominated by cultivated land. Because this area is much less diverse, it supports a less diverse wildlife population, the abundance of food notwithstanding. The pastures adjacent to the many streams in this area, however, provide excellent locations at which to allow woodland habitats to become reestablished.

LIMITATIONS--Commercial/industrial areas have little or no value to wildlife and their construction has a great impact on suitable existing habitat. From a wildlife standpoint such activities should therefore be restricted to areas containing habitat types of already poor quality in the future. Transportation routes can also have an undesireable effect on wildlife populations, especially in habitats of high quality. In the highly agriculturalized portions of the County, however, such routes often provide a significant share of the necessary cover and are quite valuable to wildlife. Residential, recreation, and various agricultural land uses can have a moderately good to very adverse effect on wildlife depending on their nature. With care and a reasonable consideration for the needs of wildlife, these land uses can be used to connect the existing scattered high quality habitat in the western and southern portions of the County. In the northcentral and eastern areas such land uses can be used to create a much higher quality habitat than is now present. A more detailed analysis would indicate specific locations where such actions could do the most good.

| | ACRES | |
|---|---|---|
| | 2,150 | HABITAT TYPES OF EXCEPTIONALLY LOW QUALITY |
| – | 312,800 | HABITAT TYPES OF LOW QUALITY |
| + | 18,900 | HABITAT TYPES OF MODERATELY LOW QUALITY |
| ⧆ | 17,100 | HABITAT TYPES OF MODERATE QUALITY |
| ▦ | 840 | HABITAT TYPES OF MODERATELY HIGH QUALITY |
| ✱ | 450 | HABITAT TYPES OF HIGH QUALITY |
| ▩ | 13,200 | HABITAT TYPES OF EXCEPTIONALLY HIGH QUALITY |





## PROJECTS

The evaluation of the application of the methods developed by the Laboratory is one aspect of the research conducted this year which has produced visable results.

Land Resource Analysis of Story County The Laboratory has been cooperating with the Story County Board of Supervisors in the use of geology, soils, vegetation, and wildlife information to evaluate the resources of the county. Data was prepared for each of these resource areas from the most detailed sources available. The resolution of the encoded data classes was determined by three factors: (1) the horizontal accuracy of the data source, (2) the time and funds available for the inventory, and (3) the user requirements.

Maps, tables, and statistical information were used to examine the quality, quantity, and location of the resources and their effect on land uses such as agriculture, recreation, and urban development. This information was used in two M.L.A. projects and one M.S. thesis (geology) to establish general resource management guidelines and recommendations for the county. The general hypothesis of these endeavors is that a flexible method of data collection and analysis is more likely to meet current and changing needs of decision-makers, such as the Board of Supervisors, than is a fixed plan.

While the project has directly provided the Board of Supervisors with resource information and analysis, it has also allowed the Laboratory to field test the methods developed in the past research effort as well as advance its own methodology development. New data preparation, testing of analysis techniques, modification and development of new techniques, and the application of these techniques has produced detailed information for a large area. A public information report[1] is expected to be available by the end of the year.

Skunk River Greenbelt The Laboratory is providing natural resource data to the Story County Conservation Board and its staff to assist

---

[1] See the Reports section of this report for further discussion.

in the initial stages of their greenbelt plan. In addition to available soils data, vegetation data, geologic data, and streams data, some detailed vegetation data at one second of arc resolution was prepared to complete a detailed data coverage of the entire Skunk River Valley between Ames and Story City. Both the existing Laboratory data and the new data prepared this fall is being used by the Conservation Board's staff for their analysis[1]. This analysis makes use of the Laboratory's expertise and the Laboratory's program system, MSDAMP.

---

[1] Brown (1974) A Resource Analysis Method for Recreation/Conservation Land Use Planning. Prepared as an M.L.A. terminal project at the Land Use Analysis Laboratory and the Department of Landscape Architecture, Iowa State University, Ames, Iowa

## FUTURE WORK

The continued operation of the Laboratory involves a variety of on going activities as well as some new areas of investigation. Most of the new areas of investigation being considered will replace completed work products in the Laboratory's activities. Current work division has approximately 30% of the effort in data preparation, 32% of the effort in scaling and classification research, 16% of the effort in methods development, 16% of the effort in documentation, and 6% of the effort in methods application.

There are a number of potential study areas which build on the work already in progress in the Laboratory. Expansion of the number of test areas of modern soil surveys to allow some statistical examinations of soil association delineations is one example where on going work can be expanded. Other examples might include extending the Laboratory's expertise in methods application using general data, expanding the number of multi-state data classes available for use, investigating the classification of land uses, development of data classes involving human influence factors, and preparation of intermediate resolution data from aerial photo mosaics. Though many more areas of investigation could be mentioned, only those under immediate consideration will be discussed.

Human Influence Factors The resources represented by the Laboratory's data do not exist in isolation, but are subject to actions of people both individually and in aggregate. Knowledge of human influences on the land is necessary in order to facilitate understanding of the processes occurring outside our individual experiences. Increasing the scope of study to include human influences on the land can provide the knowledge necessary to make decisions in areas where present information is not available or readily obtainable. To accomplish this the Laboratory will pursue two distinct courses of study: (1) the collection of county-wide data on land use, and (2) the examination of the development processes of incorporated areas over a period of time.

Applying this knowledge will help provide information as to the possible need for use restrictions or engineering recommendations on a particular site, the amount and location of suitable growth areas, the interaction

of one land use with another, assistance in preliminary plat approvals, identification of future trends in land use, the impact of future land use on the fringes, and possible justification for decisions concerning land use with health, safety, and welfare.

