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THE APPLICATION OF REMOTE SENSING TO RESOURCE MANAGEMENT AND ENVIRONMENTAL QUALITY PROGRAMS IN KANSAS

by

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Director
Space Technology Center
The University of Kansas

and

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July 1980

An Annual Report of Work
Performed Under NASA Grant
No. NGL 17-004-024

(April 1, 1979 - March 31, 1980)

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EROS Data Center
Sioux Falls, SD 57198

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KARS program staff members who have contributed to specific projects include the following:

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E. A. Martinko, Co-Investigator
Kansas Applied Remote Sensing Program

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ABSTRACT

Activities of the Kansas Applied Remote Sensing Program (KARS) are designed to establish interactions on cooperative projects with decision makers in Kansas agencies in the development and application of remote sensing procedures. This report describes the activities of the KARS program in pursuit of its objectives during the period April 1, 1979 through March 31, 1980.

Cooperative demonstration projects were undertaken with several different agencies during this period and involved three principal areas of effort: Agricultural and Rural Development; Wildlife Habitat and Environmental Quality; Urban and Regional Planning. These projects were designed to focus remote sensing concepts and methodologies on existing agency problems to ensure the continued relevancy of the program.

Completed projects during the period include (1) the analysis of tall grass prairie land-use, (2) the analysis of land-use, land-cover and prime agricultural land in Saline County, Kansas, (3) the analysis of land-use and land-cover along portions of the Arkansas River to aid in the development of a surface and ground water model for the river, and (4) the analysis of Pony and Roy's Creek watersheds' land-use and erosion in northeast Kansas and southeast Nebraska. One additional project, a wildlife habitat inventory of Pine Ford Lake in Missouri, was also completed under contract with the U.S. Fish and Wildlife Service, Kansas City Office.

Long-term projects were continued in the past year and include weed pest surveys in cooperation with the Kansas Department of Agriculture and the U.S. Environmental Protection Agency, irrigation data compilation from LANDSAT in cooperation with the Kansas Legislative Research Department and the U.S. Geological Survey, a state demonstration project for 208 planning in conjunction with a coalition of state and federal agencies and the development of an inventory of abandoned mined lands and potential hazard assessment in Kansas.

Other projects were initiated during this period which are now nearing completion or awaiting final action.

I. THE KANSAS APPLIED REMOTE SENSING PROGRAM

INTRODUCTION

The unique contemporary problems facing officials at all levels of government have created a need for objective data gathering to supplement or in some cases replace traditional methodologies. The need for objective data gathering has been further emphasized by the increasing pressures from social, environmental and economic considerations.

The University of Kansas Applied Remote Sensing Program (KARS) has established a continuing program of activities to demonstrate the utility of remote sensing technology in data gathering for decision makers in state, regional and local agencies. Now in its eighth year, the KARS Program is developing the concepts and methodologies to utilize remote sensing procedures in dealing with significant problems in Kansas related to changing urbanization patterns, rapid irrigation growth, changing agricultural needs and environmental quality. This activity is accomplished primarily through cooperative remote sensing projects with governmental agencies in Kansas on problems of immediate concern.

This report outlines the activities and accomplishments of the KARS Program during the period April 1, 1979, through March 31, 1980 in pursuit of its key objectives:

To apply remote sensing techniques, analysis and systems to the solution of significant decision oriented concerns of state and local officials.

To participate cooperatively on remote sensing projects with state and local agencies in Kansas.

To effect the transfer of applicable remote sensing technology to governmental agencies at all levels as a by-product of the demonstration projects conducted in the KARS Program.

To assist the personnel within Kansas agencies in the evaluation of the capabilities of the rapidly changing remote sensing systems and the benefits which might be achieved through their utilization.

To stimulate through multidisciplinary teams, the application of the products of remote sensing systems to the significant problems of resource management and environmental quality in Kansas.

To guide, assist and stimulate faculty, staff and students in the utilization of information from LANDSAT and Aircraft Programs of NASA

in research, education and public service activities carried out at the University of Kansas and in the State.

CONTACTS WITH AGENCIES

While projects usually develop through individual contacts between agency and KARS personnel, communications also result from more general information dissemination efforts aimed at promoting widespread interest in remote sensing applications. During the past year these activities have included (1) publication of the KARS Newsletter, and (2) numerous talks and presentations to public and professional organizations throughout Kansas.

The quarterly KARS Newsletter now reaches over 1,200 readers with news of current KARS projects and activities (Appendix I). Several new projects have developed from this medium.

On January 16, 1980, representatives of the KARS Program were invited to present to state legislators an overview of remote sensing, the LANDSAT program and remote sensing applications projects which have been carried out by the KARS Program with Kansas agencies. Professor B. G. Barr and Dr. Edward A. Martinko spoke before a joint session of the House and Senate Committees on Agriculture and Livestock at the invitation of Representative John H. Vogel, Chairperson of the House Committee. Also in attendance were members of the House and Senate Committee on Energy and Natural Resources, and representatives of other legislative committees. Approximately 75 legislators, aids and state agency representatives attended the presentation at the State Capitol in Topeka.

During the one hour presentation Professor Barr discussed the structure of the KARS Program and general principles of remote sensing and technology transfer. Dr. Martinko followed with a summary presentation of KARS applications projects in the areas of water resources, land use, agriculture and rangeland management. A short question and answer period followed the presentation.

Other presentations to public and professional organizations throughout Kansas have included, among others, the Kansas Ground Water Management District Association, National Association of Counties, Kansas Academy of Science Annual Meeting and Association of American Geographers Annual Meeting.

There continues to be substantial demand for the Kansas LANDSAT Mosaic, Kansas Land Use Patterns Map published in 1974, the Guide to Aerial Photography and Space Imagery and Center Pivot Irrigation Maps for Southwest Kansas. These have greatly increased the visibility of the KARS Program across Kansas.

COORDINATION WITH AGENCY OFFICIALS

Experience gained in the KARS Program has demonstrated that it is not sufficient to hold conferences, publish newsletters, or make occasional calls on agency personnel. A continuing association with key administrators and their staffs is carried on to develop their interest, promote KARS projects, and finally obtain agency commitment of time and resources for the projects.

During the last year we have increased personal visits to Kansas agencies. The visits are facilitating better communications between KARS and agency personnel. Agencies with which contacts have been established are listed in Table 1. Contacts are maintained with all of these agencies and additional contacts are actively pursued.

NATURE OF PROJECTS

Table 2 indicates the range of projects completed during FY 79-80. Note in Figure 1 that projects have been distributed widely over Kansas and are particularly relevant to the terrain, land use and specific problems of these areas.

PERSONNEL

The KARS Program is administered by B. G. Barr, Professor of Engineering and Director of the University of Kansas Space Technology Center. Barr, a specialist in engineering management, has been active in transmitting new technologies to industry and state agencies for over ten years.

Dr. Edward A. Martinko, Assistant Professor of Environmental Studies and Assistant Scientist in the Space Technology Center, is the Project Coordinator for the KARS Program and has primary responsibility for agency contacts and scheduling the accomplishment of demonstration projects by the joint agency-KARS teams. Dr. Martinko has had several years of experience in multidisciplinary research projects. He was a research assistant in the State Biological Survey of Kansas for two years and has an excellent working relationship with the agricultural community.

Dr. T. H. Lee Williams, Assistant Professor in the Department of Geography, has also been active on the KARS staff. He brings expertise with remote sensing platforms and theory to the team with a specialization in agricultural land use studies.

