RESEARCH ON THE APPLICATION OF SATELLITE REMOTE SENSING TO LOCAL, STATE, REGIONAL, AND NATIONAL PROGRAMS INVOLVED WITH RESOURCE MANAGEMENT AND ENVIRONMENTAL QUALITY

Semi-annual Progress Report for the Period
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Introduction

The cooperation and support from the governors of both Kansas and Missouri, and the positive response of various state and local agencies during the past six months has demonstrated increasing interest in the program of applications of satellite remote sensing to resource management and environmental quality. With this response from many varied interests, the Applications Program has evolved a core group comprised of several disciplines which can react knowledgeably to specific requests. Furthermore, such a core group can respond quickly to specific decision-oriented problems utilizing short term studies.

Establishing Contacts

A series of workshops has provided the means of communication with potential user agencies in the State of Kansas and elsewhere in the Mid-America region. The most recent workshop, the March 1973 Governor's Conference, established additional contacts with several agencies. Many agencies have now become aware of how satellite and aircraft derived data could be applied to their specific needs.

The conference including the Governor's keynote remarks, a brief overview of the KERS program and projects, a summary of the Arizona land-use project, and review of the current applications projects, concluded the second day with a workshop of representatives of several state agencies and private concerns. This workshop was devoted to discussing potential future uses of remote sensing technology to meet specific needs of several of the agencies involved. It became apparent that the data requirements of several agencies overlapped in such a way that a carefully designed program could meet the needs of such agencies in one joint project.

Meeting Agency Needs

Although agencies may be interested in long term studies to some extent,

many needs are concerned with immediate decisions. To utilize remote sensing technology to obtain essential data for these decisions, it is necessary for the Applications Program to respond quickly. To accomplish this a core committee consisting of an engineer, geologist, biologist, geographer, photographer, and interpreters, was established. This group of disciplines is now capable of providing rapid assessment of the specific need. Furthermore, the committee can design a well coordinated study to meet that immediate need. Emphasis can be directed at the short term response, while for longer term projects additional expertise can be consulted. This core group has allowed the Program to investigate many decision making problems not previously addressed by remote sensing.

Status of Current Projects

The projects initiated during the first year of the Applications Program include:

Douglas County Applications Program (completed)*
Agricultural Information Transfer (completed)
Detection of Sorghum Late Lodging (discontinued)
Vegetation Damage and Heavy Metal Concentration in New Lead Belt (continuing)*
Evaluating Reclamation of Strip-mined Land (continuing)*
Detection and Evaluation of Wheat Disease (continuing)
Remote Sensing Applied to Land Use Planning at Clinton Reservoir (completed) **
Detailed Land Use Mapping in Kansas City, Kansas (completed)*

*Summaries of these projects are attached in Appendix A.
** This project is reported in Appendix B.

Projects initiated during the second year of the program are summarized briefly below. Some of these projects are now reaching completion.

1. Clinton Reservoir and Dam Site (see Appendix A)

   The study of the Clinton Reservoir site will evaluate multiband photography as a tool for pre- and post- impoundment detection of surficial and shallow subsurface geological, hydrological, and botanical conditions. This project, initiated under the Applications Program grant, is now funded primarily by the U. S. Army Corps of Engineers.

2. Missouri River Flooding

Upon request from the Missouri Geological Survey, an aerial photography mission was flown on the Missouri River from Boonville to St. Louis at a critical period during the Spring 1973 flood. Funds for the mission were provided by the Survey. The interest was to obtain detailed underflight photography to use in assessing the ERTS imagery showing the extent of flooding.

3. Wildlife Habitat Inventory (see Appendix A)

The objective of this project is to assess the utility of high altitude aerial photography and satellite imagery as means to inventory wildlife habitat in the State of Kansas. Such a habitat survey will aid the Kansas Forestry, Fish and Game Commission in making management decisions concerning the State's wildlife resources. The Commission has committed a habitat biologist to work on this project with the Applications staff.

4. Four Rivers Resource and Conservation and Development (see Appendix B)

A regional land use map of the eight county RC&D will be produced from ERTS imagery in this project. The land use map will provide the base from which RC&D administrators will make planning decisions in the region. The project is a cooperative effort with the RC&D providing the materials and supplemental data and at the same time receiving training in the use of satellite acquired data.

5. Pattonsburg Reservoir Environmental Impact (see Appendix B)

This project, supported in part through cost sharing of several Missouri State agencies, provides information concerning land use supplementing the findings reported in the environmental impact statement. Specific land use acreages to be inundated by water, or protected by the proposed Pattonsburg Dam are summarized and delimited on aerial photography and satellite imagery. The project was designed in response to a request from the Governor's office and the Governor's Council on Water Resource Planning.

6. Chariton River - Rathbun Dam (see Appendix A)

This study demonstrates the use of remote sensing in detecting high soil moisture conditions resulting from a variety of factors including high release rates from the Rathbun Dam. It provides evidence that remote sensing may be a useful tool in evaluating optimum scheduling of outflow releases from flood control structures. The photographic mission and field observation trip were funded by the U. S. Army Corps of Engineers in this cooperative project.

Proposed Projects

The following projects are currently being considered or designed for inclusion in the Applications Program.

1. Rangeland Burning — A great deal of controversy exists as to the extent, timing and effects of rangeland burning, widely practiced in the Flint Hills region of Kansas. The objective of the proposed project utilizing ERTS imagery would be to map the burned areas and to determine the detectability of effects on vegetation growth. Groups interested in participating in this project include Kansas State University and the Kansas Livestock Association. (See Appendix A)

2. Cherokee County — The Cherokee County Commission and the Kansas Department of Economic Development, through the Kansas Geological Survey, have approached the Applications Program for assistance in gathering data concerned with specific problems of mining and associated activities in Cherokee County. They have requested a detailed land resource map for the area around Galena, Kansas, and a general land resource map of Cherokee County. The funds for this project will be provided primarily by the agencies involved. (See Appendix A)

3. Nebraska Reservoir — In response to a request for photographic data flights, the Applications Program has designed a flight to gather specific data concerned with water quality (turbidity and algal growth) in the Salt Valley reservoirs of Nebraska. The project will be funded completely by the University of Nebraska at Lincoln.

Continuity and Summary

The application of satellite and aerial remote sensing to resource management and environmental quality decisions is a developing area in which continued research is needed. The Applications Program at the University of Kansas is helping to meet this need by making current remote sensing technology available to decision making user agencies. Contacts continually being made with the potential user community assures the continued exploration of new and challenging uses of this technology.

User agencies have demonstrated their interests in the potential uses of remote sensing technology by their participation in and support of the projects which have been conducted. Their contributions in terms of manpower, material,

and cost sharing are evidence of this interest.

There are indications that remote sensing may become a useful tool for many state agencies. To establish a liaison between these agencies, the University of Kansas has initiated efforts to develop a coordinating group which would be capable of organizing the remote sensing needs of the several agencies, while working with the Space Technology Center to utilize available imagery and expertise. Such coordination would be of assistance in bringing specific needs and requests to the attention of the Applications Program staff. It would also aid in combining these needs, such that one project could serve the requirements of two or more agencies at the same time. Work is progressing on this phase of the program, and it is believed that a statewide coordinating group will be established early in 1974 by interested agencies, with support from the Office of the Governor.

APPENDIX A

Applications Project Summaries

APPLICATIONS PROJECT SUMMARY

Project Title: Douglas County Applications of Remote Sensing - DCARS

Participating Agencies:

Key Personnel:

Agency: All county officials
Douglas County Kansas
See seminar report

CRINC: John Barr, Research Assistant
Stan Morain, Prof. of Geography
Robert Walters, Coordinator
B.G. Barr, Project Director

Tentative Completion Date: June 30, 1973

Starting Date: May 15, 1972

1.0 Introduction:

The purpose of the DCARS project was to obtain a multiband/multidate photographic data base for Douglas County, Kansas. The data base is available to any interested user for the application of remote sensing information to his particular needs. In conjunction with this primary goal is a project to develop a set of land use and associated factor maps for Douglas County.

2.0 Statement of Work

2.1 Objectives:

The primary objective of this project is to provide a current source of multiband photographic information that can be applied to any public project requiring remote sensing data in Douglas County. Proximity to KU, character of terrain and expected land use changes dictated selection of this area.

2.2 Approach:

Green, red and near-infrared black and white photography and color infrared photography have been taken on a monthly schedule, weather permitting. A seminar was held in June of 1972 to inform individuals of the availability of the imagery. The secondary project associated with land use and factor mapping of the county has converged into a separate project in cooperation with the county planners and is reported on in another section. Many other uses have been made of the data base, some of which are listed below. 1. Assessment of agricultural land capability and the conjunctive farming practices. 2. Mapping and correlative interpretations with radar agricultural studies. 3. Large scale stereoscopic interpretation and mapping of vegetation. 4. Interpretation of surface materials for a heat island study of Lawrence, Kansas 5. Updating of land use information for publication of the Douglas County soil survey by the Soil Conservation Survey. 6. Interpretation of road surface materials in Douglas County. 7. Clinton Reservoir (a) Land use planning by the Douglas County planner (b) Geologic study for the Corps of Engineers of the dam site and surrounding area.

2.3 Anticipated Results:

The Use of the data base has been substantial. Many current projects are in progress that are utilizing the DCARS data base. It is anticipated that upon completion of the Clinton Reservoir Land Use Planning Project, the same process of interpretation will be performed for the remainder of Douglas County.

2.4 Funding:

Applications Grant

APPLICATIONS PROJECT SUMMARY

Project Title: The Use of Remote Sensing to Evaluate Reclamation of Land Strip-Mined for Coal

Participating Agencies: Kansas Geological Survey
Ozarks Regional Commission

Key Personnel:

Agency:
Ronald G. Hardy, Chief
Mineral Resources Section
Kansas Geological Survey
Mary Alice Soule, Research Assistant
Mineral Resources Section
Kansas Geological Survey

CRINC:
Dr. Louis Dellwig
Remote Sensing Laboratory
Space Technology Center

1.0 Introduction:

This applications project was initiated to determine the feasibility of using remote sensing data to evaluate the progress and success of reclamation of land strip-mined for coal in Southeast Kansas. Both voluntary reclamation projects and reclamation mandated by the 1969 Mined-Land Conservation and Reclamation Act are being studied to identify factors relating to the success of reclamation.

2.0 Statement of Work

2.1 Objectives:

Multiband aerial photographs taken at three times during the period of study are being compared and evaluated to determine which film/filter combinations are best and at what time of year the most useful information can be derived from the imagery. Any differences between voluntary and mandatory reclamation projects will be identified to provide information for people involved in reclamation.

It is anticipated that this project will demonstrate to the coal companies and the Kansas Department of Labor, the state regulatory agency, the efficacy of remote sensing as a means to evaluate the success of reclamation.

2.2 Approach:

Ground truth data has been collected in conjunction with the multiband photo flights. These include observation of the condition of vegetation on reclaimed land and soil sampling to determine what edaphic factors influence variations in plant vigor detected on false-color infrared imagery.

A number of secondary areas to be investigated have been suggested by evaluation of the imagery. Among these are the quality of water in the strip lakes after mining, the chemical nature of the overburden as it relates to the success of vegetation of the leveled spoils, and mining methods which influence the leveling and reclamation processes.

2.3 Results to Date:

One striking difference between voluntary and mandatory reclamation has been detected on the imagery. On mandatory reclamation sites the vigor of vegetation is relatively uniform except for irregular bare areas, "hot spots" where soil pH is too acid

to permit plant growth. On voluntary reclamation sites, bare leveled ground appears uniform in color, but fields with a vegetative cover show light and dark color banding. This banding seems caused by variation in vigor of the vegetative cover because it appears as pink and red bands on false-color infrared imagery. The red bands are fill areas, valleys between the spoils piles that have been filled with organic material and weathered debris from the peaks as they were leveled off and graded, while pink bands correspond to peaks. Surface soil samples were taken but showed no striking differences in pH or nutrient components to indicate locations of fill (valley) areas or leveled peaks.

The color of water in strip lakes and access roads in abandoned mines varies from yellow to brown to blue-green. Preliminary pH values for four such water bodies indicate they are all highly acid (3.5-4.5 pH range). This means that there is a potential acid mine drainage problem in some areas, although other strip lakes in Southeast Kansas have pH values near 7.0. The possibility of an acid problem indicates the necessity for isolating and burying acid overburden so it does not contaminate surface water.

2.4 Anticipated Results

The results of this will be to demonstrate the use of remote sensing as a tool to aid coal companies and regulatory agencies in evaluating the success of reclamation. The best film/filter combination and season for obtaining imagery will be determined so that the cost of obtaining imagery can be kept at a level consistent with corporate and state agency budgets.

A second set of soil samples which were obtained from the sub-surface levels are being analyzed to determine what variations can be related to banding on voluntary reclamation sites. The cores from the second samples were observed to determine differences in root penetration which might indicate compaction. Because these spoils had been untouched for twenty-five years before leveling both compaction and leaching may play important roles in influencing plant vigor.

2.5 Funding

Funds for flights were provided by CRINC applications project 2230-5 (NASA Grant NGL 17-004-024). Salary and travel expenses were provided by a grant from Ozarks Regional Commission and supporting services were contributed by the Kansas Geological Survey.