Investigation of Data Classifications The current vegetation classification has been used with aerial photographs to prepare data classes at five seconds of arc resolution and at one second of arc resolution. The ordinal classification is a complex blend of vegetation physiognomy and land management. Applications of the classification in Story County analyses have emphasized the need for reorganization and testing.

With the anticipation of its application in other parts of the State, the classification must also be expanded to include vegetation types not found in past study areas. A reorganized, expanded classification will allow data preparation and analysis that is more accurate and efficient.

Wildlife Analysis Analysis of wildlife resources through the use of vegetation data at the Laboratory has shown great promise and met with the initial approval of many professional wildlife biologists. To date, the wildlife analysis has taken two broad forms. One form has been to base the investigation on a consideration of the needs of wildlife in general, and the second approach has been to consider a single particular wildlife species. Each has value and merit. However, at present, each also has its limitations. The danger in considering wildlife in general is that the results may not necessarily apply to any one species but rather be generally correct for most species. A major problem with the single species approach at this time is that the vegetation categories in the datafile do not always adequately represent the habitat conditions on the ground.

To improve these techniques the Laboratory will attempt to combine species into groups based on general habitat requirements such as wetland species, riparian woodland species, upland species, etc., rather than try to consider all wildlife in a single analysis. This will undoubtedly give a truer representation of the conditions for those species which are considered in a particular analysis. In addition, by revising the vegetation

datafile classification, a single species analysis will have more value by giving a closer representation of actual habitat conditions. The level of analysis cannot reasonably become more specific (to individual species) unless the level of habitat inventory also becomes more specific. Reorganizing the datafile will greatly enhance both types of analysis for wildlife.

Intermediate Resolution Data The point of interest in this study is the development of intermediate resolution data and an examination of its use. One example might be the development of county soil association data which is cartographically more complex than the sub-state soil association data now being used by the Laboratory and yet is still generalized information. A second data class being considered is vegetation-land cover data sampled from aerial photo mosaics. This data class would be more general than the vegetation data now being used yet would be used to delineate concentrations of woodland and vegetation categories as they relate to wildlife habitat. Specifically, the Laboratory will investigate whether this level of data resolution will allow the analysis and discussion of classifications relative to regional land use decisions where large environmental impact effects are expected.

Modern Soil Survey Test Areas The test area in Fayette County where data was prepared from a modern soil survey will be examined in the data preparation report[1]. However, more extensive use of this data and similar data drawn from other county soil surveys of equal quality is anticipated by the Laboratory. One use of this data will be the statistical correlation of the test areas with the state-wide soil association data to examine the actual soils makeup of each of the extensive soil associations. A second use of the modern soils data will be an evaluation of the efficiency and quality of the data preparation processes used by the Laboratory. In particular, the complexity of the data relative to the complexity of the source information will be examined.

---

1 See the Reports section for the outline of the data preparation report.

Inter-resolution Comparisons of Soils Data With the development of intermediate resolution soil association data from county soil association maps, the Laboratory will have available soils data at four distinct levels of detail; regional soil associations, sub-state soil associations, county soil associations, and modern county soil surveys. The uses of this information have not yet been examined with regard to the level of planning to which each level might apply. It is anticipated that there will be overlapping uses of the data classes (particularly at the larger resolutions). The Laboratory will examine the use of each of the four soils data classes and prepare a report demonstrating the effects of the differences in resolution and of the differences in data sources.

# APPENDIX A

## DATAFILE - DATA CLASS INFORMATION AND COVERAGE

## 0001 COUNTY DIVISIONS (10 seconds)

Datafile:
A particular county boundary is identified by the county numbers of the counties which it divides, with the lowest number given first. For example, the boundary between Story County (85) and Boone County (08) is recorded as 0885.

Source:
U.S. Geologic Survey quadrangle maps, various dates, scale 1:250,000.

Available County Coverage:
None now available.

## 0002 WATERSHEDS (30 seconds)

Datafile:

0100 Skunk
- 0101 Drainage Ditch 71
- 0101 Long Dick Creek
- 0101 Ballard Creek
- 0101 Old Channel Skunk River
- 0101 Elk Creek
- 0102 Kegley Branch
- 0102 Buckley Creek

0110 Squaw Creek
- 0111 Montgomery Creek
- 0111 Crooked Creek

0120 Indian(east) Creek
- 0121 West Indian Creek
- 0121 Clear Creek

0130 North Skunk
- 0131 Snipe Creek
- 0131 Bear Creek
- 0131 Sugar Creek

0200 Boone
- 0201 White Fox Creek
- 0201 Drainage Ditch 46

0210 Eagle Creek
0220 Drainage Ditch 3

0300 North Raccoon
- 0301 Greenbrier Creek
- 0301 Swan Lake Branch
- 0301 Cedar Creek

0310 Hardin Creek
0320 Buttrick Creek
- 0321 Drainage Ditch 5
- 0322 East Buttrick Creek

0400 Raccoon
0401 Mosquito Creek
0401 Walnut Creek
0402 Panther Creek
0410 South Raccoon
0420 North River
0421 North Branch North River

0500 Lizard Creek
0501 North Branch Lizard Creek
0510 South Branch Lizard Creek
0511 Spring Creek

0600 Des Moines
0601 Beaver Creek
0601 Soldier Creek
0601 Prairie Creek
0601 Big Creek
0602 Gypsum Creek
0602 Crooked Creek
0603 Holliday Creek
0603 Skillet Creek
0604 Bluff Creek
0610 Brushy Creek
0611 Lateral 1
0620 Beaver Creek
0621 West Beaver Creek

0700 South Fork Iowa
0701 Beaver Creek
0701 Big Four Drainage Ditch, Lateral A
0710 Tipton Creek
0711 New York Branch

0800 Iowa
0801 Honey Creek
0801 Big Bear Creek
0801 Bear Creek
0801 Asher Creek
0802 Burnett Creek
0810 Minerva Creek
0811 Middle Minerva Creek
0820 Timber Creek
0821 South Timber Creek

0900 Beaver Creek
0910 South Beaver Creek
0911 Middle Fork South Beaver Creek

1000 Cedar
1010 Black Hawk Creek
1011 North Black Hawk Creek
1020 Wolf Creek
1021 Twelve Mile Creek

Source:
U.S. Geologic Survey quadrangle maps, various dates, scale 1:250,000.