James Merchant, Joseph Poracsky, Christopher Gunn, Gray Tappan, Emily Roth and Elizabeth Kipp carry significant responsibilities in the KARS Program and provide considerable expertise in the areas of image interpretation, cartography and data analysis.

Table 1

AGENCIES WITH WHICH CONTACTS ARE MAINTAINED
BY THE KANSAS APPLIED REMOTE SENSING PROGRAM

Municipal:

- Concordia, Kansas Camber of Commerce
- Kansas City, Kansas City Commission
- Kansas City, Kansas Department of Planning and Development
- Kansas City, Kansas Mayor's Office
- Lawrence, Kansas City Engineer
- Lawrence, Kansas City Commission
- Lawrence, Kansas Planning Department
- Ottawa, Kansas Planning Department
- Salina, Kansas Planning Department

County:

- Atchison County, Kansas Commissioners
- Cherokee, Kansas Board of Commissioners
- Cloud, Kansas Commissioners
- Douglas, Kansas County Extension Agent
- Douglas, Kansas Planning Department
- Franklin County, Kansas Planning Commissioners
- Jackson County, Kansas District Conservationist
- Johnson County Planning Department
- Nemaha County, District Conservationist
- Riley, County Engineer
- Saline County Planning Department
- Sumner County Commissioners

State:

- Kansas Agricultural Extension Service
- Kansas Attorney General's Office
- Kansas Corporation Commission
- Kansas State Board of Agriculture
- Kansas Department of Economic Development
- Kansas Department of Health and Environment
- Kansas Department of Revenue
- Kansas Department of Transportation
- Kansas Department of Energy
- Kansas State Conservation Commission
- Kansas Adjutant General Division of Emergency Preparedness
- Kansas State Biological Survey
- Kansas Bureau of Air Quality and Occupational Health
- Kansas Fish and Game Commission
- Kansas Geological Survey
- Kansas Governor's Office
- Kansas State Historical Society
- Kansas Legislative Research Department
- Kansas Mined Land Conservation & Reclamation Board
- Kansas Parks and Resources Authority
- Kansas Water Resources Board
- Missouri Water Resources Board
- Missouri Department of Natural Resources
- Missouri Governor's Office

Regional:

- Big Lakes Regional Planning Commission (Pottawatomie, Riley, Geary)
- Chikaskia-Indian Hills Regional Planning Commission (Sumner, Harper, Kingman)
- Flint Hills Resource Conservation and Development Project
- Four Rivers Resource Conservation and Development District (Jewell, Republic, Mitchell, Cloud, Ottawa, Lincoln, Ellsworth and Saline Counties, Kansas)
- Northwest Kansas Planning and Development Commission (Cheyenne, Sherman, Wallace, Rawlins, Thomas, Logan, Decatur Sheridan, Gove, Norton, Graham, Trego, Phillips, Rooks, Ellis, Smith, Osborne, and Russell Counties, Kansas)
- Ozark Regional Commission
- Soldier Creek Watershed Board of Directors
- Sunflower Resource Conservation and Development District (Sumner, Harper, Kingman, Barber, Comanche, and Kiowa Counties, Kansas)

Regional (cont'd.):

- Greater Southwest Regional Planning Commission
- Groundwater Management Districts
- Mid-America Regional Council
- Tauy Creek Watershed Planning District Board of Directors
- Missouri River Basin Commission

Federal:

- U.S. Army Corps of Engineers, Kansas City and Albuquerque Offices
- U.S. Department of Agriculture, Soil Conservation Service (SCS)
- U.S. Department of Agriculture, Agricultural Stabilization and Conservation Service (ASCS)
- U.S. Geological Survey Water Resources Division - Lawrence/Garden City, Kansas
- U.S. Environmental Protection Agency, Kansas City and Washington, D. C. Offices
- U.S. Fish and Wildlife Service
- U.S. Bureau of Indian Affairs
- National Aeronautics and Space Administration
- U.S. Department of Interior, Office of Surface Mining, Kansas City Regional Office