APPLICATIONS PROJECT SUMMARY

Project Title: Develop a Land Use Map Using Remote Sensing in the Kansas River Floodplain, Wyandotte County, Kansas

Participating Agencies:

Key Personnel:

Agency:
Thomas Palmerlee
Program Development Specialist
City Planning Commission
City of Kansas City, Kansas

CRINC:
Jerry Coiner
Don Williams
Remote Sensing Laboratory
Robert Walters, Coordinator, STC
B.G. Barr, Director, STC

Tentative Completion Date:

Starting Date:

1.0 Introduction:

The City Planning Commission of Kansas City, Kansas has a requirement that a land use map be provided by April 15, 1973 for the Armourdale District and nearby floodplain. This area is a mixed land use area composed of older residential dwellings and industrial areas. In order for the Board of City Commissioners to make an intelligent decision regarding development (both short and long range) a data set describing the present land uses and their quality is required.

2.0 Statement of Work

2.1 Objectives:

1. To obtain a data set from aerial sensors to support short and long range development plans for the Armourdale District of Kansas City, Kansas 2. To specify the types of remotely acquired data that would provide the optimum inputs to a land use data system. 3. To develop image interpretation methods that could be directly used by planning personnel without the assistance of image analysists. and 4. To further evaluate the role of various types of remotely sensed data in acquiring new types of data elements about the urban landscape.

2.2 Approach:

Straightforward approach of human interpretation of various scales of imagery.
On January 20, 1973 large scale color aerial photography was flown of the Armourdale District using the KU Remote Sensing aircraft. This material is now being interpreted by Mr. Palmerlee and his associates at the city planning department with aid and training being provided by Mr. Coiner and Williams of CRINC, RSL. At present the data elements to be extracted from the imagery have been determined and a preliminary interpretation by City Planning personnel is underway.

2.3 Anticipated Results:

Short range: Land use maps which Board of Commissioners can use in decision making process on Armourdale District.
Long range: If data elements can be successfully extracted from the imagery and are found useful to the planning and political structure within the city, then a more extensive project is envisioned to support a long range planning effort for the entire area of Wyandotte County, which includes Kansas City, Kansas.

2.4 Funding:

The Center is providing training for Planning Department personnel and the aerial photos required. The agency is supplying the ground truth and personnel to work with interpreters to develop the land use map.

APPLICATIONS PROJECT SUMMARY

Project Title: Correlation of Vegetation Damage as Determined by Remote Sensing Techniques With Heavy Metal Concentrations in the New Lead Belt

Participating Agencies: University of Missouri at Rolla (Missouri Geological Survey)

Key Personnel:

Agency:
William H. Tranter, Professor of Electrical Engineering

CRINC:
F.T. Ulaby, Professor of Electrical Engineering, Director
B.G. Barr, Director, STC
Bob Walters, Coordinator, STC
R. J. Eastmond, Professor of Botany

Tentative Completion Date: 30 September 1973 **Starting Date:** 1 April 1973

1.0 Introduction: One of the world's largest lead deposits is located in the southeastern Missouri. Increasing industrial development and mining activity has resulted in seemingly widespread pollution and associated environmental stress. An interest in the protection of the environment while at the same time allowing optimal utilization of these mineral resources has stimulated requests for assistance from the applications program in applying remote sensing technology to impact evaluation for large areas such as the New Lead Belt.

2.0 Statement of Work

2.1 Objectives: The proposed applications project will correlate vegetation damage, as determined by remote sensing, with heavy metal concentrations in the vegetation and soils. The project will explore the feasibility of using remote sensing techniques to detect and monitor changes in the vegetation damage patterns resulting from increased concentrations of heavy metals in the environment.

2.2 Approach: University of Kansas Applications staff would plan and fly color and color IR photography. Interpretation data would be compiled by the applications staff. The ground truth information would be collected in cooperation between UMR and the applications staff. The heavy metals data would be collected by UMR and the correlations would be made cooperatively.

2.3 Anticipated Results: It is anticipated that a technique for assessing selected aspects of environmental impact over large areas would be developed. Such a technique would provide the data base on which environmental quality decisions will be made. Planning decisions on optimal development would also be related to this method of impact assessment.

2.4 Funding:

The University of Missouri at Rolla is contributing $2000 to the project costs, plus ground truth data from a major NSF RANN grant and the participating agencies.

APPLICATIONS PROJECT SUMMARY

Project Title: Remote Sensing Study of Clinton Reservoir and Clinton Dam Site

Participating Agencies: U.S. Army Corps of Engineers

Key Personnel: Dr. Dellwig and M. Arif Yukler

Agency: John Moylan
Charles Rucker
U.S. Army Crops of Engineers

CRINC: Prof. L.F. Dellwig, Geology
Arif Yukler, Research Assistant
Robert Walters, Coordinator

Tentative Completion Date: September 1, 1973 **Starting Date:** March 15, 1973

1.0 Introduction:

The study of the Clinton Reservoir site evaluating multiband photography as a tool for pre- and post-impoundment detection of surficial and shallow subsurficial geologic and hydrologic conditions.

2.0 Statement of Work

2.1 Objectives:

1. Evaluation of existing imagery. 2. Multispectral coverage during the period of defoliation and after the period of defoliation. 3. Coverage of the area in spring. 4. Coverage of the area in summer.

2.2 Approach:

Bands will be studied individually and also in combinations to detect as many parameters as possible. Anomalies will be investigated in an effort to determine their origin. Anomalies will be correlated with the base and existing photography and will be tried to find their origins.

2.3 Anticipated Results:

1. An overall evaluation of multispectral photography in this environment.
2. The potential of utilization of a single or combination of bands for evaluation of geologic, hydrologic and botanical data.
3. An evaluation of multispectral photography for detection of time dependent changes, i.e., vegetation, soil moisture content, etc.
4. A summary of changes detected which appear to be related to the construction of the dam.
5. Corps of Engineers expects to fund follow-up project to monitor change after impoundment of water.

2.4 Funding:

Initiated by Applications Grant, Douglas County Study. This work now funded by Corps of Engineers contract for $1,800.

APPLICATIONS SUMMARY SHEET

Project Title: Using Remote Sensing for a Wildlife Habitat Inventory of Kansas

Participating Agencies: Kansas Forestry, Fish and Game Commission

Key Personnel:

Agency:
Mr. Keith Sexson
Small Game Research
Kansas Forestry, Fish & Game Commission
229 West 15th Street
Emporia, Kansas 66801

Mr. Jim Norman
Federal Aid Coordinator
Box 1028
Pratt, Kansas 67124

CRINC:
B. G. Barr, Project Director
Robert Walters, Coordinator
Robert Eastmond, Program Scientist
Jim Merchant, Research Scientist

Tentative Completion Date: August, 1974 Starting Date: 12 February 1973

1.0 Introduction:

The Kansas Forestry, Fish and Game Commission is charged with the responsibility of managing the wildlife resource of the state. An integral part of the data base for any wildlife management operation must be an inventory of the spatial distribution, aerial extent, and degree of interspersion of current and potential wildlife habitat types. In addition, there must exist the capability to update this inventory at regular intervals. Current modes of data collection are much too cumbersome, and are not adequate for the type of state-wide habitat survey which is required. The Forestry, Fish and Game Commission is, therefore, extremely interested in assessing the capabilities of remote sensing for acquisition of habitat information.

2.0 Statement of Work

2.1 Objectives:

The primary objective of this project is to assess the utility of high altitude (40,000 to 60,000 ft) aerial photography, and secondarily, ERTS as means to inventory the wildlife habitat of the State of Kansas. This will be done both from a technical as well as a cost-benefit standpoint, and will be totally based on user requirements. A secondary goal of this investigation is to aid the Kansas Forestry, Fish and Game Commission in establishing an independent interpretative and data processing capability in the area of remote sensing.

2.2 Approach:

High altitude aerial photography, appears to provide both the high resolution and the expansive spatial coverage necessary for a statewide habitat inventory. ERTS is believed to be of secondary value, but may have considerable utility as a tool for repetitive monitoring of regional change in habitat condition.

Both of these sensors will be analyzed with regard to their capabilities for inventory of habitat in a pilot study. NASA has been requested to provide coverage of all or part of three counties representative of the major ecological units of the state — the short grass prairies (Thomas County), mixed prairie (Ottawa County), and tallgrass-woodland mosaic (Jefferson County). In the interim, available imagery of Kansas is being utilized to develop interpretation, data extraction and data storage strategies. Current ERTS, 1969 high altitude aerial photography of Douglas County, and selected frames of March, 1973 high altitude photography of Finney, Saline and Jefferson Counties are being used in this work.

Kansas Forestry, Fish and Game Commission personnel have been engaged in all major project decisions and will be actively participating in all phases of the pilot study.

2.3 Anticipated Results:

It is believed that the results of the pilot study will be positive from the standpoint of extraction of required data. Cost-benefit results appear somewhat less encouraging, but perhaps, may serve as a catalyst to encourage cooperation and pooling of funds from several state agencies, all of which would profit from the data. A cooperative effort of this scope is under active discussion in Kansas, and will be actively considered and incorporated in development of this and other projects which might conceivably be affected.

APPLICATIONS PROJECT SUMMARY

Project Title: Evaluation of Soil Moisture Conditions Related to Release Outflow from Rathbun Dam

Participating Agencies: U. S. Army Corps of Engineers

Key Personnel:

Agency:
Mr. Darald Saratt
816/374-5652
Mr. Jack Nelson
816/374-5053
Mr. Claren Kontz
816/374-3651
U. S. Army Corps of Engineers
Kansas City, Missouri

CRINC:
B. G. Barr, Project Director
Robert Walters, Coordinator
Robert Eastmond, Program Scientist
Ted Talmon, Interpreter

Tentative Completion Date: 1 August 1973 Starting Date: 20 June 1973

1.0 Introduction:

The Rathbun Reservoir just north of Centerville, Iowa (Figure 1) is a primary flood control structure on the Chariton River. The Chariton River runs south from Rathbun eventually joining the Missouri River near Brunswick, Missouri. Much of the river from the Dam to near Worthington, Missouri has been channelized with the exception of an 8 mile stretch known as the Missouri Narrows. Outflow releases from Rathbun reportedly created moisture stress conditions along areas of the Chariton River flood plain from Rathbun to Livonia, Mo. in the spring of 1973.

2.0 Statement of Work

2.1 Objectives:

The project was designed to utilize remote sensing to evaluate soil moisture conditions and vegetation effects in the Chariton River flood plain below Rathbun Dam. An attempt was made to correlate outflow releases from the Dam with soil moisture conditions on the flood plain. Results from the present, relatively moist conditions will be compared at a future date with drier soil conditions.

2.2 Approach:

Determining soil moisture and vegetation stress requires both photo reading (the process of simple recognition of objects seen in the photograph) and photo interpretation (the evaluation of several elements of the pattern

present in the photograph). Relatively little time is required to do the photo reading. Photo interpretation requires much more time. Supplementary information may significantly reduce the time required in this phase of the analysis. In the present study, a field check will be utilized to help establish the critical recognition categories for the photo interpretation. Color and black and white infrared aerial photography will be used.

2.3 Anticipated Results:

This project will attempt to determine excessive moisture in the flood plain below the Dam and the extent of any vegetation stress. Additional flights at a later date will determine the effect of outflow change. This study provides an excellent experimental project using remote sensing in coordinating outflow releases from a reservoir as related to farming practices in the area.

2.4 Funding:

Funding for the photographic mission and ground checks will be provided by the Corps of Engineers. Interpretation will be accomplished by the Space Center staff.

APPLICATIONS PROJECT SUMMARY

Project Title: Monitoring Rangeland Burning in the Flint Hills, Kansas

Participating Agencies: Kansas State University, Kansas Livestock Association

Key Personnel:

Agency:

Clenton E. Owensby,
Professor of Agronomy,
Kansas State University

CRINC:

B. G. Barr, Project Director
Robert Walters, Coordinator
Donald Williams, Senior
Research Scientist

Tentative Completion Date:

Starting Date: August 15, 1973

1.0 Introduction:

The Flint Hills of eastern Kansas constitute one of the most important tall grass grazing areas in the United States. Spring burning to promote early growth is regularly practiced by ranchers in the Flint Hills. However, few data on the extent and timing of this burning and its effects on subsequent vegetative growth of the grasses are presently available. Interest in air pollution consequences of such burning also exists due to new air quality standards.

2.0 Statement of Work:

2.1 Objectives:

Using ERTS-1 imagery acquired during April 1973, a map of burned areas is to be prepared. Subsequent imagery will be examined to determine effects on vegetative growth.

2.2 Approach:

This project represents an interfacing of ERTS-1 investigations with user studies. Mr. Williams, in connection with an ERTS-1 project, is investigating burning patterns in relation to tree growth in the region. The maps produced will show the extent and pattern of burning on 4-5 April and 22-23 April, 1973. Cooperation with Dr. Owensby will permit transfer of interpretation techniques from the research phase to specialists in range management. Mr. John Meetz, Executive Vice President of the

Kansas Livestock Association, has indicated that organization's interest in using results of this study.

2.3 Anticipated Results:

The results of this study will provide data useful in decisions determining the utility or adverse effects of present burning practices.

2.4 Funding:

Cost to be shared by Kansas State University, NASA ERTS Research contract, and Applications grant.

APPLICATIONS PROJECT SUMMARY

Project Title: Land Resource Map of Cherokee County, Kansas

Participating Agencies: Cherokee County Commission, Kansas Department of Economic Development, Kansas Geological Survey

Key Personnel:

Agency:

Ronald G. Hardy
Geologist, Kansas
Geological Survey

Mary Alice Soule
Research Assistant
Kansas Geological Survey

CRINC:

B. G. Barr, Project Director
Robert Walters, Coordinator
Donald Williams, Senior Research Scientist
Steve Everley, Photographer

Tentative Completion Date:

Starting Date: September 1, 1973

1.0 Introduction:

Cherokee County, located in extreme southeastern Kansas, is a major mining area. As a consequence of the decline in lead and zinc mining in the area and increased mechanization of coal mining, the county is now somewhat economically depressed. Large areas in the county have been strip mined for coal. Reclamation of these lands has only recently commenced. Water pollution from mining and associated activities is a serious problem in the county. In order to seek rational solutions to these problems, the Cherokee County Commissioners and Kansas Department of Economic Development, through the Kansas Geological Survey, have approached the Kansas Applications Program for assistance in preparing land resource maps of Cherokee County.