Available County Coverage:
Webster, Hamilton, Hardin, Grundy, Boone, Story, Marshall, Dallas, Polk, and Jasper.

0003 GEOLOGY

Datafile:
1000 Cretaceous

2001 Jurassic

3000 Pennsylvanian
3110 Waubaunsee
3140 Shawnee
3150 Douglas
3210 Lansing
3220 Kansas City
3240 Pleasanton
3310 Marmaton
3320 Cherokee

4000 Mississippian
4100 Meramec
4200 Osage
4300 Kinderhook

5000 Devonian
5110 Yellow Spring
5121 Lime Creek
5123 Shell Rock
5201 Cedar Valley
5202 Wapsipinicon
5302 La Porte City

6000 Silurian
6100 Niagran
6200 Alexandrian

7000 Ordovician
7101 Maquoketa
7200 Mohawkian
7301 St. Peter
7401 Prairie Du Chien

8000 Cambrian
8100 St. Croixan

9000 Precambrian
9004 Undifferentiated
9005 Sioux Quartzite

Source:
Iowa Geological Survey, Geologic Map of Iowa, 1969, scale 1:500,000.

Available County Coverage:
Coverage is available for all Iowa counties.

## 0004 SOIL ASSOCIATIONS (30 seconds)

Datafile:
There are 89 variable units in the soil associations data class. The legend for the map is incomplete and unavailable. Association names and descriptions have been developed for only a few of the associations in preliminary draft form. In order to make interpretive map weighting schemes, the statewide soil association map was compared with county soil association maps from published modern soil surveys where they were available. Use was also made of soil maps in older soil surveys for guidance. Dr. Thomas E. Fenton assisted by providing information through personal communication. Interpretations and weighting schemes were derived by staff investigator D. D. Faxlanger.

Source:
The map was delineated at a scale of 1:253,440 (1 inch = 4 miles) and made available to the Land Use Analysis Laboratory in 1974 by Dr. Thomas E. Fenton, Soil Survey Investigations, Department of Agronomy, Iowa State University, Ames, Iowa 50010.

Available County Coverage:
Coverage is available for all Iowa counties.

## 0005 STREAM ORDER (10 seconds)

Datafile:
0001 Intermittent
0002 First Order
0003 Second Order
0004 Third Order
0005 Fourth Order
0006 Fifth Order
0007 Sixth Order
0008 Seventh Order
0009 Greater than seventh order (Mississippi)
0100 Ponded Water (not in stream channel, dammed)

Source:
U.S. Geological Survey quadrangle maps, various dates, scale 1:250,000.

Available County Coverage:
Webster, Hamilton, Hardin, Grundy, Boone, Story, Marshall, Dallas, Polk, and Jasper.

0006 GENERAL VEGETATION (15 seconds)

Datafile:
2000 Urban Vegetation
9000 Woodland Vegetation

Source:
U.S. Geological Survey quadrangle maps, various dates, scale 1:250,000.

Available County Coverage:
Worth, Mitchell, Howard, Winneshiek, Allamakee, Cerro Gordo, Floyd, Chickasaw, Fayette, Clayton, Franklin, Butler, Bremer, Webster, Hamilton, Hardin, Grundy, Black Hawk, Buchanan, Delaware, Dubuque, Jackson, Boone, Story, Marshall, Dallas, Polk, and Jasper.

0007 DATA CLASS NOT ASSIGNED

0008 DATA CLASS NOT ASSIGNED

## 0009 STREAMS - BRUSH CREEK (1 second)

Datafile:
- 0001 Intermittent Streams
- 0002 Perennial Streams
- 0100 Ponded Water
- 0200 Springs

Source:
U.S. Geological Survey quadrangle maps, 1965, scale 1:24,000.

Available County Coverage:
Approximately 35 square miles between Arlington and Wadena in Fayette County; termed the Brush Creek Study Area.

## 0010 DETAILED VEGETATION - BRUSH CREEK (2 seconds)

Datafile:
- 1000 Structures
  - 1100 Farm buildings and yard
  - 1200 Roadways
  - 1300 Commercial/industrial
  - 1400 Residential

- 2000 Urban
  - 2100 Golf courses and open playgrounds
  - 2200 Wooded parks, greenbelts, and cemeteries

- 3000 Cultivated
  - 3100 Row crops
  - 3200 Small grain, hay and soil bank

- 4000 Non-forested (less than five percent crown cover)
  - 4100 Pasture - bluegrass and other perennial grasses
  - 4200 Marsh - shallow water areas dominated by grasslike species
  - 4300 Prairie potholes - small, poorly drained areas

- 5000 Unique
  - 5100 Quarry
  - 5200 Ponds and reservoirs
  - 5300 Coal and quarry spoils - pioneer vegetation species

- 6000 Edge - narrow units of abruptly changing canopy heights
  - 6100 Wooded to row crop
  - 6200 Wooded to small grain, hay, or soil bank
  - 6300 Row crop to small grain, hay, or soil bank