Table 2

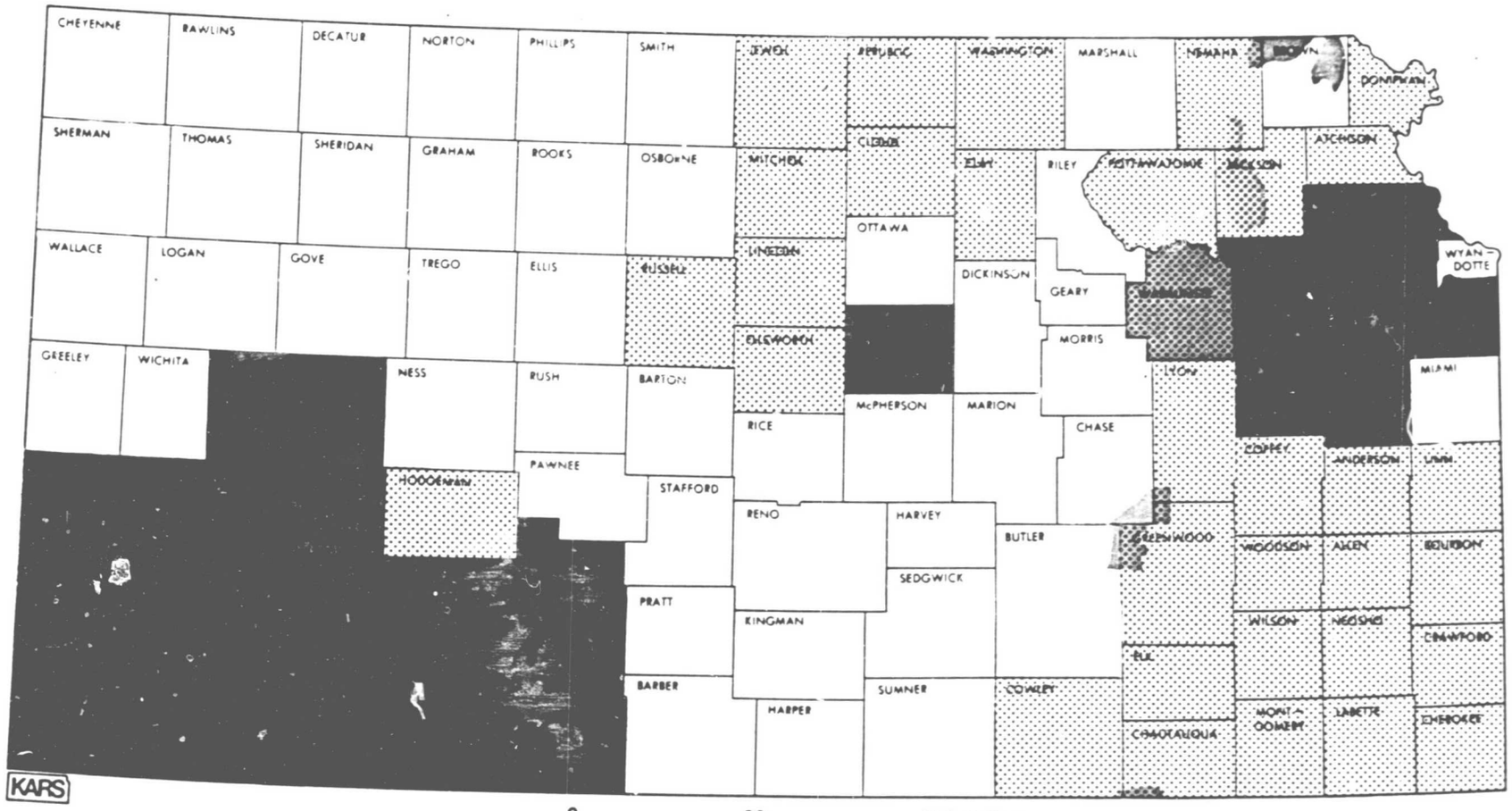
KARS PROGRAM

PROJECTS COMPLETED OR INITIATED

MARCH 1979 - APRIL 1980

PROJECT:	Soldier Creek Watershed 208 Planning
COUNTIES INVOLVED:	Jackson, Nemaha
COOPERATING AGENCIES:	Soil Conservation Service, Soldier Creek Watershed Steering Committee, Kansas Department of Health and Environment
PROJECT:	Mapping of Land Use/Land Cover & Prime Agricultural Land in Saline County, KS
COUNTY INVOLVED:	Saline
COOPERATING AGENCY:	Department of Planning & Zoning
PROJECT:	Musk Thistle
COUNTIES INVOLVED:	Douglas, Franklin, Jefferson, Johnson, Leavenworth, Osage, Shawnee
COOPERATING AGENCIES:	Environmental Protection Agency, Kansas Department of Agriculture
PROJECT:	Arkansas River Irrigation Moratorium
COUNTIES INVOLVED:	Hamilton, Kearny
COOPERATING AGENCIES:	U.S. Geological Survey - Water Resources Division, Division of Water Resources - Kansas State Board of Agriculture
PROJECT:	Land Use, Land Cover, Land Use Change, Flood Plain Scour, Gully and Stream Channel Inventory of Pony Creek and Roy's Creek Watersheds, Kansas and Nebraska
COUNTIES INVOLVED:	Brown, Nemaha (Kansas); Richardson (Nebraska)
COOPERATING AGENCY:	U.S. Department of Agriculture Soil Conservation Service
PROJECT:	Mapping the Diminishing Sandsage Prairie, Kansas
COUNTIES INVOLVED:	Clark, Comanche, Edwards, Finney, Ford, Grant, Gray, Hamilton, Haskell, Kearny, Kiowa, Lane, Meade, Morton, Scott, Seward, Stanton, Stevens
COOPERATING AGENCY:	Kansas Fish and Game Commission
PROJECT:	Tall Grass Prairie National Park
COUNTIES INVOLVED:	Butler, Wabaunsee
COOPERATING AGENCY:	Save The Tall Grass Prairie, Inc.
PROJECT:	Abandoned Mined Lands Inventory and Hazard Assessment in Kansas
COUNTIES INVOLVED:	Allen, Anderson, Atchison, Bourbon, Chautaugua, Cherokee, Clay, Cloud, Coffey, Cowley, Crawford, Doniphan, Douglas, Elk, Ellsworth, Franklin, Greenwood, Hodgeman, Jackson, Jefferson, Jewell, Labette, Leavenworth, Lincoln, Linn, Lyon, Mitchell, Montgomery,

	Nemaha, Neosho, Osage, Pottawatomie, Republic, Russell, Shawnee, Wabaunsee, Washington, Wilson, Woodson.
COOPERATING AGENCY:	U.S. Department of the Interior - Office of Surface Mining
PROJECT:	Wildlife Habitat Inventory For The Proposed Pine Ford Lake, Missouri
COUNTIES INVOLVED:	Franklin, Jefferson, St. Francois, Washington
COOPERATING AGENCY:	U.S. Fish and Wildlife Service - Kansas City, Missouri



Musk Thistle

Arkansas River Irrigation Moratorium

Pony and Roy's Creek Watersheds

Soldier Creek Watershed

Sandsage Prairie

Tall Grass Prairie

Saline County Land-Use

Abandoned Mined Lands

April, 1979 - March, 1980

Figure 1

Projects requiring major scientific effort are staffed primarily by graduate students from the various academic disciplines assisted by faculty advisors when appropriate. Personnel from the various state and local agencies are involved in their own applications projects at no cost to the NASA grant. We continue to work with the various extension agencies in the state to gain their assistance in translating remote sensing technology to a broader audience.

FACILITIES

The KARS laboratories located on the second floor of the K.U. Space Technology Center serve as the headquarters of the Kansas Applied Remote Sensing Program. Light tables, a Bausch and Lomb Zoom Transfer Scope and other equipment needed by the KARS team have been provided by the Space Technology Center for the demonstration projects. In-house graphic arts and photographic services facilities offer complete cartographic and film processing services. Computation services are available both in-house and through a remote terminal to the University Computation Center.

One of the KARS Program's two laboratories is used for the interpretation of remotely sensed images. An Itek Color Additive Viewer/Printer (ACVP) has the ability to enlarge, superimpose and register up to four separate black and white transparencies for viewing, printing, or color enhancement. Both LANDSAT imagery and aerial photography in 70 mm formats can be accommodated. In addition to the ACVP, the KARS Program has a Variscan Rear Screen Variable Magnification Viewer. This instrument is capable of rear projection of film transparencies of any size from 35 mm to 9½ inches in format at several enlargements up to approximately 48 times the original scale. Together these instruments complement the optical equipment in the KARS Program image interpretation laboratory and expedite more involved interpretations and image analysis.

The second of the KARS Program laboratories is used for map production. Procedures have been established for efficiently producing quality products for agency use. These procedures include mapping on stable base materials in negative mode and using color preseparation overlays to display data. This allows the user to separate the interpretation categories into individual displays, provides for inexpensive multiple copy reproduction, and increases the possibility that the material can be used by more than one agency.

A current file of LANDSAT, Skylab and aerial imagery is maintained by the KARS Program for the use of project personnel and user agencies. The LANDSAT file contains the best quality imagery for specific time periods during the year. The imagery is catalogued in an accessible file providing complete coverage of Kansas.

An extensive map collection is maintained by the KARS Program. This collection contains a variety of maps including general regional maps, topographic maps, image mosaics and specific thematic maps.

The KARS Program also maintains a substantial reference library for both in-house and agency use. This material includes reports, articles, periodicals, manuals, textbooks, etc., pertinent to applications of remote sensing.

II. PROGRAM OF WORK APRIL 1, 1979 - MARCH 31, 1980

Agricultural and Rural Development

Mapping and Monitoring of Musk Thistle

For the past four years the KARS Program has been involved in a multi-disciplinary analysis of musk thistle (Carduus nutans), a noxious weed that has become a serious threat to cattle and crop production in the United States. Since its introduction to the United States from Europe 125 years ago, musk thistle has spread throughout the United States. Recent studies indicate that infestations of significant economic consequences have occurred in thirty of the forty-eight mainland states.

In those states that have placed musk thistle on the noxious weed list, landowners are required to treat musk thistle infestations on their property. Failure to comply can result in substantial fines and in assessments against the landowner for work performed by county weed control agents.

Extensive control efforts have been undertaken in areas identified as having musk thistle infestations with state and federal aid available for the purchase and application of control herbicides. The principle herbicide used for musk control is 2,4-Dichlorophenoxyacetic acid (2,4-D). In spite of the heavy 2,4-D usage, to date, musk thistle spread and economic impact is at an all time high.