2.0 Statement of Work

2.1 Objectives:

The first objective is to prepare a detailed land resource map for the town of Galena, Kansas, and its immediate environs. This map will be based on interpretation of multi-band aerial photography and ground surveys to provide data in the style of the New York State Land Use Classification System. These data will be supplemented by a series of data related to geology and mineral resources acquired by techniques presently being used by the Kansas Geological Survey. The resulting

classification is expected to be at the fourth level of the U. S. G. S. land-use classification system.

The second objective is to prepare a general land resource map for Cherokee County by interpretation of multi-band photography.

2.2. Approach:

Details of the classification will be agreed upon by representatives of the participating agencies. Techniques for the interpretation of data elements from the photography will be developed by Applications personnel. Personnel of the Kansas Geological Survey will be trained in the use of these interpretation techniques and will then begin interpretation, assisted by members of the Applications staff. Ground data will be acquired by members of the Kansas Geological Survey.

2.3 Anticipated Results:

The resource maps produced by this project will be used by the Cherokee County Commission and the Kansas Department of Economic Development in planning economic development strategies of the county. The potential of this type of mapping for the entire state will be analyzed by the Kansas Department of Economic Development.

2.4 Funding:

The Cherokee County Commission and Kansas Department of Economic Development are sharing the acquisition costs of the multi-band photography and the costs of interpretation and ground surveys performed by the Kansas Geological Survey. The Applications grant is covering the costs of technical assistance related to image interpretation.

APPENDIX B

Applications Project Reports

APPLICATIONS PROJECT SUMMARY

Project Title: Clinton Reservoir Land-Use Mapping Using Multispectral Aerial Photography and ERTS-1 Satellite Imagery

Participating Agencies: Lawrence-Douglas County Planner

Key Personnel:

Agency: 843-4600
Dick McClanathan, Planner
Martha Munczek

CRINC:
Robert Eastmond, Professor of Botany
John Barr, Research Assistant
B.G. Barr, Project Director
Robert Walters, Coordinator

Tentative Completion Date: 15 March 1973 **Starting Date:** 5 February 1973

1.0 Introduction:

The Clinton Reservoir, presently being constructed by the U. S. Army Corps of Engineers, is located southwest of Lawrence, Kansas. When completed the multipurpose reservoir will have a surface area of 7,000 acres all in Douglas County. At full capacity the surface area would be 12,000 acres and would extend into eastern Osage County. It is expected that such a lake will have some impact on the land use in the surrounding area. To plan and control land use changes will require background on the present conditions and detailed information concerning present and potential land uses.

2.0 Statement of Work

2.1 Objectives:

In response to a request from the Lawrence Douglas County Planner, the Kansas Applications program has undertaken this project to assist in the development of a series of map overlays describing specific land use characteristics required for future planning decissions.

Land use data from available 70mm aerial photography and ERTS-A imagery will be compared to determine the utility and cost/benefits of each in such land use mapping.

2.2 Approach:

The Lawrence-Douglas County Planning staff will utilize conventional data sources to obtain information on flood prone areas, soils, slopes, historic sites, utilities, and scenic and land values.

Applications staff will utilize 70mm aerial photography (Color IR, Multiband B & W) to compile data on surface water, miner al resources, vegetation, agriculture, wildlife habitat, transportation routes, earth forms and residential and commercial land use. Level 2 land use data from the ERTS data will be compared with the above.

2.3 Anticipated Results

It is anticipated that the Douglas County Planning Commission will take action on the results of this study by developing the planning and zonning policies in connection with development in the Clinton Reservoir area. Future planning decisions can then be made on the basis of the present conditions and potentials of the area involved. Updating of base data may be accomplished using satellite imagery or selected aerial photography.

2.4 Funding:

Funded by Applications Grant; cost sharing by Lawrence - Douglas County Planning Commission.

APPLICATION OF REMOTE SENSING TO LAND USE CLASSIFICATION SURROUNDING CLINTON RESERVOIR, DOUGLAS COUNTY, KANSAS

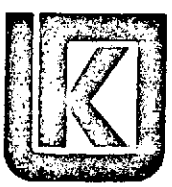
Robert J. Eastmond
John C. Barr

in cooperation with the

Lawrence-Douglas County Planning Department

Technical Report 2230-8
May 1973

Partially Supported by NASA Grant NGL 17-004-024



THE UNIVERSITY OF KANSAS CENTER FOR RESEARCH, INC.
2385 Irving Hill Rd.—West Campus Lawrence, Kansas 66044

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The Clinton Reservoir, presently being constructed by the U.S. Army Corps of Engineers southwest of Lawrence, Kansas, will have considerable impact on the land use in the surrounding area. The multipurpose pool will have a surface area of 7,000 acres all in Douglas County. Temporary storage at full capacity (flood pool) will cover 12,000 acres of Wakarusa River Valley. At flood pool the water would extend about 4 miles into Osage County. (Figures 1 and 2)

Clinton Lake was authorized by Congress in 1962 as a unit of the Kansas River and Missouri River Comprehensive Plans for flood control and water development. In 1965, the State of Kansas included Clinton Lake in the State Water Plan Act for multi-purpose use including flood control, municipal and industrial water supply, streamflow regulation, recreation and fish and wildlife enhancement. To plan and control such multiple use changes requires background information on the present conditions and detailed data concerning the present and potential land uses.

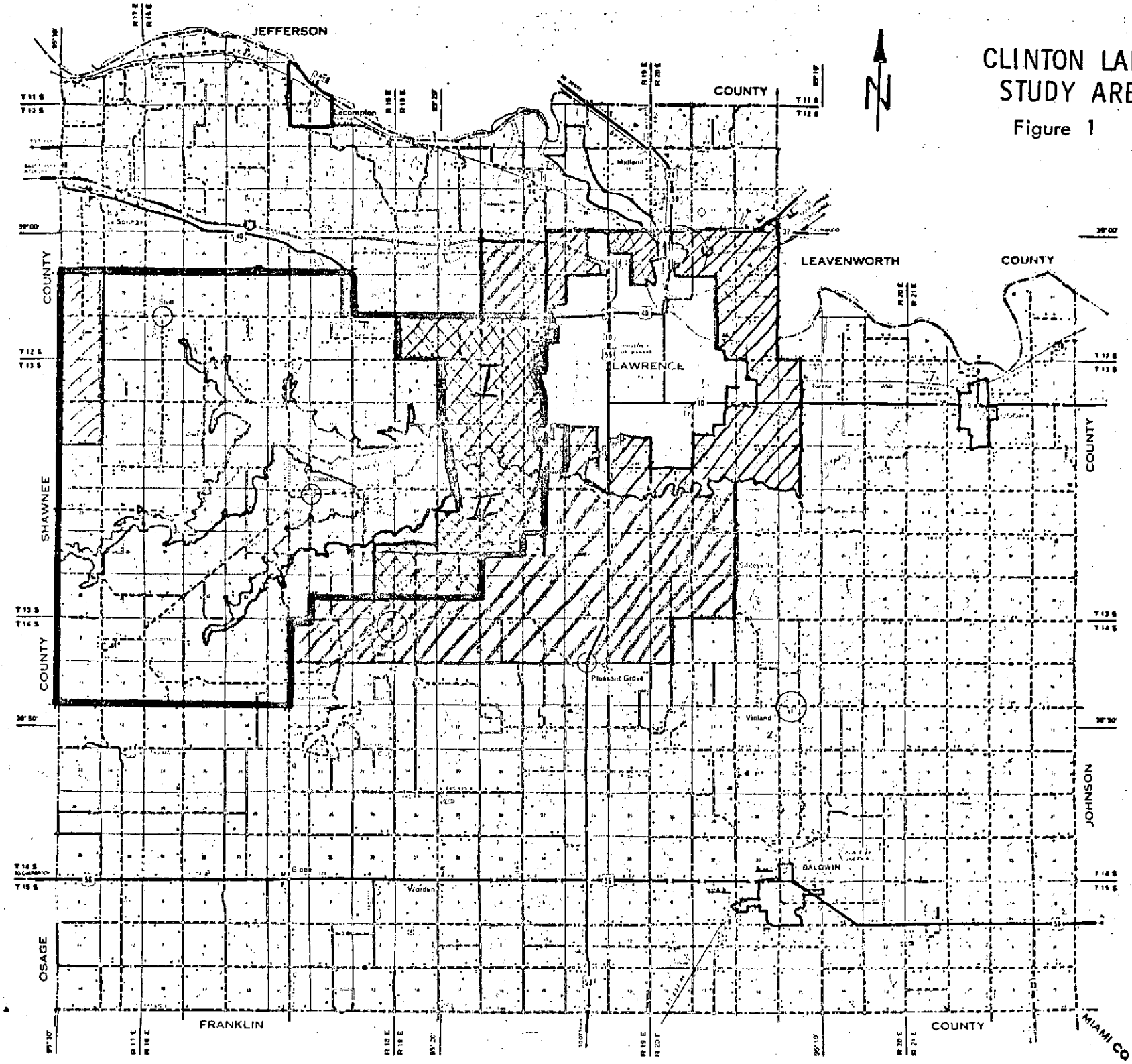
In response to a request from the Lawrence-Douglas County Planner, the Kansas Applications Program developed this project to assist in describing specific existing land use characteristics required for future planning decisions. The Lawrence-Douglas County Planning Staff will utilize conventional data sources to obtain information on flood prone areas, soils, slopes, historic sites, utilities, and land values, etc. The Applications staff has utilized remote sensing technology to compile data on surface water, mineral resources (quarries), agricultural and natural vegetation, wildlife habitat, transportation routes (roads), earth forms, and residential/commercial land use.

Photography and Interpretation

The imagery used for the land use interpretation was flown by CRINC with a Cessna 182 aircraft on July 7, 1972. Both color infrared and multiband photography were taken. The multiband imagery included green, red and near infrared black & white bands. The original scale of the photography is approximately 1:80,000. The interpretation was done utilizing the original films and prints of the red band at two different scales, one set at approximately 1:24,000 and the other at approximately 1:16,400. Most often the land use data was taken from the 1:24,000 prints. But for each classification category, there was generally a combination of scales and bands needed for interpretation. Considerable supplemental data including ground truth information was used in the interpretation process.

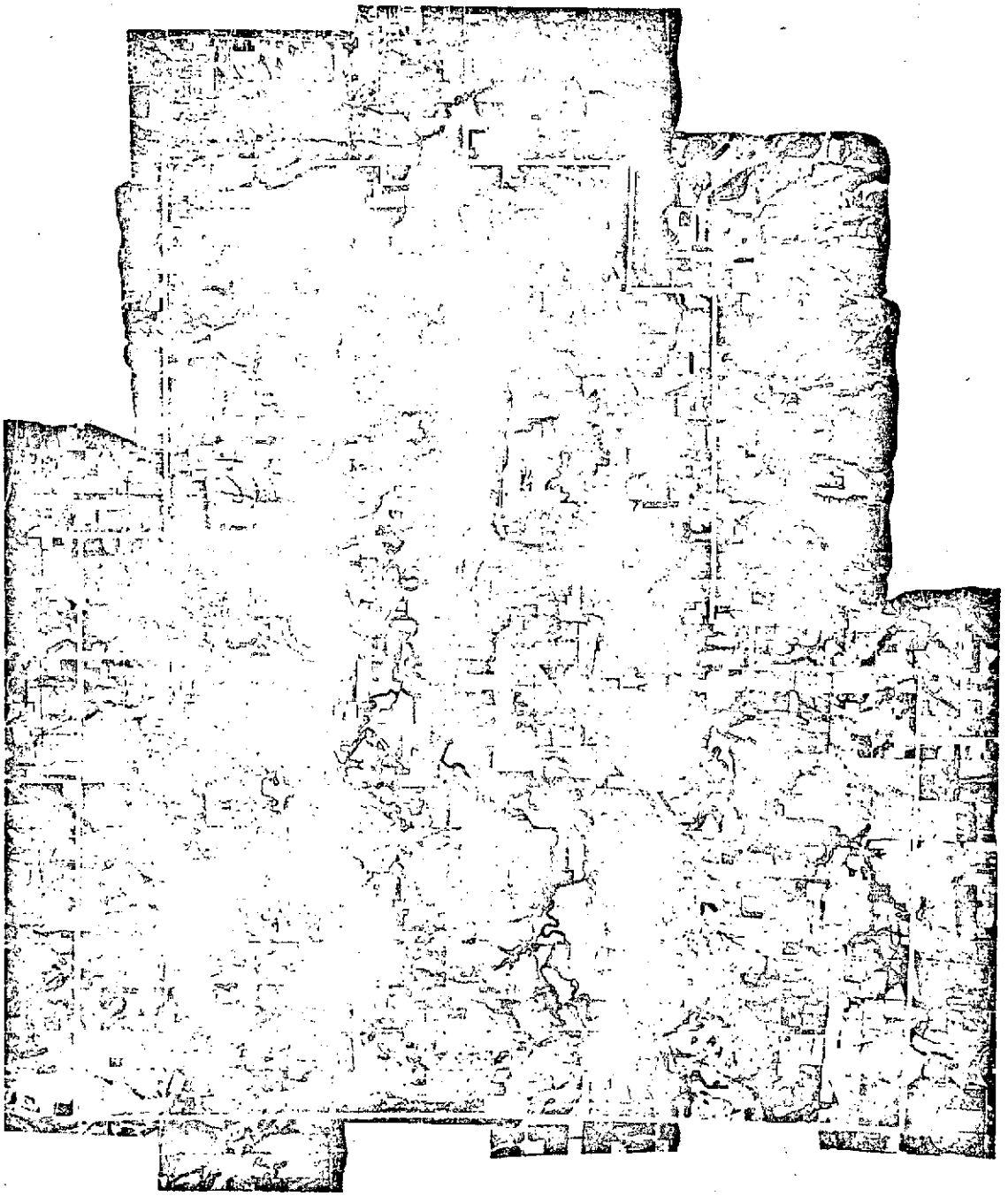
Definitions and Descriptions of Categories

The land use categories were defined in terms of tone, shape, and pattern on the photographs. The interpretation was then cross referenced with available supplemental data prior to construction of the overlays. A detailed description of each of the seven



CLINTON LAKE STUDY AREA

Figure 1



land use categories follows including: surface water, mineral resources (quarries), transportation routes (roads), residential/commercial land use, earth forms, agricultural and natural vegetation, and wildlife habitat potential.