6400 Stringers - riparian growth
6500 Fence rows - hedges, shrubby fences, rank herbaceous growth
6600 Ditches and roadsides

7000 Savanna-like (five to twenty-five percent crown cover)
7100 Scattered large trees with little woody understory
7200 Scattered large trees with mixed woody understory

8000 Tree plantings
8100 Conifer timber
8200 Christmas tree
8300 Orchard
8400 Windbreaks and woodlot

9000 Forest (greater than twenty-five percent crown cover)
9100 Upland forest
9200 Bottomland forest
9300 Boreal forest relic - whitepine, balsam fir, yew understory

Source:
Agricultural Stabilization and Conservation Service, U.S. Department of Agriculture aerial photographs, 1964, scale 1:20,000.

Available County Coverage:
Brush Creek Study Area, Fayette County.

## 0011 ELEVATION - BRUSH CREEK (2 seconds)

Datafile:
All codes are direct elevations sampled to the nearest contour.
Elevations range from a maximum of 1220 feet to a minimum of 840 feet.

Source:
U.S. Geologic Survey quadrangle maps, 1965, scale 1:24,000.

Available County Coverage:
Brush Creek Study Area, Fayette County.

## 0012 SOIL TYPES - BRUSH CREEK (1 second)

Datafile:
0008 Judson silty clay loam (equivalent 0098, Huntsville silt loam)
0011 Colo-Huntsville-Turlin complex
0041 Sparta loamy fine sand
0063 Chelsea loamy fine sand
0084 Clyde silty clay loam
0096 Turlin loam
0098 Huntsville silt loam (equivalent 0008)

0108 Wadena (equivalent 0177, Sande loam)
0109 Backbone silt loam
0110 Lamont fine sandy loam
0115 Sandy terrace escarpment
0120 Tama silt loam
0129 Nodaway - unnamed silt loams
0133 Colo silty clay loam
0133C Silty clay channelled (equivalent 0135)
0151 Marshand loam mod. deep
0152 Marshand loam deep
0154 Loamy textured escarpment
0158 Dorchester silt loam
0158C Dorchester silt loam channelled (equivalent 1057)
0162 Downs silt loam
0163 Fayette silt loam
0171 Bassett loam
0175 Dickinson fine sandy loam
0177 Sande loam (equivalent 0108)
0178 Waukee loam (equivalent 0308)
0182 Dubuque silt loam mod. deep
0183 Dubuque silt loam deep
0193 Camden silt loam
0198 Floyd loam
0202 Cylinder loam mod. deep (equivalent 0225)
0203 Cylinder loam deep(equivalent 0226)
0207 Whalen loam mod. deep
0213 Rockton loam deep
0214 Rockton loam mod. deep
0215 Cherty land
0220 Nodaway silt loam
0221 Muck
0225 Lawler loam mod. deep (equivalent 0202)
0226 Lawler loam deep (equivalent 0203)
0265 Bixby loam
0284 Flagler sandy loam
0285 Burkhardt sandy loam
0287 (no name available)
0293 Chelsea-Lamont-Fayette complex
0302 Coggon loam
0308 Wadena loam (equivalent 0178)
0315 Alluvial land
0323 (unnamed sandy loam)
0378 Steep Rockyland
0391 Clyde-Floyd complex
0394 Ostrander loam
0395 Kenyon loam
0407 Schley loam
0408 Olin fine sandy loam
0409 Dickinson fine sandy loam
0443 Lawler loam deep (clay shale substratum)
0444 Jacwin loam
0471 Oran loam

0478 Steep rockyland
0480 Orwood silt loam
0480F Fayette variant, 18-40" to till (equivalent 0481)
0482 Racine loam
0484 Lawson silt loam
0485 Spillville loam
0488 Downs silt loam, gray subsoil variant
0489 Ossian silt loam
0490 Caneek silt loam
0491 Renova loam
0492 Terril loam
0495 Fayette-Renova-Roseville complex
0496 Dorchester-Volney complex
0497 Fayette-Dubuque-Nordness complex
0498 (unnamed sandy loam)
0499 Nordness silt loam
0512 Marlean silt loam
0714 Winneshiek loam mod. deep
0725 Hayfield loam mod. deep
0726 Hayfield loam deep
0763 Fayette silt loam, gray subsoil variant
0771 Waubeek silt loam
0777 Wapsie loam
0779 (no name available)
0780 (unnamed poorly drained loamy firm till)
0782 Donnan loam
0783 Cresco loam
0784 Riceville silt loam
0798 Protovin loam
0826 Rowley silt loam
0926 Canoe silt loam
0977 Richwood silt loam
0978 Festina silt loam

Source:
U.S. Department of Agriculture, Soil Conservation Service, advance field sheets, Fayette County Soil Survey, 1973, scale 1:15,840.