A cooperative effort among the disciplines of botany, entomology and remote sensing was designed several years ago to assess the biological and migratory aspects of musk thistle, the effectiveness of current control measures and to propose alternative methods of control as derived from the data that are being analyzed in the current research effort.

The KARS portion of the study has three major objectives: 1) to accurately estimate the number of acres infested and the average number of flowering plants per acre by county and by cover-type (e.g., crop, pasture, forest, etc.); 2) to monitor changes in the density of musk thistle infestations and concurrently the effectiveness of the weed control programs; and 3) to project the spread of musk thistle populations into high probability areas by locating the distribution of preferred habitats.

Progress to date has been made with studies which relate to objectives 1) and 2), primarily in connection with aspects of multistage sampling survey scheme, which uses satellite imagery, aerial photography and ground work to derive musk thistle population estimates. Since the procedure is based on recognition of the flowering plant on aerial photography, the remote sensing data collection is concentrated in the short flowering period of early to mid-June in northeastern Kansas. This is the best time for film acquisition because

most of the vegetation in pastures and successional areas is short, while thistle plants that are going to flower have reached a height of four feet or more. Further, the color of the yellow flower heads is distinctive. This summary covers results arising from the data acquired during the summer of 1979, and does not cover work to be completed during the 1980 flowering period.

Sample Design:

The final sampling procedure for estimating musk thistle populations will be based on a multistage sampling scheme, where sample selection is based on prior knowledge of preferred musk thistle habitat types, i.e., pasture and disturbed areas. The sampling procedure involves the following:

1) A map of the area to be studied will be derived from LANDSAT imagery, providing land cover/habitat types. Work is currently being carried out to identify the smallest size pasture that can be discerned on LANDSAT imagery.
2) The study area will be stratified systematically into equal-area units, each of which will be given a habitat preference value, based on a numerical preference value of thistle for each cover type and the proportion of the unit occupied by that cover type. Numerical preference values of finding musk thistle in particular habitat types will be derived from 1979 transect data and confirmed with 1980 transect data.
3) Sample units for the study area will be selected (termed SUA's) according to a PPES (Probability Proportional to Expected Size) scheme, where the probability of selecting any given SUA is proportional to the thistle/habitat preference value for the SUA.
4) Low-altitude aerial photography will be flown over each SUA to derive an estimate of musk thistle presence and density per SUA.
5) Finally, a calibration curve of preference value vs. thistle density will be produced from the estimates from the SUA's and used to derive population estimates for the remaining stratified units in the study area, and for the study area as a whole.

Film Acquisition:

Habitat preference values for musk thistle derived from aerial photography data were not available in 1979, so the sampling scheme involved a series of seven transects flown over Douglas County from south to north bearing N 10.5°E with a regular photographic interval. This particular angle was chosen because it is parallel to LANDSAT flight lines. Further, it was chosen after a computer

simulation model determined that there were no sampling biases in relation to section lines as long as the timing interval of the photographs did not correspond to the one-mile periodic nature of the landscape, and the transect angle was greater than two degrees N-S, E-W, NW-SE or NE-SW.

Based on previous work, the decision was made to fly the 1979 transects of Douglas County with color infrared film at two scales, 1:3,800 and 1:800, using 40 mm and 200 mm lenses respectively on Hasselblad cameras, at 500 ft above ground level. The small scale frames (1:3,800) gave a large area coverage and were used almost exclusively to identify thistle infestations along the transects. The frames taken at 1:800 covered a smaller subsample of the tandem small scale frame, and were frequently useful for identifying the vegetation type, and occasionally for confirming the presence of thistle.

Approximately 70 photographs were taken on each of the seven transects at a 10-second interval. Since the plane was flying at 176 ft/sec, a photograph was taken every 598 yards, or approx. 1/3 mile. For the 1979 survey a total of 506 pairs of frames were available for analysis, with each pair consisting of one frame at a scale of 1:3,800 and a second frame at a scale of 1:800 for greater detail.

Interpretation Methods:

Kodak Aerochrome Infrared 2443 provides good to excellent imagery for distinguishing musk thistle from surrounding vegetation. The five basic interpretation keys that were developed for locating the presence of thistle on the color infrared aerial film were:

1) Site association: most musk thistle plants are found in overgrazed areas of pasture; some are found along the boundary of crop fields, along roadside edges, in barnyards, or in construction sites or areas of other disturbance.
2) Color tone: the leaves of the musk thistle plant are a light pink, and the flowers in mid-June are a distinctive yellow.
3) Texture: musk thistle leaves are very dissected, so the rosette has a characteristic roughness.
4) Shape: musk thistle plants are either in a large rosette stage in mid-June or a tall flowering stalk with numerous flower heads.
5) Shadow: musk thistle plants are one of the few plants with flower stalks up to four feet tall in June, so they cast a shadow against the surrounding vegetation.

Ground Truth Procedure:

An important aspect of interpretation of the transect photography was the ability to estimate thistle density in each frame where it was identified. Nine calibration sites were established and a procedure was devised for estimating the density of thistle, so calibration ground truth involved working those plots. The density scale that was established was:

1--1,000	bolting plants/hectare	very light
1,001--10,000		light
10,001--50,000		moderate
50,001--100,000		heavy
>100,000		very heavy

Verification ground truth involved visiting over 50 sites from the 1979 transect flights, to develop interpretive techniques for identifying the presence of thistle. The location of each frame was carefully mapped on a mosaic of Douglas County 9-inch photography, and then transferred to a county road map. Thistle occurrence was verified in nine sites, while other sites were inaccessible making verification impractical.

Accuracy ground truth involved taking a random sample of frames from the transect lines, followed by site visits to see if thistle were present where it had been interpreted to exist. Every tenth frame in Transect 1 was visited, and no additional thistle was found to be present.

RESULTS FROM 1979 TRANSECTS

The following land use percentage values were estimated for Douglas County:

Crop	39%	116,759 acres
Pasture	29%	85,693 acres
Succession	4%	12,648 acres
Forest	13%	39,528 acres
Other	15%	44,372 acres
		299,000 acres in Douglas County

Pasture was found to be the most important habitat type for thistle infestation, with 8% of all pasture in Douglas County containing some thistle. The degree of infestation in other habitats was not consistent and consequently the values were insignificant.

The following table gives a breakdown of land use type and thistle density:

Table 3

PERCENT LAND COVER WITH THISTLE, BASED ON DENSITY, IN DOUGLAS COUNTY

	no thistle	very light	light	moderate	heavy	very heavy
Pasture	92.15	4.56	2.82	0.39	0.04	0.03
Succession	99.05	0.95	*	0.0	0.0	0.0
Road verge	99.0	*	0.0	0.0	0.0	0.0
Field verge	99.0	*	0.0	0.0	0.0	0.0
Commercial-industrial	92.94	0.0	7.06	0.0	0.0	0.0
Barnyard	96.0	*	0.0	0.0	0.0	0.0

* present, percentage insignificant.

Acreage conversion:

92.15% of all pasture, no thistle = 78,966 acres
4.56% of all pasture, VL thistle = 3,908 acres
2.82% of all pasture, L thistle = 2,417 acres
0.39% of all pasture, M thistle = 334 acres
0.04% of all pasture, H thistle = 34 acres
0.03% of all pasture, VH thistle = 26 acres

Arkansas River Irrigation Moratorium

Since about 1970, there has been a continual decrease in streamflow in the Arkansas River downstream of the Kansas-Colorado state line. The availability of water for diversion at the head gates of irrigation canals is now inadequate to meet legal commitments and to satisfy crop demands. There has also been a die-off of woody vegetation along extensive reaches of the river.