Surface Water

Smooth, still water normally appears fairly dark in color on black and white photographs. Sediment in the water tends to reflect light, therefore, on the photograph such water appears grey to white in tone. On the black and white infrared photographs water stands out very dark (black) in tone and is easily identified. Ponds and lakes were identified on both the color and black & white infrared films. The water bodies identified were then located on the 1:24,000 red band prints to enable areal mapping onto the topographic sheets.

Extractive Mineral Resources

Quarries were mapped on the topographic sheets and thus only needed confirmation of existence or updating where new quarries existed. The extractive quarry (limestone or sand and gravel) land use was identified on the basis of road networks and disturbed vegetation patterns. Shadow is an index to the depth of pits and quarries. Generally active sand pits or quarries appear much lighter than the surrounding ground cover.

Transportation Routes (Roads)

Roads are very prominent on aerial photographs, and details of the road net are quite apparent. They appear as narrow bands of light lines.

Hard surface roads of concrete or asphalt are clear-cut in outline with emphasis on uniform width, easy curves, and smooth surface. Improved gravel or dirt roads usually appear wider and lighter than paved roads. Unimproved roads are of irregular width. Usually they are narrow and follow a more erratic course than improved roads.

Road surfaces in the study area were either asphalt, gravel or dirt. The topographic maps were very accurate as to the extent and location of the road network. A map obtained from the Douglas County Engineer was used to check both the extent and location of the network and also as a check on the interpretation of the type of road surface. A set of green band prints (scale approximately 1:16,400, July 7, 1972) from another project was found to be the best imagery for interpretation of the road surfaces.

Residential/Commercial Land Use

Residential

Residential types for most classifications could be distinguished on the 1:24,000 scale, red band prints. Where classification as to type was difficult, the larger scale

prints were used to provide a larger "image". When more detail was required, the original film was used under a microscope that was capable of 3X magnification. This same method to obtain scale and resolution advantage when necessary was used for all categories.

Farm Homes

Farm homes were identified generally on the presence near the structure of barns or other out-buildings. Also used as indicators were roads or stock paths to fields adjacent to the structures. The category delimited on the map as farm homes included all of the area occupied by the home, those out-buildings very near the home and open spaces or yards directly associated with these structures. Two farms of commercial stature were identified.

Out-Buildings

This classification was given to isolated structures that did not fit any of the previously mentioned categories. Generally they were either associated with a farm or were abandoned structures.

In several instances, a question mark (?) was placed on the land use map. This indicates a lack of "sureness" with the classification assigned. Where no classification was made and a question mark exists, two situations are possible.

1. A structure was mapped (by the Geological Survey) on the topographic sheet but was not observable in the imagery.
2. A structure existed in the imagery for which its category of land use was not known.

Mobile Homes

Mobile homes were generally classified on the basis of there length to width ratio. Increasing use of "double-wide" mobile homes may have caused the incorrect identification of some mobile homes as regular single family dwellings. Driveway pattern was also used to separate the mobile from single family homes. For single family homes, and especially those with garages, the driveway is generally perpendicular to the house itself. For a mobile home, the driveway would generally either end at a point not adjacent to the structure or would be a semi-circle drive, tangent to the structure.

Single Family Home

Essentially the single family home classification was the process of elimination of the other two categories. The presence of dual driveways, porches or patios could serve to indicate multiple-family dwellings, but no dwellings of this type were identified within the study area. Obviously some multiple-family dwellings do exist within the boundaries of Lecompton and Clinton but this distinction was not needed for the land

use map. In some instances, structures that fit the criteria for single family homes were in fact farm homes. These structures could be identified as farm homes by observation of otherlarge isolated structures in the area that were barns or other out-buildings and were connected by minor road networks. Such a classification is by necessity very subjective.

Commercial and Industrial

No industrial classifications were made in the area. Only one commercial classification was made and this was by both elimination and the presence of what appeared to be space allocated as a parking lot. In addition, two farms were classified as "commercial farms" because of their obvious complexity.

Public

Public land areas generally were schools and park areas. Most of these uses were already identified on the topographic maps that were used as the base for the land use map. Generally such uses could be identified by their size, spatial context and associated surrogates such as recreational facilities.

Semi-public

Semi-public uses consisted of such categories as churches and cemeteries. Again, many of these uses were already on the topographic sheets. Because of the scale of the imagery used for interpretation, the topographic maps were heavily relied upon for semi-public land uses such as churches. Cemeteries could easily be identified because of their areal extent and their road and vegetation patterns.

The 1:24,000 red band prints were used as the mapping base for all interpretations. Transparent plastic was overlayed on the prints to delimit the areal extent and spatial allocation of the land uses. These transparencies were the overlayed on the topographic sheets and the land use data transferred to the maps.

In addition, a map indicating the general spatial distribution of structures for which building permits had been issued was used to cross-check the interpretation. This was helpful where the exact use of a structure (that appeared on both maps) was difficult to identify. But, the map also contained some errors and did not accurately locate the structures.

Agricultural and Natural Vegetation

Agricultural and natural vegetation wereclassified into the following general categories: dense woods, open woods, grassland with scattered trees, native grassland, tame grassland and pasture, and cropland.

The woodlands of eastern Kansas are difficult to classify into composition classes due to their high variability. This variation results from factors such as human occupation and treatment, aspect involving slope and exposure, soils, and moisture. Commonly upland forest species include Elm, Ash, Hickory, Oaks, Hackberry, and Locust as well as numerous others. Riparian forests commonly consist of Sycamore, Cottonwood, Box Elder and several Willows. For the purposes of this study and considering the data base (aerial photography) and the time limitations, an ecological or species composition classification was not attempted. Rather, forested areas were classified as to the density of tree cover. Some inferences may be made to possible composition but ground checking will be required to accomplish definitive discriptions.

Dense Woods

Dense woods include those areas of apparently impenetrable expanse of tree top canopy. Terrain features are largely or completely hidden by canopy cover. The outline of the forested area is sharply defined. It can be infered that where these areas occur along stream banks that the common riparian species may be found and on slopes or uplands species associated commonly with upland forests will be present.

Open Woods

Open woods include those areas of dark somewhat separated canopies exhibiting less distinct boundary definition. Light does penetrate the canopy and reflects off the ground beneath appearing as lighter areas on the photographic image. Some limited terrain features may be visible in this type. These woods may consist of riparian or upland forest types but restricted in canopy closure by some aspect of site quality (soil, moisture, etc.). In some cases these areas may represent areas where succession is occurring, ie. where disturbance has occurred in the past and recovery or invasion is taking place. Common sucessional or invader tree species include Honey Locust, Osage Orange, Walnut, and occassionally Hackberry, Red Haw, Box Elder, or Elms. The specific ecological classification of "open woods" will require some historical information or ground truth data.

Grasslands - Scattered Trees

Grasslands with scattered trees or shrubs are distinguished from open woodlands in that the trees or shrubs occur singly and scattered but not in difinable groves or patches. The area is generally lighter in color and terrain features are plainly visible. Where grazing occurs and may be responsible for the lack of tree cover, the scattered trees may commonly be one of the following species: Osage orange, Red haw, Hackberry, Coffee tree, or Ash. These species commonly occur as single trees in rangelands. Scrub or brush may be distinguished on the photography because of its sparse character and low height.

The distributions of grasslands and agricultural croplands in eastern Kansas is largely controlled by topography. The smooth, flat areas and gentle slopes are generally inhabited by these two general vegetation categories. Wooded areas surrounding these lands are typically on rougher topography, ie. steeper slopes and scarps.

Native Grassland

Native grassland or rangeland is defined as potential native or naturally occurring vegetation predominately grasses or grass-like plants and some forbs. In the photography these areas generally appear as large irregularly shaped areas of consistant grey tones. Terrain features are well defined and there are no signs of cultivation.

Tame Grassland

Tame grasslands and pastures are distinguished from native grasslands in that they are generally smaller areas having clearly definable rectangular or more regular boundaries. Where both native and tame grassland occur in smaller units, textural differences indicating cultivation or seeding techniques can be used to separate tame grassland. In addition, in color infrared photography early in the year the tame (seeded) grasslands appear bright red or pink while the native grassland appear magenta or bluish. Meadows and pastures may often appear mottled due to the patchiness of the vegetation.

Agricultural Cropland

Agricultural cropland is defined as that land used primarily for production of crops or farm commodities. The appearence of cultivated fields varies considerably with the season and the state of cultivation. Cultivated fields which have recently been plowed reflect large amounts of light and therefore are very light toned or white on the photography. Ripened crops or crops being harvested are also light in color. Most often the patterns of cropping (rows, contours, etc.) are well defined and readily distinguished. Often terrain features, particularly contours, are not only visible but may be exaggerated by contour farming.

Wildlife Habitat

Evaluation of wildlife habitat in terms of value or potential can be accomplished at several levels. Considering the area involved, the time limitations for the study, and the data base available,a generalized evaluation was conducted. The technique involved evaluating each quarter section in the study area using the following criteria: food, cover, grassland, distribution and size, interspersion, and communication. For purposes of this study food was broadly defined as agricultural cropland, cover as woodland or trees, and grassland included all three classifications although tame grasslands were weighted somewhat compared to native types. The distribution of these three vegetation types involves the spacial relationship of one type to another while size considers the areal extent of each type. Interspersion is the scattering of these different types along sampling transects, ie. the number of times a different type occurs along the transect (Baxter and Wolfe, 1972). Communication involves the routes of travel to and from feeding areas or grasslands, eg. wooded areas or hedge rows.

The primary data base was the vegetation map produced from the aerial photographs. Vegetation maps have commonly been used to provide an index to the biotic potential in an area. In addition to the vegetation map secondary data from a study of wildlife in the Wakarusa River Watershed (Choate, 1967) was used to aid in defining the criteria in reference to the specific study area.

Three "wildlife potential" values were used in evaluating each quarter section. It should be understood that these are only potential values and not actual wildlife counts or surveys since no field studies were conducted. The values have particular reference to upland game and song birds, however, some indication of potential for deer and some smaller mammals can be made.

High wildlife potential was classified on the basis of the presence of all three vegetation categories, a good distribution of smaller size units of each vegetation type, a high degree of interspersion, and the presence of good communication lanes.

Moderate potential required the presence of at least two of the vegetation types, balanced with a good distribution of smaller sized units, moderate interspersion, and at least some possible communication lanes or some balanced combination of the above factors any one of which may be suboptimal.

Poor potential for wildlife indicates areas where one or more of the criteria were missing entirely or very poorly represented. For example areas where only one vegetation type occurred or where communication lanes were missing.

Anticipated Use of Results

It is anticipated that this study will provide a detailed, overall view of the present conditions and land use surrounding the proposed Clinton Lake. Evaluation of the results will provide information on the interrelationship of such physical factors as drainage, topography, soils, vegetation, and man-made features. Furthermore, it is anticipated that the Lawrence-Douglas County Planning Commission will take action on the results of this study by developing the planning and zoning policies in connection with development in the Clinton Lake area. Future planning decisions will be based on the present conditions and potentials identified.

APPLICATIONS PROJECT SUMMARY

Project Title: Clinton Reservoir Land-Use Mapping Using Multispectral Aerial Photography and ERTS-1 Satellite Imagery

Participating Agencies: Lawrence-Douglas County Planner

Key Personnel:

Agency: 843-4600
Dick McClanathan, Planner
Martha Munczek

CRINC:
Robert Eastmond, Professor of Botany
John Barr, Research Assistant
B.G. Barr, Project Director
Robert Walters, Coordinator

Tentative Completion Date: 15 March 1973 **Starting Date:** 5 February 1973

1.0 Introduction:

The Clinton Reservoir, presently being constructed by the U. S. Army Corps of Engineers, is located southwest of Lawrence, Kansas. When completed the multipurpose reservoir will have a surface area of 7,000 acres all in Douglas County. At full capacity the surface area would be 12,000 acres and would extend into eastern Osage County. It is expected that such a lake will have some impact on the land use in the surrounding area. To plan and control land use changes will require background on the present conditions and detailed information concerning present and potential land uses.

2.0 Statement of Work

2.1 Objectives:

In response to a request from the Lawrence Douglas County Planner, the Kansas Applications program has undertaken this project to assist in the development of a series of map overlays describing specific land use characteristics required for future planning decissions.

Land use data from available 70mm aerial photography and ERTS-A imagery will be compared to determine the utility and cost/benefits of each in such land use mapping.