Available County Coverage:
Brush Creek Study Area, Fayette County

## 0013 DETAILED VEGETATION - STORY COUNTY (5 seconds)

Datafile:
1000 Developed
1100 Incorporated
1110 Residential
1120 Commercial, industrial
1130 Institutional
1131 Cemeteries

- 1140 Recreation
  - 1141 Hard surfaced, play lots, tennis courts, etc.
  - 1142 Open field, turf, golf course, playgrounds, etc.
  - 1143 Savanna-like parks - 5-25% crown cover
  - 1144 Wooded parks and greenbelts - more than 25% crown cover
- 1150 Mining
  - 1151 Quarry - active
  - 1152 Spoils - pioneer vegetation species
- 1200 Unincorporated
  - 1210 Residential
  - 1220 Commercial, industrial
  - 1230 Institutional
    - 1231 Cemeteries
  - 1240 Recreation
    - 1241 Hard surfaced, play lots, tennis courts, etc.
    - 1242 Open field, turf, golf course, playgrounds, etc.
    - 1243 Savanna-like parks - 5-25% crown cover
    - 1244 Wooded parks and greenbelts - more than 25% crown cover
  - 1250 Mining
    - 1251 Quarry - active
    - 1252 Spoils - pioneer vegetation species

- 2000 Agricultural
  - 2100 Rainfall
    - 2110 Farm buildings and yard, feedlot
    - 2120 Cultivated
    - 2130 Pasture - bluegrass and other perennial grasses
    - 2150 Tree plantings
      - 2151 Conifer timber
      - 2152 Hardwood timber
      - 2153 Christmas tree
      - 2154 Orchard
      - 2155 Nursery
      - 2157 Farm woodlot
    - 2160 Old field
      - 2161 Pioneer vegetation species

- 3000 Woodland
  - 3100 Eastern deciduous forest
    - 3110 Forest - more than 25% crown cover
    - 3120 Savanna-like - 5-25% crown cover
      - 3121 Scattered large trees with no woody understory
      - 3122 Scattered large trees with mixed woody understory

- 4000 Grassland
  - 4100 Unimproved
    - 4110 Prairie
      - 4111 Xeric - dry upland prairie remnants
      - 4112 Mesic - poorly drained prairie potholes
    - 4120 Marsh - shallow water areas dominated by grasslike species
  - 4200 Improved
    - 4210 Interstate right-of-way

5000 Water
5100 Fresh water
5120 Ponds and lakes
5130 Reservoirs

Source:
U.S. Department of Agriculture, Agricultural Stabilization and Conservation Service panchromatic aerial photographs; 8-7-72, 8-16-72, and 9-22-72; negative scale 1:40,000 and enlargement scale 1:15,840.

Available County Coverage:
Story County.

## 0014 DETAILED VEGETATION - SKUNK RIVER (1 second)

Datafile:
1000 Developed
1100 Incorporated
1110 Residential
1120 Commercial, industrial
1130 Institutional
1131 Cemeteries
1140 Recreation
1141 Hard surfaced, play lots, tennis courts, etc.
1142 Open field, turf, golf course, playgrounds, etc.
1143 Savanna-like parks - 5-25% crown cover
1144 Wooded parks and greenbelts - more than 25% crown cover
1150 Mining
1151 Quarry - active
1152 Spoils - pioneer vegetation species
1200 Unincorporated
1210 Residential
1220 Commercial, industrial
1230 Institutional
1231 Cemeteries
1240 Recreation
1241 Hard surfaced, play lots, tennis courts, etc.
1242 Open field, turf, golf course, playgrounds, etc.
1243 Savanna-like parks - 5-25% crown cover
1244 Wooded parks and greenbelts - more than 25% crown cover
1250 Mining
1251 Quarry - active
1252 Spoils - pioneer vegetation species

2000 Agricultural
2100 Rainfall
2110 Farm buildings and yard, feedlot
2120 Cultivated
2130 Pasture - bluegrass and other perennial grasses

2140 Edge - narrow units of abruptly changing canopy heights
- 2141 Wooded to cultivated
- 2142 Cultivated to wooded
- 2143 Wooded to pasture
- 2144 Pasture to wooded
- 2145 Stringers - riparian growth
- 2146 Fence rows - hedges, shrubby fences, rank herbaceous growth
- 2147 Ditches and roadsides
- 2148 Cultivated to pasture
- 2149 Pasture to cultivated

2150 Tree plantings
- 2151 Conifer timber
- 2152 Hardwood Timber
- 2153 Christmas tree
- 2154 Orchard
- 2155 Nursery
- 2156 Windbreak
- 2157 Farm woodlot

2160 Old field
- 2161 Pioneer vegetation species

3000 Woodland
- 3100 Eastern deciduous forest
  - 3110 Forest - more than 25% crown cover
  - 3120 Savanna-like - 5-25% crown cover
    - 3121 Scattered large trees with no woody understory
    - 3122 Scattered large trees with mixed woody understory

4000 Grassland
- 4100 Unimproved
  - 4110 Prairie
    - 4111 Xeric - dry upland prairie remnants
    - 4112 Mesic - poorly drained prairie potholes
  - 4120 Marsh - shallow water areas dominated by grasslike species
- 4200 Improved
  - 4210 Interstate right-of-way

5000 Water
- 5100 Fresh water
  - 5110 Streams
  - 5120 Ponds and lakes
  - 5130 Reservoirs

Source:
U.S. Department of Agriculture, Agricultural Stabilization and Conservation Service panchromatic aerial photographs; 8-7-72, 8-16-72, and 9-22-72; negative scale 1:40,000 and enlargement scale 1:15,840.

Available County Coverage:
Approximately 20 square miles between Story City and Ames along the Skunk River as well as approximately 1 square mile south of Ames along Worle Creek in Story County.

## 0015 DETAILED VEGETATION (edge only) - SOPER'S MILL (1 second)

Datafile:

2140 Edge - narrow units of abruptly changing canopy heights
- 2141 Wooded to cultivated
- 2142 Cultivated to wooded
- 2143 Wooded to pasture
- 2144 Pasture to wooded
- 2145 Stringers - riparian growth
- 2146 Fence rows - hedges, shrubby fences, rank herbaceous growth
- 2147 Ditches and roadsides
- 2148 Cultivated to pasture
- 2149 Pasture to cultivated

2150 Tree plantings
- 2156 Windbreak

5110 Streams

Source:

U.S. Department of Agriculture, Agricultural Stabilization and Conservation Service panchromatic aerial photographs; 8-7-72, 8-16-72, and 9-22-72; negative scale 1:40,000 and enlargement scale 1:15,840.