A measureable decline of water levels in the aquifer adjacent to the river has accompanied this streamflow reduction. In January 1977 water levels in Hamilton County were 4 to 5 feet lower than January levels in 1970. Water levels near the river channel in eastern Kearny County had also declined nearly 12 feet during the last decade.

In addition annual precipitation at Syracuse, Kansas during 1970-78 averaged 2.4 inches below the long-term, 80-year mean of 16.5 inches. The corresponding decrease in effective precipitation during the growing season has produced an unprecedented demand on the surface and ground water resources in the area.

In an attempt to prevent excess stress on the hydrologic system beyond its natural capacity to recover, the Chief Engineer of the Kansas Board of Agriculture, Division of Water Resources (DWR) in January, 1977 placed a moratorium on approval of applications for ground water and surface water in a 480 square-mile area along the Arkansas River in Hamilton and Kearny Counties. The moratorium has continued because available information is insufficient to allow sound judgments regarding the extent to which additional development of the water resources would impair water used under existing rights. In particular, the Division of Water Resource needs a means by which to predict future hydrologic conditions in the area in response to additional development of ground water, different rates of incoming streamflow from Colorado, and different climatological possibilities.

To obtain the information necessary to make valid judgments, the United States Geological Survey (USGS) was commissioned to conduct a comprehensive study of the surface-water and ground-water resources of the Arkansas River Valley between the Finney-Kearny county line and the Kansas-Colorado state line. Conducted from the Geological Survey's Garden City, Kansas office, the study began in July, 1977 and will continue through September, 1982.

Specific objectives of the study are to: 1) determine the extent of interaction between ground-water, surface-water and climatic factors, 2) evaluate the potential for stream depletion in response to ground water pumping and 3) develop

a digital-computer model of the exchange of water between the surface and subsurface. Once the computer model has been calibrated to simulate the sequence of observed responses to a history of hydrologic events, it can be used to predict the effects of different distributions of recharge and discharge. In addition to indicating opportunities for water conservation, the model will demonstrate ways to improve the use of both ground and surface water in the Arkansas River Valley.

The KARS Program was asked to provide, for the USGS study, land use and land cover information for the project site. Remote sensing data, it was believed, would be the most direct and efficient source of such information, would be helpful in reducing the requirement for field work, and would be compatible with the model being developed.

Large scale (1:10,000) color infrared aerial photography acquired in July 1978 served as the principal source of land use/land cover data. LANDSAT multispectral scanner images (Band 5; 1:500,000 scale) acquired during May and August 1978 were used to assist in identification of irrigated cropland and to supplement the aerial photography in areas having incomplete photo coverage.

Land use/land cover classes identified on the aerial photography were as follows:

Irrigated cropland
Unirrigated cropland
Live woodland -- 30%-100% tree cover
Dead or stressed woodland
Cleared woodland -- tree cover has been, or in the process of being, removed
Shrubland
Rangeland
Bare sand
Water
Quarries
Builtup areas
Hazardous activities -- such as dumps and feedlots
River channel, tributaries, canals -- main channel of the Arkansas River, its tributary creeks and irrigation canals.

The following land use/land cover classes were identified on LANDSAT imagery:

Irrigated cropland
Unirrigated cropland
Rangeland
Bare sand or bare ground

All image interpretation was accomplished at the original image scale and subsequently registered to a 1:63,360 base map of the study area (Figure 2). A final color map was produced on a stable-based Kwik-proof™ material.

The five year USGS geohydrologic study will be accomplished in three phases:

Phase 1 (2 years)
Determination of boundaries of stream-acquifer system,
Hydraulic characteristics of aquifer, and
Hydrologic stresses imposed on system

Phase 2 (1 year)
Determination of hydrologic stresses on system,
Construction and testing of model

Phase 3 (2 years)
Application of model
Report preparation

The KARS provided map will be used in all three phases of the study. Initially it has been utilized to locate stream channels, canals and water bodies in the project area, to determine where stress is placed on the ground water supply (e.g., irrigation), to evaluate the effects of such stresses on riparian vegetation, and to locate a network of stream gauging and monitoring stations.

Data extracted from the map is now being used in development of the digital model being constructed by USGS. The model will be employed to predict the effects of various water use and management alternatives on the Arkansas River system. The KARS provided map is being used to define areas of recharge and discharge, and to assign values to areas known to contain a specific vegetation type (phreatophytes), irrigated cropland and other water-demanding land use/land cover types in order to better distribute evapo-transpiration demands in the model.

Once the model has been calibrated (to correctly simulate historic sequences of observed responses to hydrologic events), it will be used by USGS to test the probable effects of various demands on ground water, drought, and variations in surface water flow from Colorado along with a variety of factors.

The results of these tests will be used by the Kansas State Board of Agriculture's Division of Water Resources (DWR) to decide whether to lift the moratorium or make it permanent, and to decide on future appropriation of water rights and regulation of water use in the project area.

Rene' A. Barber, USGS Hydrologist in charge of the Arkansas River study, asserted in January 1980 that the KARS Program's image interpretation and mapping effort has stimulated interest in continuing application of remote sensing.