2.2 Approach:

The Lawrence-Douglas County Planning staff will utilize conventional data sources to obtain information on flood prone areas, soils, slopes, historic sites, utilities, and scenic and land values.

Applications staff will utilize 70mm aerial photography (Color IR, Multiband B & W) to compile data on surface water, mineral resources, vegetation, agriculture, wildlife habitat, transportation routes, earth forms and residential and commercial land use. Level 2 land use data from the ERTS data will be compared with the above.

2.3 Anticipated Results

It is anticipated that the Douglas County Planning Commission will take action on the results of this study by developing the planning and zoning policies in connection with development in the Clinton Reservoir area. Future planning decisions can then be made on the basis of the present conditions and potentials of the area involved. Updating of base data may be accomplished using satellite imagery or selected aerial photography.

2.4 Funding:

Funded by Applications Grant; cost sharing by Lawrence - Douglas County Planning Commission.

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Baxter, W.L. and C.W. Wolfe. 1972. The interspersion index as a technique for evaluation of Bobwhite Quail habitat. A Contribution of Federal Aid to Fish and Wildlife Restoration. Nebraska Game and Parks Commission Publication.

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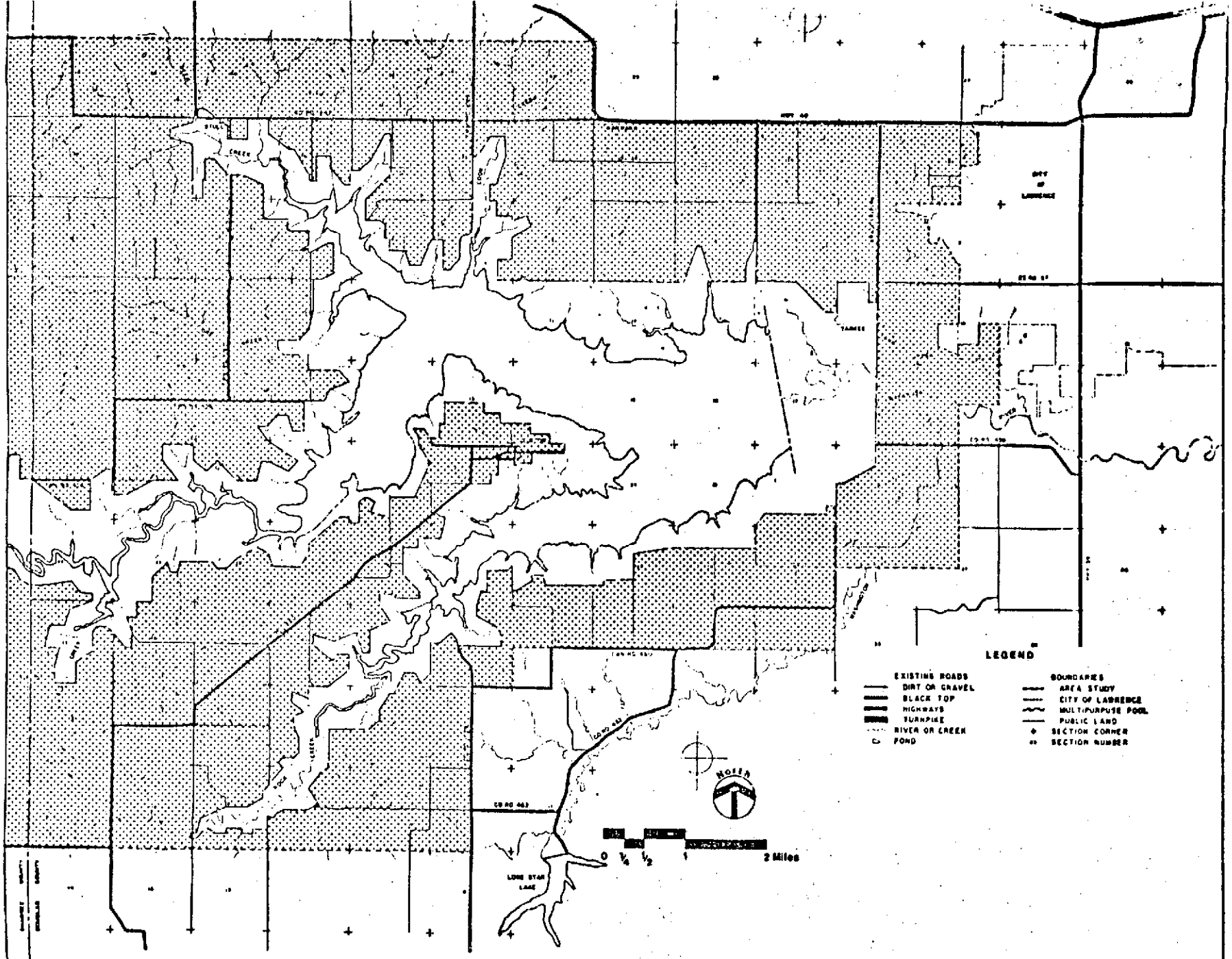
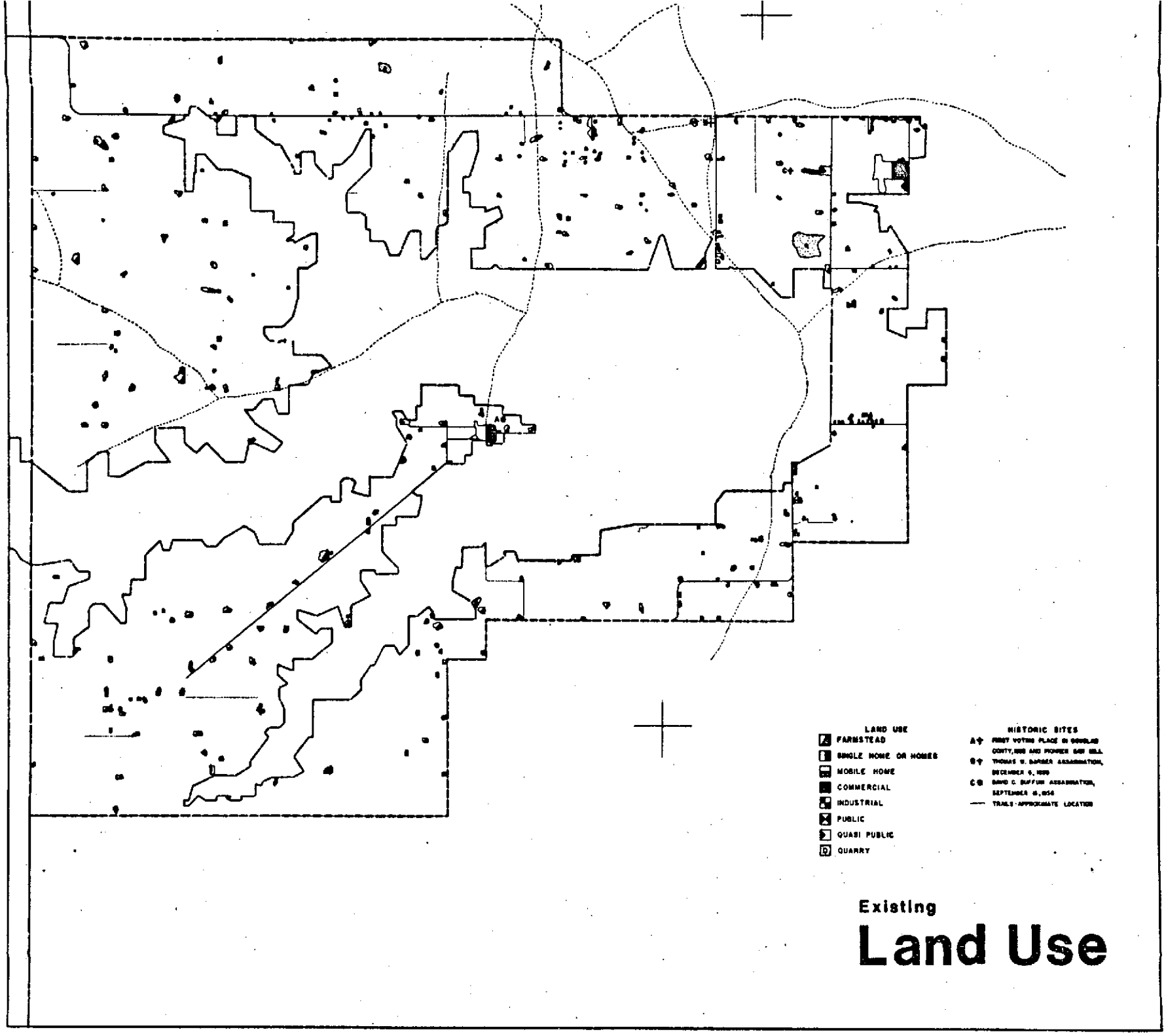


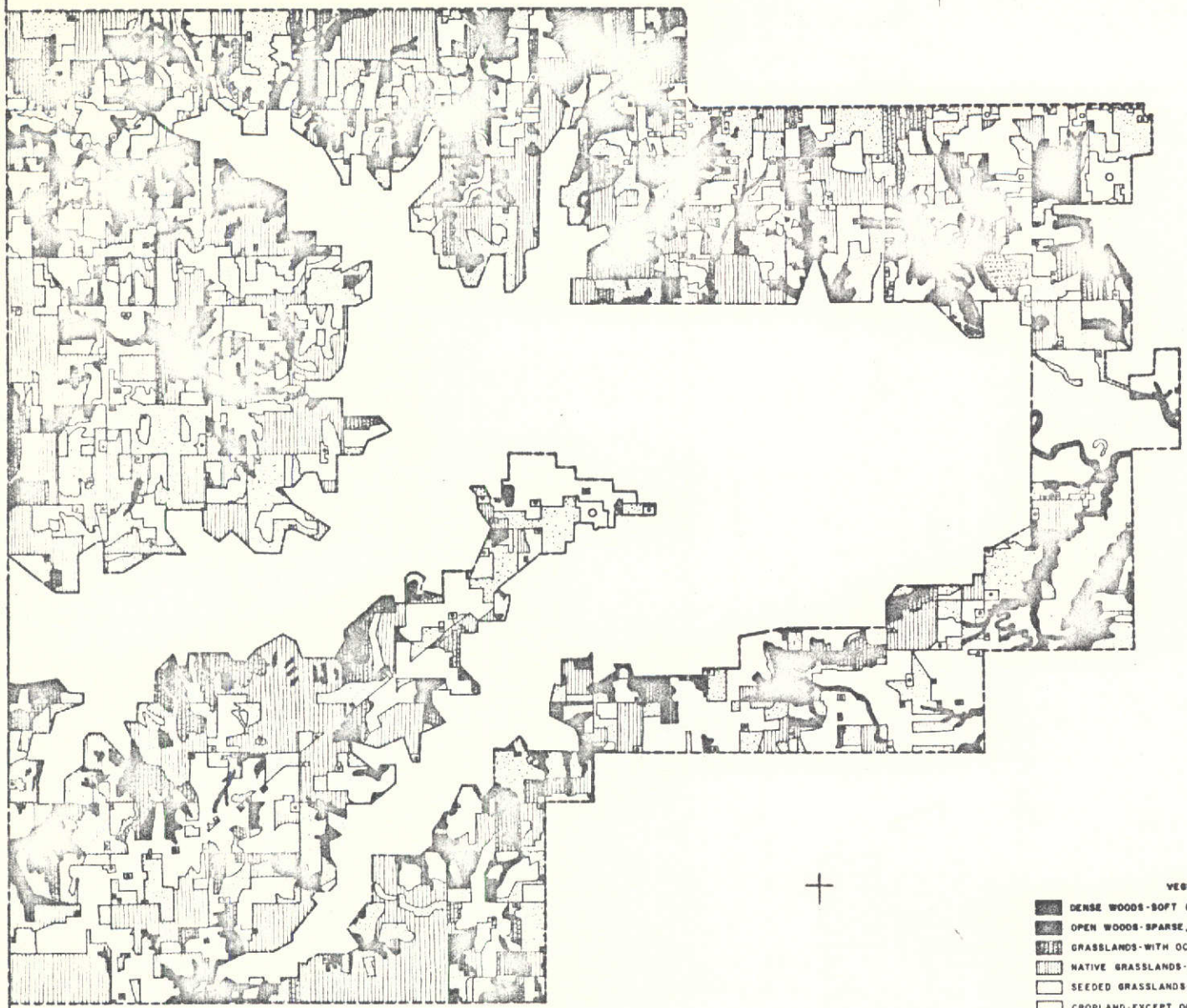
Study Area

THIS REPORT WAS PREPARED FOR THE PLANNING DIVISION, KANSAS DEPARTMENT OF ECONOMIC DEVELOPMENT AND WAS FINANCED IN PART THROUGH A COMPREHENSIVE PLANNING GRANT FROM THE DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT.