Available County Coverage:

This information was coded for an area of approximately six square miles north of Ames in Story County but is not debugged and is not available.

## 0016 SOIL TYPES - STORY COUNTY (3 seconds)

Datafile:

0012 Bremer loam
0021 Peat
0027 Wabash silty clay
0038 Buckner loam
0043 Bremer silty clay loam
0045 Buckner fine sandy loam
0048 Wabash loam
0055 Webster loam
0056 Webster clay loam
0060 Waukesha loam
0062 Wabash fine sandy loam
0065 Lindley loam
0102 Sarpy fine sandy loam
0107 Webster silty clay loam
0108 O'Neill loam
0110 O'Neill fine sandy loam
0111 Lamoure silty clay loam
0112 Lamoure loam
0138 Clarion loam

0149 Clarion fine sandy loam
0151 Clarion loam, steep phase
0175 Dickinson fine sandy loam
0187 Lindley loam, steep phase
0203 Thurman loamy fine sand
0234 Clarion fine sandy loam, steep phase
0252 Clarion loam, eroded phase
0256 Muck
0301 Clarion fine sandy loam, eroded phase
0302 Ames fine sandy loam

Source:
U.S. Department of Agriculture, Soil Conservation Service, Story County Soil Survey; Series 1936, number 9, issued November 1941; scale 1:63,360.

Available County Coverage:
Story County.

## 0017 SURFICIAL AQUIFER (30 seconds)

Datafile:
0001 Drift
0005 Buried Channel Aquifer
0009 Alluvial Aquifer

Source:
Iowa Geologic Survey Water Atlas #1, Water Story in Central Iowa; 1965; scale 1" = 12 miles.

Available County Coverage:
Webster, Hamilton, Hardin, Grundy, Boone, Story, Marshall, Dallas, Polk, and Jasper.

## 0018 ELEVATION (30 seconds)

Datafile:
All codes are direct elevations above mean sea level recorded to the next lowest contour for consistency. Elevations range from a maximum of 1100 feet to a minimum of 800 feet.

Source:
U.S. Geologic Survey quadrangle maps, various dates, scale 1:250,000.

Available County Coverage:
Story County.

0149 Clarion fine sandy loam
0151 Clarion loam, steep phase
0175 Dickinson fine sandy loam
0187 Lindley loam, steep phase
0203 Thurman loamy fine sand
0234 Clarion fine sandy loam, steep phase
0252 Clarion loam, eroded phase
0256 Muck
0301 Clarion fine sandy loam, eroded phase
0302 Ames fine sandy loam

Source:
U.S. Department of Agriculture, Soil Conservation Service, Story County Soil Survey; Series 1936, number 9, issued November 1941; scale 1:63,360.

Available County Coverage:
Story County.

## 0017 SURFICIAL AQUIFER (30 seconds)

Datafile:
0001 Drift
0005 Buried Channel Aquifer
0009 Alluvial Aquifer

Source:
Iowa Geologic Survey Water Atlas #1, Water Story in Central Iowa; 1965; scale 1" = 12 miles.

Available County Coverage:
Webster, Hamilton, Hardin, Grundy, Boone, Story, Marshall, Dallas, Polk, and Jasper.

## 0018 ELEVATION (30 seconds)

Datafile:
All codes are direct elevations above mean sea level recorded to the next lowest contour for consistency. Elevations range from a maximum of 1100 feet to a minimum of 800 feet.

Source:
U.S. Geologic Survey quadrangle maps, various dates, scale 1:250,000.

Available County Coverage:
Story County.

0019 JORDAN SANDSTONE (60 seconds)

Datafile:
All codes are direct elevations below mean sea level recorded to the next lowest contour for consistency. Elevations range from a maximum of 500 feet below sea level to a minimum of 1800 feet below sea level.

Source:
Iowa Geologic Survey Water Atlas #1, Water Story in Central Iowa; 1965; scale 1" = 12 miles.

Available County Coverage:
Webster, Hamilton, Hardin, Grundy, Boone, Story, Marshall, Dallas, Polk, and Jasper.

0020 UPPER BEDROCK AQUIFER (30 seconds)

Datafile:
All codes are direct elevations above mean sea level recorded to the next lowest contour for consistency. Elevations range from a maximum of 1100 feet to a minimum of 350 feet.

Source:
Iowa Geologic Survey Water Atlas #1, Water Story in Central Iowa; 1965; scale 1" = 12 miles.

Available County Coverage:
Webster, Hamilton, Hardin, Grundy, Boone, Story, Marshall, Dallas, Polk, and Jasper.

0021 MIDDLE BEDROCK AQUIFER (60 seconds)

Datafile:
All codes are direct elevations above or below mean sea level recorded to the next lowest contour for consistency. Elevations range from a maximum of 900 feet above sea level to a minimum of 200 feet below sea level.

Source:
Iowa Geologic Survey Water Atlas #1, Water Story in Central Iowa; 1965; scale 1" = 12 miles.

Available County Coverage:
Webster, Hamilton, Hardin, Grundy, Boone, Story, Marshall, Dallas, Polk, and Jasper.

## 0022 LOWER BEDROCK AQUIFER (60 seconds)

Datafile:
All codes are direct elevations below mean sea level recorded to the next lowest contour for consistency. Elevations range from a maximum of 100 feet below sea level to a minimum of 1400 feet below sea level.