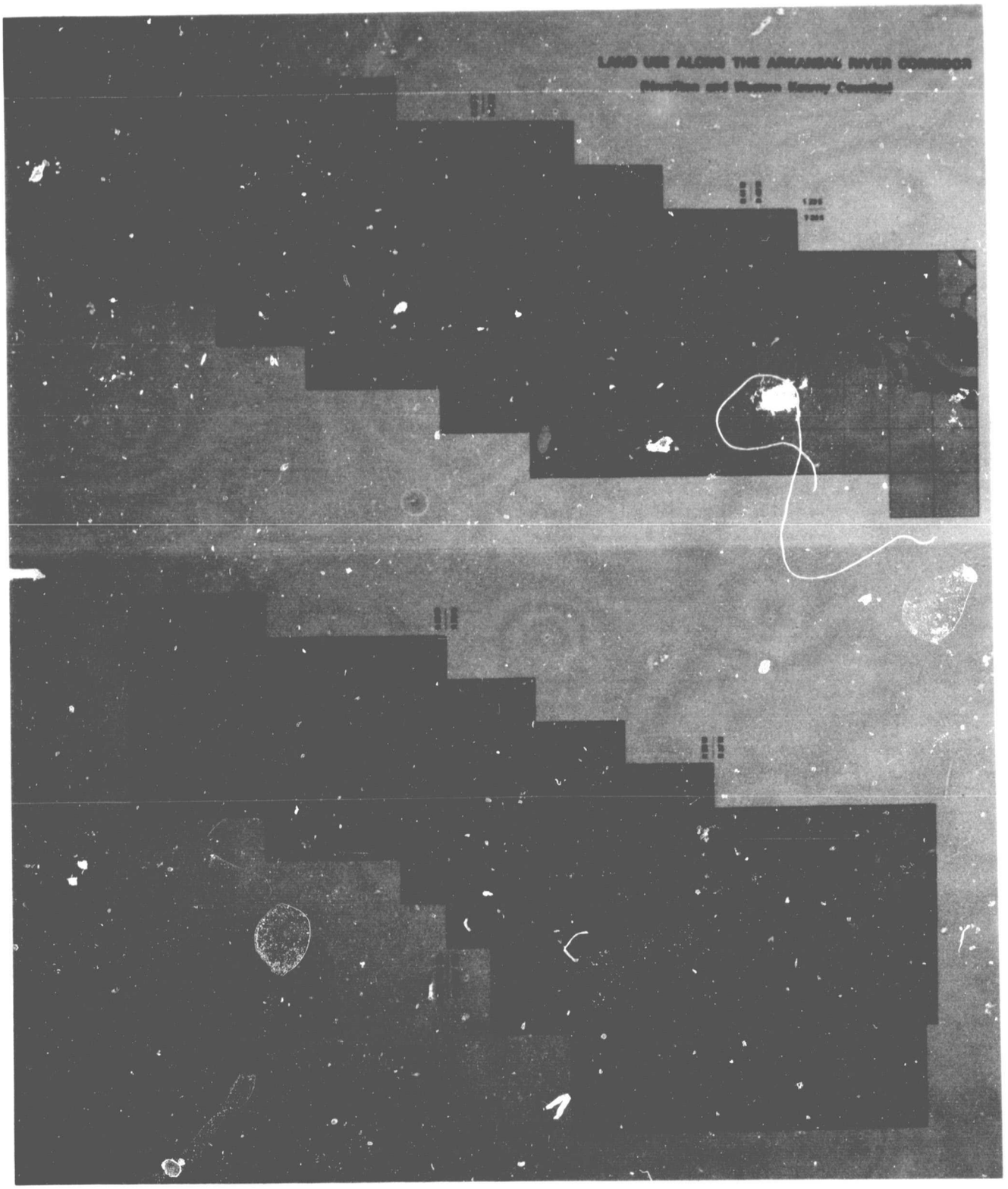


Figure 2.

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He noted,

> The possibility of using additional interpretations of the physical system as determined from remote sensing is of considerable interest to us. Such interpretation-when accomplished in a timely fashion-prevents our having to delineate essentially the same information using a less-direct, and less-efficient, approach. If other water-related agencies also received such interpretation through your facility, the overall need for field work could be reduced. This would seem to minimize the duplication of interpretive activities which might otherwise result from the fact that our study and other State and Federal agencies are mutually interested in the geohydrology of western Kansas.

Irrigated Lands Inventory

In 1975, 94% of the U.S. water consumption occurred in the 17 western states, where by far the largest single use was for irrigation. During the same year, 93% of all the water used in Kansas was for irrigation, with a total estimated irrigated area of 3,033,101 acres. By 1978 the irrigated land in Kansas had increased to an estimated 3,417,981 acres, an increase of 12.7% in three years.

Virtually all of the irrigation water in Kansas is derived from groundwater sources, the most notable being the Ogallala aquifer in the western third of the state. In addition to being the largest aquifer in the state, the Ogallala also underlies the portion of the state with the lowest yearly rainfall totals and is therefore heavily drawn upon by irrigators. However, the rate of recharge or replenishment of the Ogallala is very slow and lags far behind the rate of withdrawal. Marked declines in groundwater levels throughout the Ogallala have been recorded for many years but have recently become larger and more alarming. In some areas the groundwater level has dropped more than 100 feet in 30 years.

The KARS Program has been actively working in the area of remote sensing of irrigated lands in the Ogallala area for several years. Initial work in the period 1973-1977 was oriented towards mapping and monitoring growth in the use of center pivot irrigation systems, the fastest growing type of irrigation in the state. That work established an efficient technique for interpreting center pivot sprinkler irrigation on LANDSAT imagery, based on the characteristic center pivot circular shape. However, most of the irrigation in Kansas is of the older, non-center pivot type and has no characteristic shape; therefore, other identification criterion were required in order to identify these lands.

During 1978 a project was undertaken for the Kansas Legislative Research Department that allowed the KARS Program to develop and demonstrate a technique for mapping and identifying all types of irrigated lands, again in the Ogallala region of western Kansas. This development work was reported at two major meetings in 1979, the Annual Meeting of the Association of American Geographers in April and the William T. Pecora Symposium in June.

A detailed study was conducted in one of the counties to determine accuracy figures for the interpretation technique. A total of 18 four-section sample areas were selected and detailed crop/irrigation information collected from the ASCS county agent's files. Data for 72 sections (383 fields) comprising 5.5% of the county area was collected and a field-by-field check of accuracy made. Contingency tables of ASCS data versus LANDSAT interpretation were drawn up for each crop and percent accuracies calculated (see Table 4). Accuracies for identifying irrigated crops ranged from 85% to 99%. Note that these figures were mapping accuracies. Accuracies for areal statistics will be higher, e.g., the accuracy of estimating irrigated wheat acreage is 94% and the accuracy of estimating total (three crops) irrigated acreage is 99%.

At both meetings the work was well-received and resulted in an invitation to participate in a special Symposium on using LANDSAT to Identify Irrigated Lands sponsored by the Missouri River Basin Commission in November.

The presentation in November consisted of two parts, a survey of the key parameters involved in doing a LANDSAT-based identification of irrigated lands and an examination of how the data might be correlated, with other factors, especially drawdown. The work related to drawdown correlations has proceeded along two somewhat different paths. One effort has taken the irrigation data and the correlations and by using spatial-averaging techniques is producing maps of irrigation intensity for portions of western Kansas (see Figure The other effort has resulted in a demonstration project in conjunction with the Groundwater Section of the Kansas Geological Survey (KGS).

Personnel at the KGS are involved in developing a groundwater model for the alluvial aquifer of the Walnut Creek Area in west-central Kansas, a valley just east of the Ogallala formation. In developing their model they are concerned with three major factors -- the amount of groundwater currently in the aquifer, the amount of annual recharge and the annual withdrawals. Though well-established techniques are available for quantifying the first two factors, the third factor remains a problem. Discussions with the KGS personnel about prior KARS work in mapping irrigated lands and presentation of the desired accuracy statistics for the LANDSAT-based techn[illegible]e convinced them of the possible utility of

Table 4

ASCS/LANDSAT COMPARISON CONTINGENCY TABLE
Table entries are in acres

Wheat		Landsat Interpretation		Resulting Landsat Accuracy
		Irrigated	Non-Irrigated	
ASCS	Irrigated	5440	957	85%
	Non-Irrigated	1330	5380	80%

Corn		Landsat Interpretation		Resulting Landsat Accuracy
		Irrigated	Non-Irrigated	
ASCS	Irrigated	5011	165	97%
	Non-Irrigated	—	—	

Sorghum		Landsat Interpretation		Resulting Landsat Accuracy
		Irrigated	Non-Irrigated	
ASCS	Irrigated	3260	30	99%
	Non-Irrigated	0	1431	100%

ASCS/Landsat interpretation comparison contingency tables; table entries are in acres.

SAMPLE LINE PRINTER MAP OF IRRIGATED LANDS INTERPRETATION

(This version produced on a matrix printer terminal)

Figure 3.

remote sensing for their work. As a result they included a remote sensing component in the proposal describing the modeling effort. The KGS recently received approval of the proposal and the KARS Program will be undertaking a demonstration project with the KGS during the summer of 1980.

A Half-day Introductory Short Course on Remote Sensing

During April, 1980, The University of Kansas Applied Remote Sensing (KARS) Program conducted a half-day short course in remote sensing in eleven cities across the state of Kansas. The course, entitled "Remote Sensing: An Overview", was funded by the National Aeronautics and Space Administration (NASA) contract NAS 13-131. It was designed to encourage the use and understanding of state-of-the-art remote sensing techniques, especially LANDSAT and digital processing, by personnel in colleges, universities and state and local agencies in the state of Kansas.