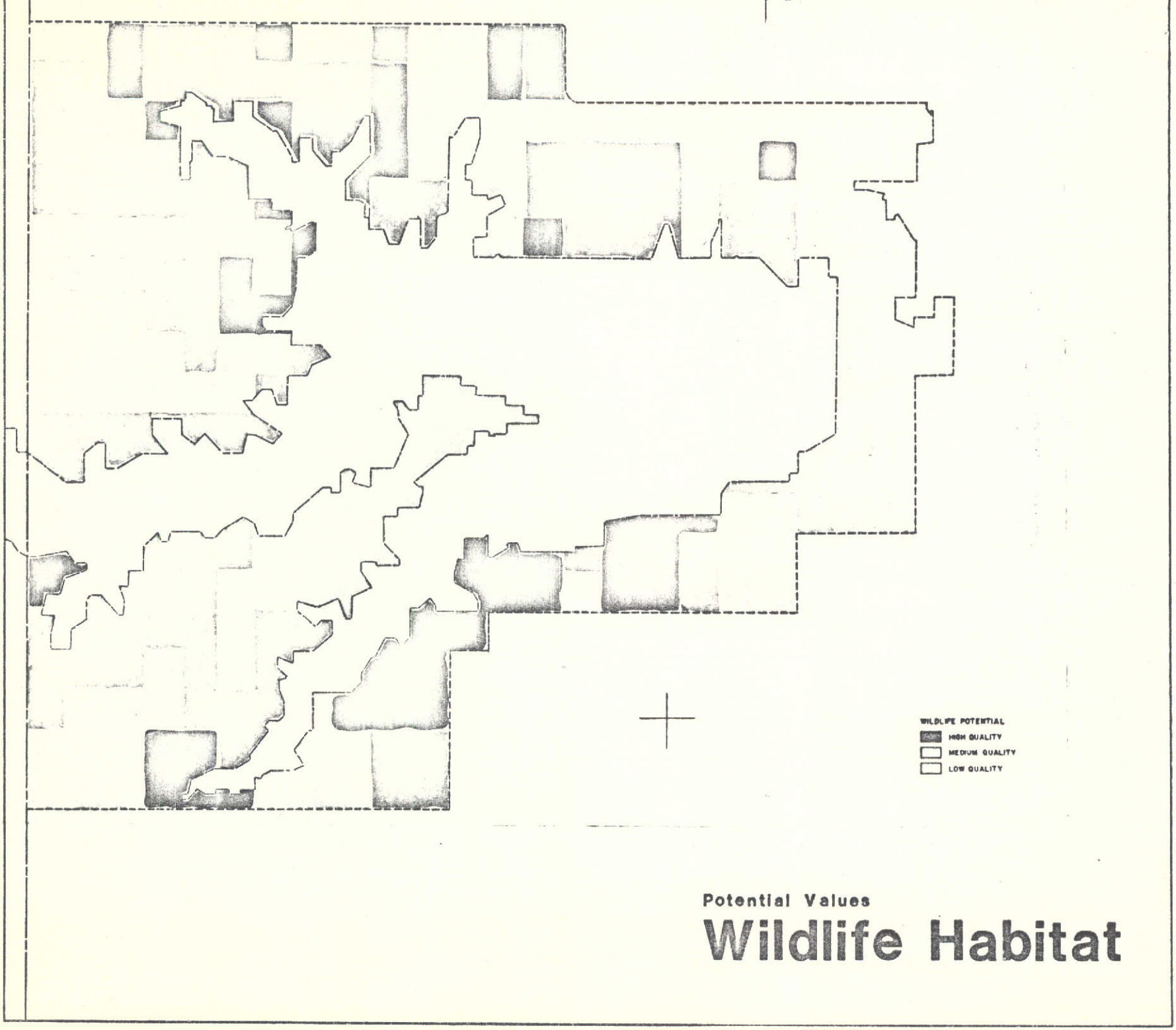
Existing

Land Use



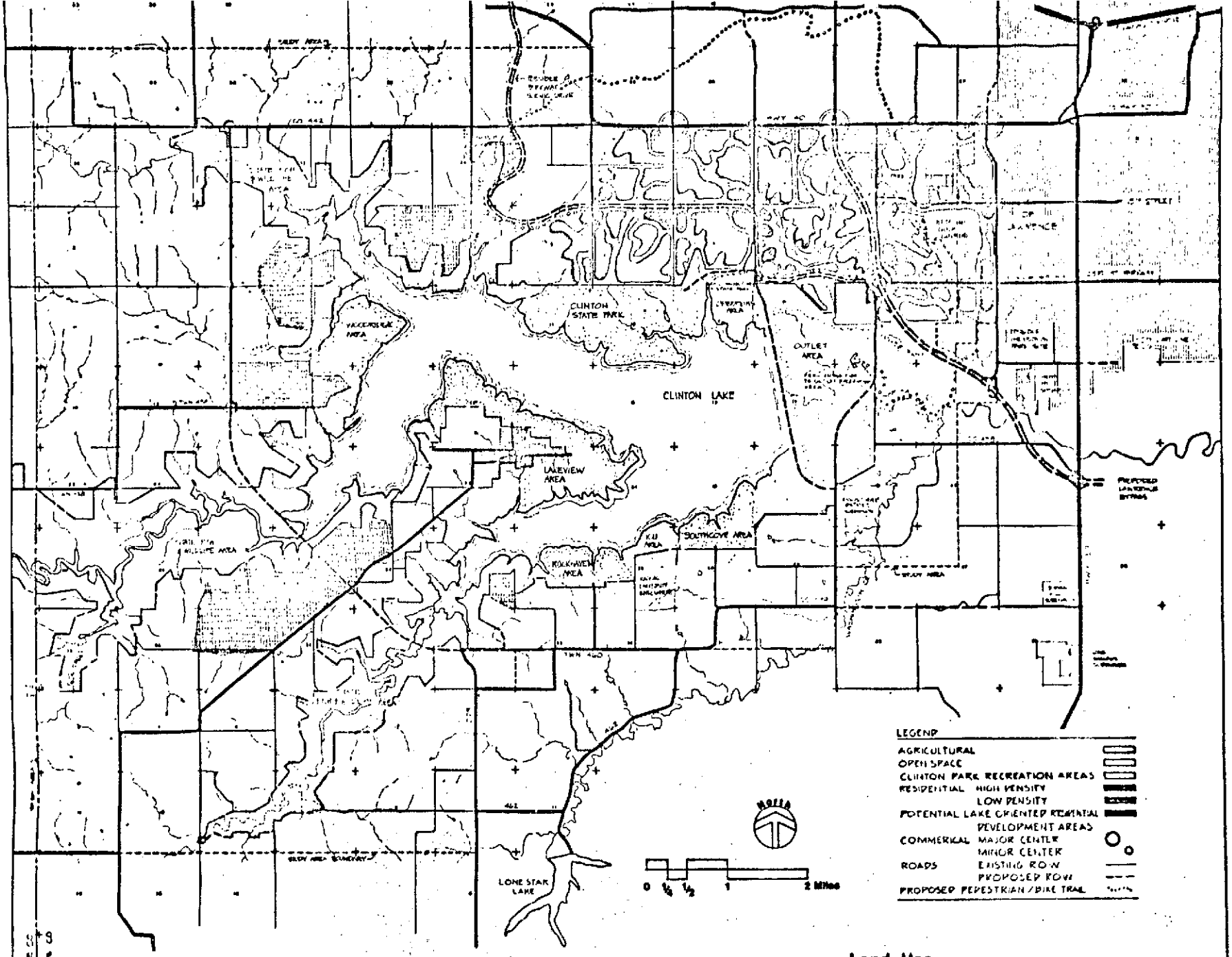
Existing

Vegetation



Potential Values

Wildlife Habitat



Land Use
Guide Plan

CLINTON RESERVOIR AREA MINI-COMPREHENSIVE PLAN • LAWRENCE - DOUGLAS COUNTY PLANNING COMMISSION

LAWRENCE - DOUGLAS COUNTY PLANNING COMMISSION

RICHARD A. McCLANATHAN
DIRECTOR OF PLANNING

913-843-4600
EXTENSION 36

910 MASSACHUSETTS STREET
BOX 708
LAWRENCE, KANSAS 66044

March 13, 1973

Mr. Bill Barr, Executive Director
Space Technology Laboratories
West Campus, Kansas University
Lawrence, Kansas 66044

Dear Mr. Barr:

First of all, I wish to thank you for allowing the Lawrence-Douglas County Planning Department the use of your Remote Sensing Program, through the applications grant, in developing a comprehensive land use plan for the Clinton Reservoir area.

Through remote sensing, we hope to gain an overall view of the entire ninety-two (92) square mile study area. (This figure includes federal lands) In addition, we hope that this will give us a detailed view and the interrelationship of such specific physical factors as: drainage; topography; the suitability and capability of soils; vegetation; and man-made features.

We feel that utilization of remote sensing will provide our physical planning a savings in time while providing a deeper knowledge of the study area.

It is further our intention and hope that through analysis and evaluation of the data obtained from the remote sensing program additional information will be developed that could be applied to socio-economic planning.

Again, thank you for making this program available to us.

Sincerely,

Richard A McClanathan

Richard A. McClanathan
Lawrence-Douglas County
Director of Planning

RAM/ed

LAWRENCE - DOUGLAS COUNTY
PLANNING COMMISSION

RICHARD A. McCLANATHAN
DIRECTOR OF PLANNING

913-843-4600
EXTENSION 38

910 MASSACHUSETTS STREET
BOX 708
LAWRENCE, KANSAS 66044

April 18, 1973

Mr. Bill Barr, Director
University of Kansas
Space Technology Laboratories
2291 Irving Hill Drive
Campus West
Lawrence, Kansas 66044

Dear Bill:

As you requested in your letter of April 10, 1973, I have attempted to jot down essentially what I said during the presentation of our project at the March 29, 1973, Governor's Conference.

If this write up needs to be edited or changed, please feel free to do so.

Sincerely,

Richard A. McClanathan

Richard A. McClanathan
Director of Planning

RAM/ed
enc.

Richard A. McClanathan
Director of Planning
Lawrence-Douglas County Planning Department
Project Presentation of Clinton Reservoir Land Use Mapping for Mini-Comprehensive Plan.
Governor's Conference
March 29, 1973

During the late 1950's the U.S. Army Corps of Engineers determined that a lake or water impoundment on the Wakarusa River in Douglas County would be advantageous to the overall Kansas River Flood Protection program. At the time this project was first proposed and through the 1960's little concern was shown by the community for the project or its obvious impact. Although some community organizations attempted, during this time, to point out various problems that would be incurred there was little widespread community reaction.

However, recently, due to recreational proposals for the lake, possible urban development on the lake fringes, concern of overdevelopment and proliferation of commercial uses, considerable community concern has arisen. Because of this community concern, the Lawrence-Douglas County Planning Commission in late 1972 placed a moratorium on zoning changes in the Clinton Reservoir area and directed the planning staff to develop a mini-comprehensive plan for the area.

Clinton Reservoir is located approximately two (2) miles west of Lawrence and three (3) miles south of U.S. Highway 40.

It is expected that the recreational value of the lake will draw a considerable number of people from the south Kansas City area and the Topeka area, thus placing an unanticipated burden on the major trafficways through Lawrence and northern Douglas County. These trafficways are for the most part, presently two lane thirty (30) foot wide roads and vary in type of surfacing material from concrete to rock.

The economic and physical growth of the County and City of Lawrence will experience a considerable impact due to the lake development. However, this is somewhat conjecture on the part of local planners as there is no other lake development in the State of Kansas, or adjoining states, having this proximity to an urban center from which experience could be evaluated.

Because of the time constraints placed on the planning staff to develop this mini-comprehensive plan, the Space Technology Laboratories here at the University, offered the assistance of their remote sensing program. Through this program our study is being provided with information on surface water, cropland, trees, flora, unique scenic views, wildlife values, land use, circulation, and utilities. Other information could have been made available through remote sensing such as: drainage basins, mineral resources, and historical site values; however, at the time this information was available from other sources.

Our department has been and is very appreciative of the cooperation and assistance given us by the Space Technology Laboratories and we wish to thank them for coming to our aid.

Through the remote sensing program, we hope that an overall view of the entire ninety-two (92) square mile study area will be gained. In addition, we anticipate that the information developed here will provide us with a detailed view as well as information to determine and evaluate the interrelationship of such physical factors as: drainage; topography; suitability and capability of soils; vegetation; and man-made features.

It is also our hope and intention, that through analysis and evaluation of the data provided through the remote sensing program that information can be developed that could be applied to socio-economic planning in general.

Utilization of remote sensing is providing our physical planning with a savings in time and a deeper knowledge of the study area.

LAWRENCE - DOUGLAS COUNTY PLANNING COMMISSION

RICHARD A. McCLANATHAN
DIRECTOR OF PLANNING

913-843-4600
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910 MASSACHUSETTS STREET
BOX 708
LAWRENCE, KANSAS 66044

September 7, 1973

Mr. Bill G. Barr, Executive Director
Center for Research, Inc.
West Campus, Kansas University
Lawrence, Kansas 66045

Dear Mr. Barr:

Thank you for the contribution of the University of Kansas Center for Research, Inc., in the development of the Clinton Reservoir Area Mini-Comprehensive Plan.

The information gathered by the CRINC staff, through interpretations of aerial photographs and field surveys, included data on existing native vegetation and agriculture; earth forms; potential for wildlife habitats; and existing land use.

The Lawrence-Douglas County planning staff utilized this information to complement, and compared with, other factors compiled by our office. For instance, soil capability information provided by the Soil Conservation Service and present agricultural use areas, as compiled by the CRINC staff, were checked for correlation. The land use information allowed us to update existing base data on transportation routes and type of road surfacing; utility service systems; quarries; surface water; and residential, commercial, and industrial properties. The earth forms data assisted in locating areas having possible scenic value. Data showing areas having a high degree for potential wildlife habitat was compared with and utilized as argumentative reinforcement for the preservation of dense wood stands, marshlands, and unique topographical areas.

Finally, the information compiled and analyzed by both the CRINC and local planning staffs served as the data basis from which Mr. Ronald Jones, Planning Consultant, developed the proposed Clinton Reservoir Area Mini-Comprehensive Plan.

We would also like to emphasize that CRINC's contributions have led on to a better understanding and evaluation of many social, political, and economic factors in addition to developing an approach to physical land use planning.