Source:
Iowa Geologic Survey Water Atlas #1, Water Story in Central Iowa; 1965; scale 1" = 12 miles.

Available County Coverage:
Webster, Hamilton, Hardin, Grundy, Boone, Story, Marshall, Dallas, Polk, and Jasper.

## 0023 BEDROCK SURFACE (30 seconds)

Datafile:
All codes are direct elevations above mean sea level recorded to the next lowest contour for consistency. Elevations range from a maximum of 1100 feet to a minimum of 550 feet.

Source:
Iowa Geologic Survey Water Atlas #1, Water Story in Central Iowa; 1965; scale 1" = 12 miles.

Available County Coverage:
Webster, Hamilton, Hardin, Grundy, Boone, Story, Marshall, Dallas, Polk, and Jasper.

## 0201 MAJOR SOILS OF THE NORTH CENTRAL REGION, U.S.A. (180 seconds)

Datafile:
0100 Brunizem and Humic Gley
- 0101 Wadena-Hubbard
- 0102 Onagra-Maumee-Morocco
- 0103 Warsaw-Ringwood-Plano
- 0104 Monona-Ida-Hamburg
- 0105 Brenton-Martinton-Renssalaer
- 0106 Saybrook-Parr-Drummer
- 0107 Clarion-Nicollet-Webster
- 0108 Flanagan-Drummer-Sidell
- 0109 Port Byron-Joy
- 0110 Galva-Primghar-Sac
- 0111 Primghar-Marcus-Sac
- 0112 Marshall-Knox
- 0113 Tama-Downs-Dodgeville
- 0114 Tama-Muscatine-Sable

0115 Sharpsburg-Marshall-Burchard
0116 Shelby-Sharpsburg
0117 Mahaska-Taintor
0118 Bolivia-Ipava-Illiopolis
0119 Kenyon-Floyd-Clyde
0120 Shelby-Grundy-Harg
0121 Pawnee-Grundy-Burchard
0122 Harrison-Herrick-Virden
0123 Shelby-Seymour-Edina
0124 Summit-Woodson-Labette
0125 Elliot-Ashkum
0126 Skyberg-Cresco-Clyde
0127 Swygert-Bryce-Clarence

0200 Reddish Prairie
0201 Pratt-Albion-Derby
0202 Grant-Albion-Vernon
0203 Idana-Renfrow-Kipson

0300 Chernozem
0301 Lovell-Ulen
0302 Lovell-Gardena-Fordville
0303 Fordville-Sioux
0304 Fordville-Lovell
0305 Hecla-Ulen
0306 Thurmon-Moody
0307 Bonilla-Cavour
0308 Holt-Valentine
0309 Houdek-Bonilla
0310 Beadle-Houdek
0311 Aastad-Hamerly-Barnes
0312 Renville-Hamlet
0313 Bottineau
0314 Barnes-Aastad
0315 Barnes-Buse
0316 Arco-Hendricks
0317 Barnes-Gardena-Lovell
0318 Westhope-Overly
0319 Bearden-Barnes
0320 Overly-Gardena
0321 Holdrege-Colby
0322 Hastings-Holdrege
0323 Moody-Crofton
0324 Hall-Wood River
0325 Reliance
0326 Kranzburg-Vienna
0327 Poinsett-Sinai
0328 Crete-Hastings-Nuckolls
0329 Hastings-Crete
0330 Crete-Butler
0331 Crete-Goessel
0332 Crete-Hastings-Kipp
0333 Beotia-Aberdeen
0334 Boyd-Hamill

0400 Chestnut and Brown
- 0401 Lihen
- 0402 Rosebud-Keota-Epping
- 0403 Vebar
- 0404 Williams-Zahl
- 0405 Bainville-Morton
- 0406 Morton-Bainville
- 0407 Monton-Flasher-Rhoades
- 0408 Agar-Williams
- 0409 Williams-Morton
- 0410 Anselmo-Keith-Rosebud
- 0411 Keith-Colby
- 0412 Keith-Rosebud-Canyon
- 0413 Keith-Keota
- 0414 Tripp-Bridgeport
- 0415 Richfield-Colby
- 0416 Raber-Agar
- 0417 Dalhart-Richfield-Mansker
- 0418 Pierre-Promise-Lismas

0500 Solonetz and Chestnut
- 0501 Noonan-Williams
- 0502 Rhoades-Morton

0600 Gray-Brown Podzolic
- 0601 Coloma-Plainfield
- 0602 Dexter
- 0203 Hixton-Boone
- 0604 Kennan-Omega
- 0605 Fox-Oshtemo-Warsaw
- 0606 Fox-McHenry-Spinks
- 0607 Antigo-Onamia
- 0608 Tracy-Door-Kalamazoo
- 0609 Marathon-Fenwood
- 0610 Princeton-Bloomfield
- 0611 Boone-Bolivar
- 0612 Wooster-Canfield-Massillon
- 0613 Hayden-Bluffton
- 0614 Lester-Hayden
- 0615 Miami-Dodge-Conover
- 0616 Birkbeck-Pecatonica-Russell
- 0617 Fayette-Seaton
- 0618 Fayette-Dubuque-steep rocky land
- 0619 Menfro-Alford-Hosmer
- 0620 Clinton-Lindley-Alma
- 0621 Lindley-Weller-Gara
- 0622 Milaca-Hibbing
- 0623 Milaca-Santiago
- 0624 Almena-Spencer-Freer
- 0625 St. Clair-Blount-Pewamo
- 0626 Baxter-Eldon-Nixa
- 0627 Union-Weldon
- 0628 Rittman-Wadsworth-Trumbull
- 0629 Mahoning-Trumbull-Ellsworth
- 0630 Venango-Mahoning