The proximate objectives of the course were to encourage and improve the teaching of remote sensing techniques within Kansas institutions of higher education, and to increase the usage of remote sensing data by state governmental personnel. Further objectives were to provide an overview of remote sensing, to demonstrate the applications of LANDSAT data, and to stimulate interest in developing additional LANDSAT applications.

Topics covered by the course included the following:

1. An overview of remote sensing introducing (1) the electromagnetic spectrum, (2) remote sensing platforms, (i.e., aircraft, LANDSAT, Space Shuttle, etc.), and (3) remote sensing systems (i.e., cameras and scanners, including LANDSAT).
2. The interpretation and use of remote sensing data including manual interpretation, digital interpretation, collateral data, (i.e., maps, field data, soil surveys).
3. Remote sensing applications -
   - Planning - including land use and land cover studies and urban development studies.
   - Agricultural - including crop inventories, yield prediction, and irrigated land inventories.
   - Natural resources - including wildlife habitat studies, surface mining, surface water mapping, and geological exploration.
   - Environmental quality - including water pollution, thermal problems, waste disposal site location, etc.
4. Sources of remote sensing data.

Lectures were liberally illustrated with slides, imagery prints, maps and graphics. Handouts were distributed to all participants which included sources of remote sensing imagery, information, publications, audiovisual and educational materials, newsletters and information regarding the Kansas Applied Remote Sensing Program.

Courses were presented as follows:

Kansas City, Kansas	KU Regents Center	April 2, 1980
Salina, Kansas	Marymount College	April 9, 1980
Wichita, Kansas	KU Medical School	April 10, 1980
Emporia, Kansas	Emporia State University	April 14, 1980
Topeka, Kansas	Washburn University	April 16, 1980
Hays, Kansas	Ft. Hays State University	April 21, 1980
Colby, Kansas	Colby Community College	April 22, 1980
Lawrence, Kansas	Kansas University	April 23, 1980
Garden City, Kansas	Garden City Community College	April 24, 1980
Manhattan, Kansas	Kansas State University	April 28, 1980
Pittsburg, Kansas	Pittsburg State University	April 30, 1980

A total of two hundred and twenty-one persons attended the course. They represented many different disciplines - geology, hydrology, engineering, planning, archaeology and anthropology - to name a few. Attending the course were university faculty (professors of geology, geography, civil engineering, earth science, chemistry, biology), representatives of regional planning commissions (e.g., planners from Johnson County Community Development and the C.G.I. Association of Local Government), and individuals from various federal, state and local agencies, including the Federal Highway Administration, the U.S. Army Corps of Engineers, National Oceanographic and Atmospheric Administration, Kansas Fish and Game Commission, Kansas Department of Health and Environment, the U.S. Agricultural Stabilization and Conservation Service and the U.S. Soil Conservation Service.

The workshop was judged to be successful in introducing many of the state's educators to remote sensing and its applications, and also in reaching people in the various disciplines in which remotely sensed data can be utilized.

Plans are now in progress for two 5-day sessions of a more comprehensive remote sensing course entitled, "Fundamentals of Applied Remote Sensing", to be held at the Space Technology Center, Lawrence, Kansas, August 11-15 and September 8-12, 1980. The course will offer training and hands-on experience in image interpretation and numerical analysis of LANDSAT data. Some of the topics to be covered, in addition to an introduction to remote sensing, are manual image

interpretation (including the analysis of LANDSAT imagery) and the numerical analysis of LANDSAT data (including supervised and unsupervised classification). In this course, lectures, discussions, laboratory exercises and field trips will focus upon developing an understanding of how remote sensing may be employed by course participants in their own professional work.

Pony Creek and Roy's Creek Watershed Analysis

Pony Creek and Roy's Creek Watersheds are the sites of watershed protection planning by the U.S. Department of Agriculture Soil Conservation Service (SCS). Pony Creek Watershed is located in western Brown County and northeast Nemaha County, Kansas and southern Richardson County, Nebraska. Roy's Creek Watershed is located in northeast Brown County, Kansas and southern Richardson County, Nebraska. Pony Creek Watershed covers an area of 42,406 acres and Roy's Creek Watershed contains 30,403 acres. The watersheds at present experience periodic flooding, severe erosion problems, and contribute excessive amounts of silt and sediment to the Nemaha and Missouri River systems. Information contained in this summary concentrates on the Kansas portion of the watersheds since most of the area lies within Kansas boundaries.

Planning for the design and implementation of land treatment and surface modification measures to alleviate flood and erosion problems is being carried out by SCS personnel at the state office in Salina, Kansas. The key to this planning lies in the identification of specific problem areas and assessment of general land surface conditions that affect erosion and flooding in the watersheds.

In June, 1979 the University of Kansas Applied Remote Sensing (KARS) Program was commissioned by the SCS to prepare land use, land use change, stream basin scour, gully, and stream classification maps of the Pony and Roy's Creek Watersheds. The maps were to be accompanied by areal statistical data summarizing the acreages of the land use, land use change, flood plain scour, gullies, and stream channel classification elements that were mapped. The maps and areal statistics will be used by SCS in the watershed evaluations.

Land use, gully, and stream channel classification data for 1979 were taken from two sets of aerial photographs supplied to the KARS Program by SCS on loan for the duration of the contract. Large scale (1:24,000) black and white photographic prints acquired in April, 1979 provided the primary data source for the 1979 land use, gully, and stream channel classification tasks. Black and white photographic prints at a scale of 1:36,000 and 1:6,000, also acquired in April, 1979, were used as supplemental data sources. Black and white photographic prints (scale 1:9,600) acquired in February, 1970 were employed to analyze 1979 land use, land use change and flood plain scour.

Additional data sources used included (1) annotated xeroxgraphic copies of the 1:6,000 scale 1979 coverage of the main channel for each watershed showing areas of flood plain scour (provided by SCS and produced by a separate contracting organization); (2) SCS supplied topographic base maps; and (3) selected published material pertaining to the Pony and Roy's Creek Watershed sites. Field surveys performed in the watershed both before and after the interpretation effort provided additional information.

Land use, land cover, flood plain scour, gullies, and stream channel classification classes to be portrayed on the maps were defined by mutual agreement of SCS and the KARS Program, and were based on SCS data requirements and a preliminary analysis by the KARS Program of the capacity for accurately distinguishing the desired cover classes on aerial photography which would constitute the primary source of the required data.

Fifteen classes of information were defined. They are:

1. Large Grain Crops -- areas ten acres or larger featuring corn, sorghums, milo or soybeans as the crop cover at the time of image acquisition.

2. Small Grain Crops -- areas ten acres or larger featuring wheat as the crop cover at the time of image acquisition.

3. Forage Crops -- areas of ten acres or larger where alfalfa or red clover is the predominant cover at the time of image acquisition.

4. Grassland -- areas ten acres or larger where domestic or native grasses are the primary cover at the time of image acquisition. Included are both natural stands and stands seeded by man.

5. Woodland-Riparian -- an area one acre or larger and at least 100 feet wide dominated by native tree species associated with streams, rivers, lakes, or watercourses most readily identified where flood plains exist. A tree canopy cover greater than 25% is necessary.