We again thank you for making this program available to us and are sincerely hopeful collaboration between CRINC and the Lawrence-Douglas County planning staff will again be possible in the future.

Yours truly,

Richard A. McClanathan
Lawrence-Douglas County
Director of Planning

RAM/ed

APPLICATIONS PROJECT SUMMARY

Project Title: A Regional Land Use Map for the Four Rivers Resource Conservation Development Project

Participating Agencies: U.S.D.A. Soil Conservation Service at Salina, Kansas

Key Personnel:

Agency:
- Donald R. Robertson, State Resource Conservationist
- Robert K. Griffin, Deputy State Resource Conservationist
- U.S.D.A.-S.C.S., 760 S. Broadway, P.O. Box 600, Salina, Kansas, 67401, 823-9534
- Jim Habigar, Four Rivers RC&D Coordinator

CRINC:
- B. G. Barr, Project Director
- Bob Walters, Coordinator
- Robert Eastmond, Professor of Botany
- Ted L. Talmon, Research Assistant
- Ron Shaklee, Research Assistant
- Don Williams, Research Assistant

Tentative Completion Date: October 22, 1973 Starting Date: April 1, 1973

1.0 Introduction:

The Four Rivers Resource Conservation and Development Program in an eight county area in North Central Kansas has requested the Space Technology Center to investigate the feasibility of producing an up-to-date land use map of the eight county area. The Four Rivers RC&D program has the responsibility of planning and developing the natural resources of this area. A land-use map taken only from ERTS imagery is expected to provide a general overview as to the type of land-use taking place in this RC&D district.

2.0 Statement of Work:

2.1 Objectives:

In creating the land-use maps, the U.S.D.A. Soil Conservation Service in Salina, Kansas has cooperated in supplying the Space Technology Center with materials and information for the final products. Materials and information used include base maps of each county, herculene drafting material for the overlays, and soil survey maps of the eight county area.

It was agreed upon by the Four Rivers Resource Conservation and Development Executive Committee and Program Coordinator, Jim Habiger, that the Space Technology Center produce a set of overlay maps for each of the eight counties involved in the program. Map overlays will show land-use geological structure, oil and gas areas, saturated thickness of cenozoic deposits and ground water availability.

2.2 Methods:

Development of the land use overlay and relating overlays were compiled by ERTS-1 imagery and existing U.S.G.S. maps, respectively.

The land-use or resource classification to be employed on the Four Rivers project is an adaptation of the U.S.G.S. Geological Survey Circular 671, "A Land-Use Classification System for Use With Remote Sensor Data".

After thoroughly discussing what could be mapped (with confidence) using this system, the following categories were decided upon:

01. Urban and build-up (any detail within this category will be mapped separately).

02. Agricultural land

    02.01 Cropland and pasture land
    02.01.01 Cropland
    02.01.01.01 Irrigated
    02.01.01.02 Dry
    02.01.02 Pastureland
    02.01.03 Feeding Operations
    02.01.04 Other

03. Rangeland

04. Forest land

05. Water including natural drainage, irrigation canals, water bodies (reservoirs, ponds, municipal sites, etc.)

06. Wetlands

07. Barrenland

Using a Saltzman Enlargement Projector the ERTS-1 imagery was scaled to 1:250,000 and mapped. Photo analysis of the imagery gave the delineation of boundaries between the seven classifications. ERTS-1 images of different dates were used to assure the most possible accuracy. These included dates of 26 October 1972, 17 March 1973, and 6 April 1973. All four bands were used to verify boundary delineations.

After boundaries were drawn, each individual county was scaled to the base map, 1:126,720. Supplemental data, provided by the RC&D district, are transferred to overlays and scaled to the base map prior to final drafting.

Results (present status):

At the time of this report, compilation of all eight counties has been done. Revision, using the recent ERTS-1 imagery of 6 April 1973 will be done on six counties. Therefore, two counties, Ellsworth and Lincoln, are in the final drafting process. The other overlays including the land-use map are also in final drafting.

A deadline date for all overlays to the eight counties will be October 22, 1973. At this time the Space Technology Center will present the committees in each county with their maps. Following completion of these county overlays, a regional compilation of the eight counties will be constructed at a scale of 1:250,000.

APPLICATIONS PROJECT SUMMARY

Project Title: Pattonsburg Lake Land Use Assessment

Participating Agencies: Governor's Office Mo., Water Council Mo., MGS

Key Personnel:

Agency: Mr. Robert Lindholm and
Mr. Marvin Nodiff
Executive Office of Missouri 314/751-2368

Dr. George Smith, Director
Water Resources Res. Center 314/882-3421

Bill Allen
Missouri Geol. Survey 314/364-1752

CRINC: B. G. Barr
Robert L. Walters
Robert J. Eastmond

Tentative Completion Date: 31 July 1973

Starting Date: 1 June 1973

1.0 Introduction:

Pattonsburg Lake is a key project for development of the 7,900 square mile Grand River Basin. The Lake would have a 42,000 acre surface in the multipurpose pool and a full pool area of 77,000 acres. Included in the purpose for the Lake are flood control (Grand River & Missouri River basins), power generation, and recreation. The project is located in Daviess, DeKalb, Gentry and Harrison Counties, Missouri, northeast of Kansas City. An environmental statement has been prepared and is presently being evaluated by the Governor's Office and the Missouri Water Council. Upon request from the Office of the Governor, the Applications Program will provide supplemental land use and water data critical to the impending decision on the Lake.

2.0 Statement of Work

2.1 Objectives: The primary objective of this project is to supply the Governor's Office and the water council with information concerning land use, both in the lake area and the flood prone area down river to the Missouri River. The remotely sensed information will provide up-to-date data. Several specific information needs have been requested in addition to conventional remotely sensed data such as flooding extent during this spring's flood and land use acreages.

2.2 Approach: The Applications staff, working closely with the Governor's Water Council, Governor's Office, U. S. Army Corps of Engineers, Missouri Geological Survey and Missouri Department of Community Affairs, will utilize ERTS imagery supplemented by medium altitude photography to determine existing land use overlays, acreage descriptions, and flooding information.

2.3 Anticipated Results: The results of this study will provide the Governor of Missouri with data to assist him in an independent review of the proposed Pattonsburg Dam project. The information will be utilized by the Governor's Council on Water Resource Planning, specifically organized to aid in decision making concerning the Pattonsburg Lake project. The Governor has requested the recommendations of the Council by a 31 July deadline. Resting upon this decision is the pressing decision as to the type of crossing structure for I 35 which crosses the lake area.

APPLICATION OF REMOTE SENSING TO LAND USE CLASSIFICATION AND FLOODING IN THE PATTONSBURG LAKE AREA GRAND RIVER BASIN, MISSOURI

Robert J. Eastmond

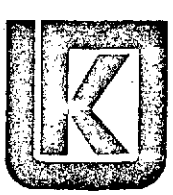
in cooperation with the

Executive Office, State of Missouri
Missouri Clean Water Commission
Governor's Council on Water Resource Planning

Technical Report 2230-19

August 1973

(Patrially supported by NASA Grant NGL 17-004-024)



THE UNIVERSITY OF KANSAS CENTER FOR RESEARCH, INC.
2385 Irving Hill Rd.—West Campus Lawrence, Kansas 66044

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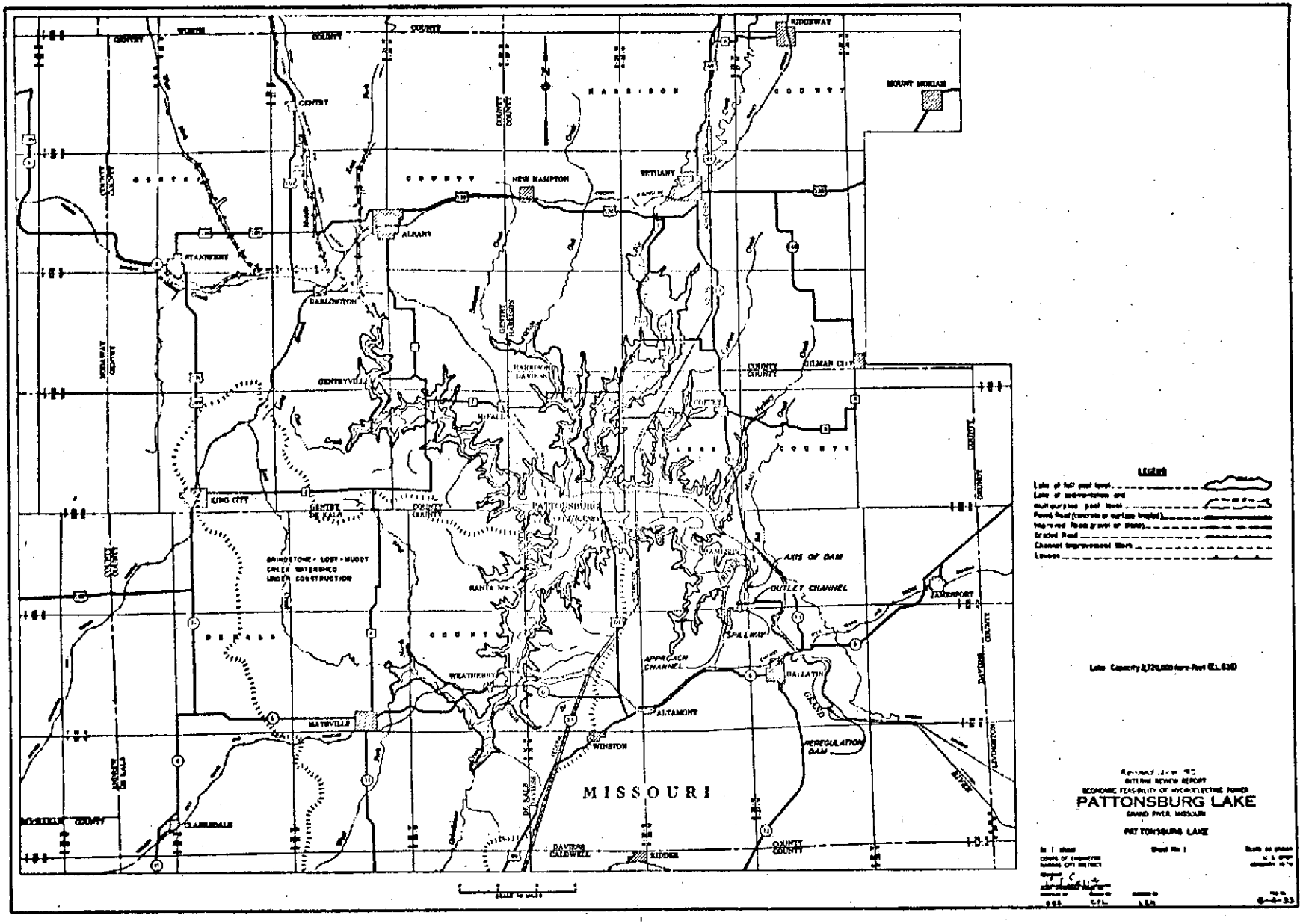
INTRODUCTION

The proposed Pattonsburg Lake is part of the Grand River Basin comprehensive flood control and water resource development plan. This plan outlines a system of multiple use lakes and stream improvement projects in the 7,900 square mile Grand River Basin of Missouri and Iowa. The proposed lake is located in Daviess, DeKalb, Gentry and Harrison Counties of Missouri, northeast of Kansas City. The dam would be located on the Grand River about five miles north of Gallatin, Missouri (Figure 1). The purpose of the lake includes flood control, recreation, and power generation. The lake would have a 42,000 acre surface in the conservation pool and an area of 77,000 acres at full flood pool.

OBJECTIVES

The primary objective of this study is to provide specific information to the Governor of Missouri and to the Governor's Council on Water Resource Planning (Appendix A). This information will supplement the findings reported in the Environmental Impact Statement prepared by the U. S. Army Corps of Engineers. The results of the study will assist the Water Council and the Governor in the decision-making process concerning Pattonsburg Lake.

There are two areas of particular interest, the area to be inundated by the lake, and the area from below the dam to the confluence of the Grand and Missouri Rivers near Brunswick, Missouri. In the area to be inundated by the lake, a determination was made of the existing land use. This determination was made separately for the area within the conservation pool boundary and for the area within the "lease back" flood pool boundary, i.e., that area from the conservation pool to full flood pool. For the area below the dam, the land use along the Grand River from the dam site to the Missouri River was determined within the spring, 1973 flood boundaries.


RIDGEWAY
MOUNT MORIAH
HARRISON COUNTY
NEW HAMPTON
BETHANY
ALBANY
STANBERRY
GILMAN CITY
DAVIESS COUNTY
KING CITY
GENTRY COUNTY
DE KALB COUNTY
BRIMSTONE - LOST - MUDDY CREEK WATERSHED UNDER CONSTRUCTION
PATTONSBURG
AXIS OF DAM
OUTLET CHANNEL
SPILLWAY
APPROACH CHANNEL
POWERPORT
DAVIESS COUNTY
WEATHERBY
ALTAMONT
WINSTON
DALLATIN
GRUNDY COUNTY
REREGULATION DAM
MATHVILLE
CLAIRVALE
MISSOURI
RAYMORE
CALDWELL COUNTY
RICHMOND
LEGEND
Lake at full pool level
Lake at intermediate and multipurpose pool level
Paved Road (concrete or surface treated)
Improved Road, gravel or stone
Graded Road
Channel Improvement Work
Levee
Lake Capacity 2,720,000 Acre-Feet EL. 830
INTERIM REVIEW REPORT
ECONOMIC FEASIBILITY OF HYDROELECTRIC POWER
PATTONSBURG LAKE
GRAND RIVER, MISSOURI
PATTONSBURG LAKE
Sheet No. 1
CORPS OF ENGINEERS
KANSAS CITY DISTRICT
6-8-33

DATA SOURCE

Aerial photography was obtained covering the lake area and the Grand River flood plain from the dam site to the Missouri River on three separate dates. Color infrared (Kodak 2424) and black and white infrared (Kodak 2443) vertical imagery was obtained on all three dates. An 89B filter was used in combination with the color infrared film and a Wratten 15 filter was used with the black and white film.