0700 Gray-Brown Podzolic and Humic-Gley
- 0701 Plainfield-Granby-Zimmerman
- 0702 Berrien-Wauseon-Coloma
- 0703 Hixton-Arland-Vesper
- 0704 Alexandria-Bennington-Marengo
- 0705 Miami-Crosby-Brookston
- 0706 Russell-Fincastle-Brookston
- 0707 Painesville-Canadea-Lorain
- 0708 Blount-Pewamo-Morley
- 0709 Kewaunee-Oshkosh-Poygan
- 0710 Montgomery-McGary

0800 Gray-Brown Podzolic and Lithosol
- 0801 Casco-Rodman-Fox
- 0802 Muskingum- Keene-Wellston
- 0803 Hanover-Muskingum
- 0804 Muskingum-Keene-Zanesville
- 0805 Muskingum-Upshur-Brooke

0900 Gray-Brown Podzolic and Red-Yellow Podzolic
- 0901 Clarkesville-Taney
- 0902 Clarkesville-Ozark
- 0903 Darnell-Stephenville
- 0904 Cincinnati-Rossmoyne-Fairmount
- 0905 Ashe-Tilsit-Hagerstown
- 0906 Bratton-Maddox
- 0907 Frederick-Crider-Pembroke
- 0908 Lebanon-Hanceville

1000 Gray Wooded
- 1001 Nebish-Rockwood
- 1002 Waukon-Barnes
- 1003 Taylor-Grygla-peat
- 1004 Nester-Kawkawlin-Selkirk
- 1005 Watton-Ontonagon-Bohemian
- 1006 Ontonagon-Pickford-Bergland

1100 Podzol and Brown Podzolic
- 1101 Rubicon-Vilas-Grayling
- 1102 Menahga
- 1103 Baraga-Champion-rock knobs
- 1104 Vilas-Munising-rock knobs
- 1105 Onota-Waiska
- 1106 Longrie-St. Ignace-Moran
- 1107 Marenisco-Munising-Hiawatha
- 1108 Montcalm-Kalkaska-Emmet
- 1109 Goodman-Gogebic-rock knobs
- 1110 Gogebic-Trenary-Hiawatha
- 1111 Munising-Keweenaw-Skanee
- 1112 Wakefield-Gogebic
- 1113 Iron River
- 1114 Goodman-Iron River
- 1115 Onaway-Emmet-Guelph

1200 Humic-Gley and $CaCO_3$ (Lime) Solonchak
- 1201 Ulen-Tanberg-Sioux
- 1202 McIntosh-Winger
- 1203 Rocksbury-Kittson-peat
- 1204 Saline-Bearden
- 1205 Fargo-Bearden

1300 Humic-Gley and Low Humic Gley
- 1301 Roscommon-Au Gres-peat
- 1302 Brevort-Iosco-Sims
- 1303 Angelica-Brimley-peat
- 1304 Wisner-Essexville-Marsh
- 1305 Sims-Kawkawlin-Capac
- 1306 Toledo-Colwood-Fulton
- 1307 Hoytville-Nappanee-Wauseon
- 1308 Paulding

1400 Organic
- 1401 Peat and muck

1500 Planosol
- 1501 Oswego
- 1502 Parsons
- 1503 Cherokee-Parsons
- 1504 Putnam-Cowden
- 1505 Hoyleton-Cisne
- 1506 Bluford-Vigo-Clermont
- 1507 Robinson-Otwell

1600 Regosol, Lithosol, Rendzina
- 1601 Valentine
- 1602 Rough mountainous land
- 1603 Rocky and stony land
- 1604 Canyon-Mansker
- 1605 Canyon-Colby
- 1606 Vernon-Quinlan-Albion
- 1607 Badlands and rough broken land
- 1608 Zahl
- 1609 Bainville-Zahl
- 1610 Buse
- 1611 Hedville-Lancaster
- 1612 Sogn-Florence
- 1613 Fairmount-Switzerland

1700 Alluvial
- 1701 Huntington-Wheeling
- 1702 Havre-Farland
- 1703 Genesee-Huntsville-Wabash
- 1704 Waverly-Bonnie-Philo
- 1705 Onawa-Luton
- 1706 Bottomlands, undifferentiated
- 1707 Sharkey

## 0301 RAIL TRANSPORT SYSTEMS

Datafile:

0001 Chicago, Rock Island and Pacific Railroad Company
0002 Chicago, Milwaukee, St. Paul and Pacific Railroad Company
0003 Chicago and North Western Railway Company
0004 Burlington Northern Incorporated
0005 Illinois Central Railroad Company
0006 Des Moines and Central Iowa Railway Company
0007 Atchison, Topeka and Santa Fe Railway Company
0008 Union Pacific Railroad Company
0009 Norfolk and Western Railroad Company
0010 Davenport, Rock Island and Northwestern Railway Company
0011 Cedar Rapids and Iowa City Railway Company
0012 Fort Dodge, Des Moines and Southern Railway
0013 Waterloo Railroad Company
0014 Iowa Terminal Railroad Company

Source:

Railroad Map of Iowa, Iowa State Highway Commission in cooperation with the U. S. Department of Transportation and U. S. Geologic Survey quadrangle maps, various dates, scale 1:250,000. Data was obtained for delineation of current status from the Transportation Data Base, 1973, U.S. Department of Transportation, Federal Highway Adminstration.

Available County Coverage:

All of the Iowa roadbed of the Chicago, Rock Island and Pacific Railroad Company.