On 25 May 1973, photography was obtained from 10,000 feet MSL, utilizing a Hasselblad two-camera cluster flown in the Center's C45J twin engine aircraft. The scale of the photography was approximately 1:75,000 covering the flood plain below the dam site. On 11 June 1973, photography was obtained for the eastern half of the proposed lake area from Pattonsburg to Gallatin. This imagery was obtained from 14,000 feet MSL at a scale of approximately 1:102,000. This same scale was used to obtain photographic coverage of the remaining western half of the lake area on the 20th of June. Also on 20 June 1973 additional photography was obtained for the downriver flood plain at 1:102,000 scale.

Imagery from the Earth Resources Technology Satellite (ERTS-1) was used in conjunction with the aerial photography to determine the flood limits of the spring, 1973 flooding along the Grand River. The 9 May 1973, MSS - 7 imagery was used for this purpose (Figure 2).

METHODS

The accomplishment of the objectives related to land use required photo reading and analysis of the aerial photographs obtained. This process involves recognition of an object or an area on the photograph. The recognition is usually defined in terms of tone, shape, and pattern. Cross referencing this information with supplemental data such as maps or ground observations helps confirm the interpretation. For purposes of this study four general recognition categories were defined: urban land, agricultural land, pasture land, and forest land.

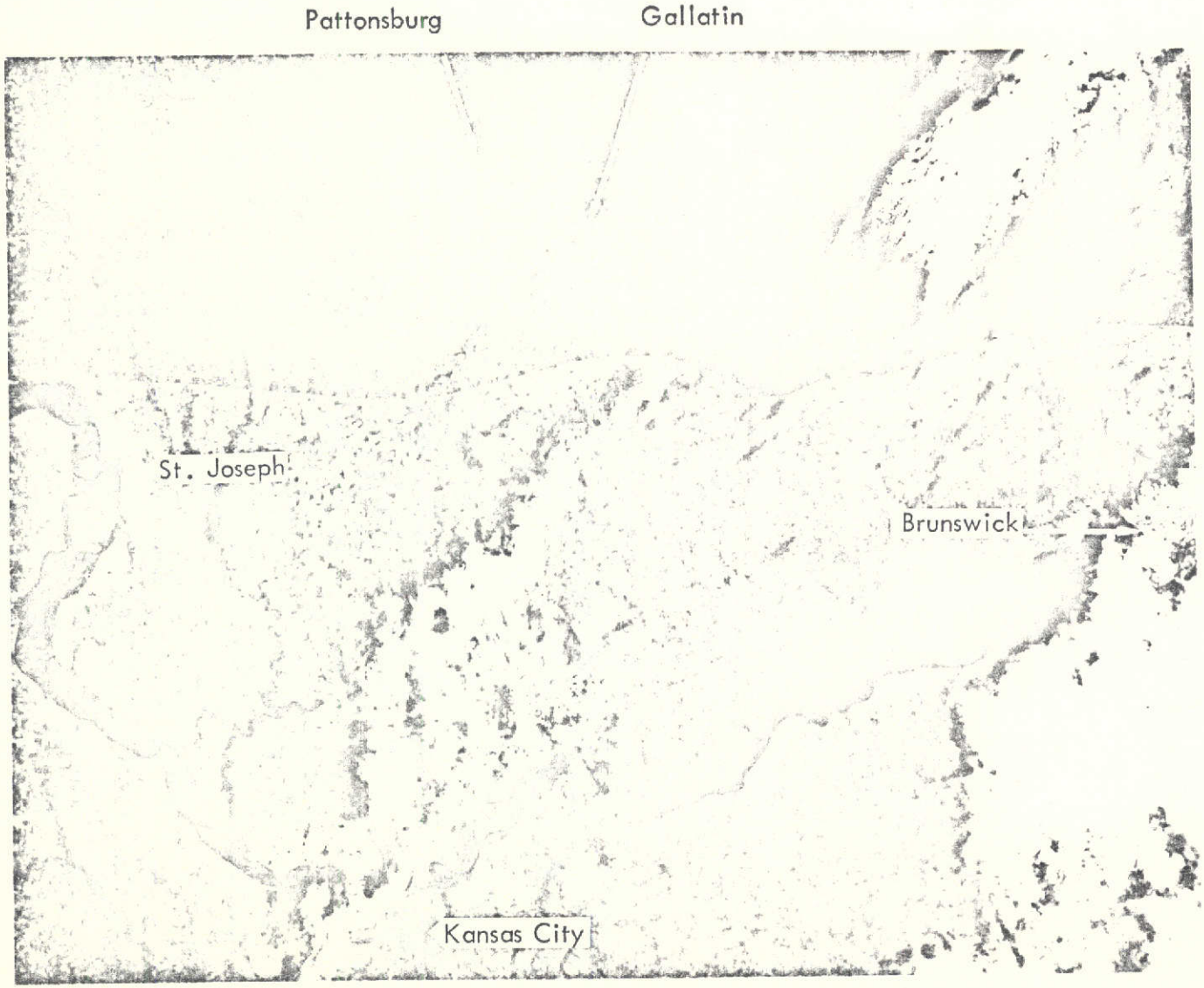


Figure 2. 9 May 1973, MSS-7 ERTS-1 imagery showing the Pattonsburg Lake area northeast of Kansas City, Missouri. Scale 1:1,000,000

Urban land includes towns or mixed residential and commercial settlements. Agricultural crop land is defined as that land used primarily for production of crops, and was identified by dark tones of bare, plowed ground or by cultivation patterns. Pasture land is primarily grassland used for grazing and was identified by its lighter tones. Often times pasture lands have scattered trees or well defined paths further characterizing the identification pattern. Forest land is distinguished by the presence of numerous trees or closed tree canopy.

Once the boundaries of land use categories were delimited on 1:62,500 scale enlargements, the boundaries were transferred to a scale overlay showing the lake boundaries. The conservation pool boundary was the 810 foot contour and the flood pool boundary the 840 foot contour. Following this transfer, the acreages for each classification were determined by using a Hewlett Packard 9107A Digitizer and 9100B Calculator.

The downstream area was analyzed by transferring the wet soils boundary, as complete as possible, from the 9 May 1973 ERTS-1 imagery to an aerial photo mosaic reproduced at 1:62,500 scale. The area within these boundaries was then analyzed and classified according to the recognition categories described earlier. The approximate acreages were determined as before.

RESULTS

The total surface area of the lake at full flood pool as measured from the overlay is 80,061 acres. Of that total, 37,153 is within the conservation pool and 42,908 acres is in the "lease back" flood pool between the 810 and 840 foot contours. These figures differ slightly from those given in the Environmental Impact Statement. This difference is due primarily to the fact that the MSL contour of the conservation pool used in the impact report is 811 feet and the full pool 836 feet while in this study the 810 and 840 foot contours respectively were used.

Within the conservation pool area 23,387 acres or 62.9% of the area is presently crop land, 5.6% or 2,072 acres is pasture, 11,500 acres or 31.5%is forest, and 194 acres is urban land. The "lease back" flood pool land is also primarily agricultural crop land. This category covers 24,480 of the 42,908 acres or 57.0% of the area. Pasture land covers 4,571 acres, or 10.7%, forest lands cover 13,844 acres or 32.3%, and urban land use accounts for only 13 acres in this area. These figures are summarized in Table 1 and the areas are shown in Figure 3.

Table 1

Category	Conservation Pool Area in acres	Percent of total
Cropland	23,387	62.9
Pasture	2,072	5.6
Forest	11,500	31.0
Urban	194	0.5
Total	37,153	
"Lease Back" Flood Pool		
Cropland	24,480	57.0
Pasture	4,571	10.7
Forest	13,844	32.3
Urban	13	--
Total	42,908	
Totals in Full Flood Pool		
Cropland	47,867	59.8
Pasture	6,643	8.3
Forest	25,344	31.7
Urban	207	0.2
Total	80,061	

According to the USDA Survey in 1967 the Grand River Basin as a whole was characterized as 62.8% cropland, 19.2% remanent pasture,

(Figure 3 was not available at the time of initial distribution)

14.9% forestland, and 3.1% other. The variations of these values with those of the Pattonsburg Lake area reported above can be resolved on the basis of the location of the lake area. The lake area is located in lowlands of the Grand River and its tributaries. This leads to the higher proportion of forest as opposed to pasture, considering the river bottom habitat and associated woodlands along the Grand River and the lower wooded scarps associated with the tributaries.

Downstream in the area between the Pattonsburg Dam site and the confluence of the Grand and Missouri Rivers there are about 113,000 acres of cropland, 3,000 acres of pasture, 16,000 acres of forest and 2,000 acres of urban land and wildlife reserve lakes. The total area within the boundaries of this year's flooding is about 134,000 acres. This figure comes very close to the 133,180 acres described in the environmental statement as being subject to flooding.

The alternative using the wet soil boundary transfer method involving satellite imagery and aerial photography was selected because the boundaries of the 100 year project design flood and the flood levels for the 1947 base flood had not yet been obtained. The wet soil boundaries depicted of the 9 May 1973 ERTS-1 imagery were highly correlated with the same boundaries interpreted from the black and white infrared aerial photography. This technique has been shown to be an effective use of satellite imagery.[1]

SUMMARY

This project has described the present land use of the area to be inundated by the proposed Pattonsburg Lake. It also provides information on the land use and acreages which would theoretically be protected by the proposed flood control dam. The project has involved the application of both aerial photography and satellite imagery to specific objectives in environmental impact analysis and land use decision making.

---

[1] Hallberg, G. R., B. E. Hoyer, and A. Rango. "Application of ERTS-1 Imagery to Flood Inundation Mapping." In: Symposium on Significant Results Obtained from ERTS-1, Vol. 1, Goddard Space Flight Center, New Carrollton, Maryland, March, 1973, p. 745-753.

APPENDIX A

EXECUTIVE OFFICE
STATE OF MISSOURI
JEFFERSON CITY

CHRISTOPHER S. BOND
GOVERNOR

May 10, 1973

Dr. William Barr, Director
The University of Kansas Center
for Research, Inc.
2291 Irving Hill Road - Campus West
Lawrence, Kansas 66044

Dear Bill:

On behalf of all of us who were able to meet with you, Bob Walters and Bob Eastmond, may I offer our sincere thanks. I am very hopeful that better utilization by our state agencies, and increased inter-agency cooperation will result from the meeting.

We would like to ask you whether you could supply us with some information on the Grand River in Missouri. Enclosed please find two maps to help determine the area to be studied.

The data we need will be concerned with the proposed Pattonsburg Dam project, to determine existing land use patterns both in the areas which would be inundated and the new areas below the dam which would become more useful. If we are supplied with ERTS or high-altitude or middle-altitude imagery, we would, of course, need your help in interpreting the data to determine land use in the areas. We would also be able to utilize your data on the lands covered by the recent flooding to determine those areas to be protected by the project.

The information would be for Governor Bond to assist him in his independent review of the proposed Pattonsburg Dam project. The information would be utilized by the Governor's Council on Water Resource Planning which he has established to assist in this decision-making process.

Since the Council must have all of its information together in order to provide the Governor with its recommendation by July 31, it hopes to have accumulated all of its research material by the end of June. In this case, however, we could utilize information provided by you closer to the July 31 deadline.

We would appreciate knowing whether you would be able to work with us on this tight time schedule. Once again, thank you for your kind assistance. We look forward to a close and beneficial working relationship with you.

Sincerely yours,

Marvin J. Nodiff
Program Assistant

MJN:cw

Enclosures

University of Missouri
COLUMBIA · KANSAS CITY · ROLLA · ST. LOUIS

424 Clark Hall
Columbia, Mo. 65201

WATER RESOURCES RESEARCH CENTER
Office of the Director

Telephone
314-882-3421

May 24, 1973

Dr. Robert Eastmond
Space Science Center
2291 Irving Hill Drive
University of Kansas - West Campus
Lawrence, Kansas 66044

Dear Dr. Eastmond:

Under separate cover we are sending you a copy of the Draft Environmental Impact Statement for the Pattonsburg Lake (Missouri). This material contains maps and historical material that will furnish you background material. Enclosed is an analysis of the power facilities that is a later authorization.

As we discussed on the phone I believe that information you could secure on land use and moisture conditions now would be useful to our group. There are two district areas of interest (a) above the dam where land will be used for water storage, flood water retention and access area, and (b) the flood plain of the Grand to its joining the Missouri. This last area will receive benefits from reduced flooding.

Any land use information your method could provide should be useful. Probably an indication of water content of surface soil would be most valuable. A mapping of land that is or has been under water this season, a designation of cultivated crops, grass and forest acreage and location would be helpful. At this time a measure of the amount of land that has been cultivated this spring would be meaningfull. I doubt that any recently planted crops will show much surface soil differences between species. Can you distinguish between soil types that might show differences in color or heat accumulation due to moisture?

We appreciate your interest and assistance. Let me know if we can provide any information. We will be happy to arrange a meeting with our group if it will be useful.

Sincerely,

George E. Smith, Director

jg

cc: Marvin Nodiff
Bob Lindholm