6. Woodland-Upland -- an area one acre or larger and at least 100 feet wide dominated by native tree species associated with those areas topographically above flood plains. A tree canopy greater than 25% is necessary. Continuous segments of an area with similar species is considered woodland if any portion of the area meets the woodland criteria. An area of woodland dissected by a gully is considered a continuous segment for the purpose of definition.

7. Water -- an area composed of shallow water or open water and includes seasonally flooded wetlands. This includes ponds, lakes, and wetlands of one acre or larger.

8. Urban or Built-up Land -- area of habitation, transportation corridor, industrial development, utilities, or functional recreation area. Includes areas of any identifiable size.

9. Farmsteads -- area greater than one acre that contains buildings and equipment storage facilities associated with agricultural production.

Includes areas which contain functional or abandoned residential structures in conjunction with farm related structures.

10. Other -- land that does not fit any of the preceeding classifications. Where the function of the area is identifiable, an appropriate notation appears on the map and in the accompanying report.

11. Treated Land -- in addition to identifying the general land cover category, notations were made to indicate land protected by mechanical conservation practices such as terraces, waterways, grade stabilization structures, etc.

12. Untreated Land -- a similar notation was made for all areas upon which no signs of conservation practices were in evidence or were discerned on the imagery.

13. Gullies -- areas afflicted with gully erosion are identified and marked to show their location. In conjunction with field surveys, gullies will be measured to show the length, depth and width of the gully in areas with less than one square mile of drainage.

14. Stream Drainage Pattern -- all stream patterns with more than one square mile of drainage are displayed and classified as per SCS guidelines.

    a. Perennial Streams -- a stream or reach of stream in which perennial flow persists to the outlet except during extreme drought. The permanancy of flow is usually attributable to acquifer effluent.

    b. Intermittent Stream -- a stream or reach of a stream that generally flows only during a part of the year. It continues to flow after the cessation of surface runoff, but effluent ground water will not sustain flow through moderate periods of little or no precipitation. It may contain reaches of perennial flow.

    c. Ephemeral Stream -- a stream or reach of a stream that flows only during periods of surface runoff. It receives little or no water from springs and no long-continued supply from melting snow or other sources. Its channel is at all times above the water table.

15. Flood Plain Scour Channel -- flood plain scour activity was interpreted from 1970 photography for comparison with flood plain scour action as interpreted and mapped by another contractor.

The final map product was compiled at a scale of 1:24,000 and was keyed to copies of topographic base maps supplied by SCS. A set of five overlays and prepared for each watershed. The first overlay portrays subreach and watershed boundaries. A second overlay portrays land use and land cover (see Figure 4). and the third overlay identifies land use change between 1970 and 1979. The final two overlays show stream channel classification/gullies and flood plain scour respectively.

ROY'S CREEK WATERSHED

LAND USE/ LAND COVER, 1979

- L Large Grain - Untreated
- L1 Large Grain - Terraced
- L2 Large Grain - Grass Waterways
- S Small Grain - Untreated
- S1 Small Grain - Terraced
- S2 Small Grain - Grass Waterways
- G Grassland - Untreated
- G1 Grassland - Terraced
- G2 Grassland - Grass Waterways
- FC Forage Crop - Untreated
- FC1 Forage Crop - Terraced
- FC2 Forage Crop - Grass Waterways
- UV Upland Woodland
- RV Riparian Vegetation
- U Urban and Built-up
- W Water
- FS Farmsteads

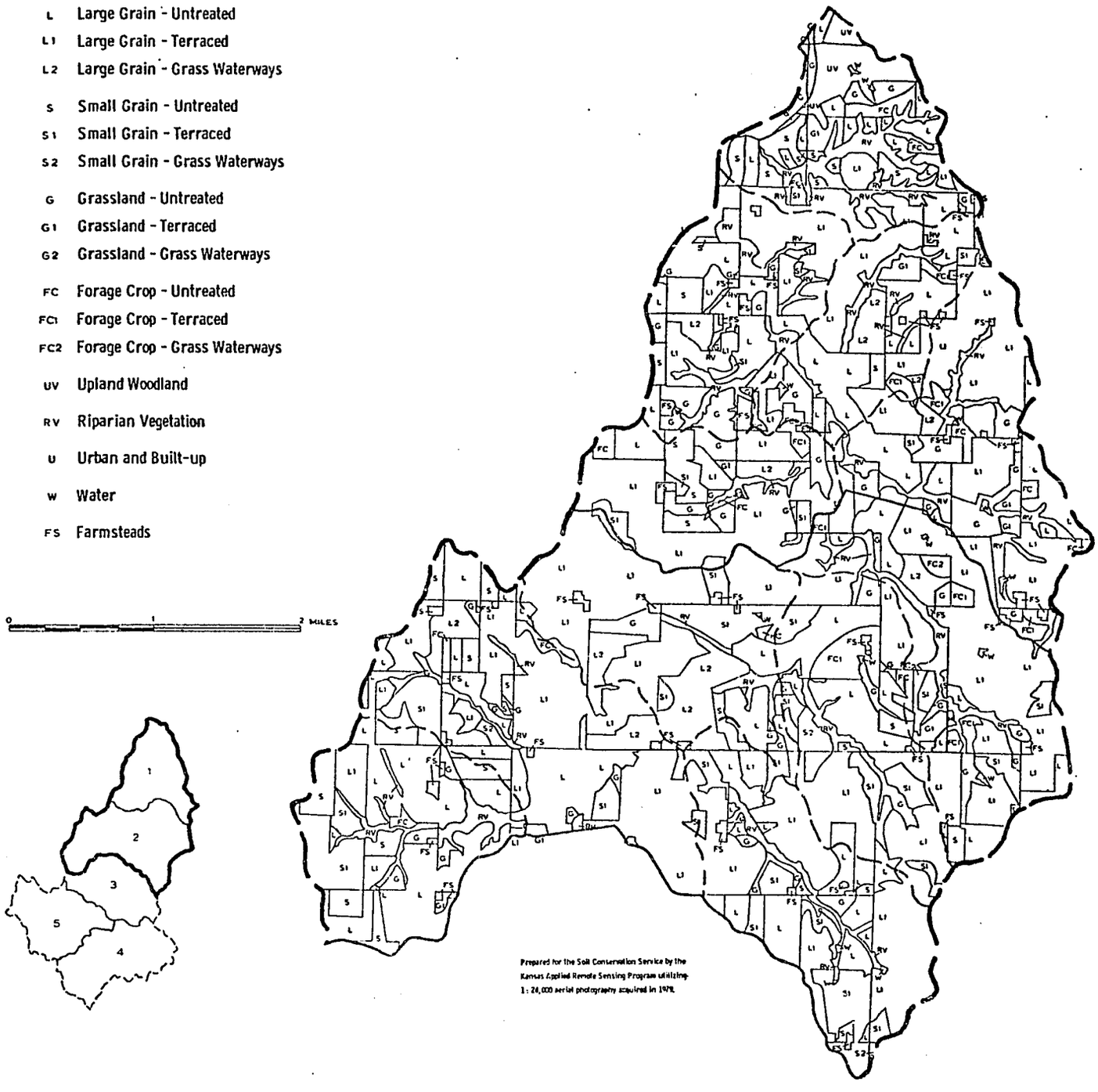

Figure 4

The overlays were produced photographically from inked versions of the raw data maps on frosted acetate. Legends provide the key to symbols used to identify classifications of each data element.

Areal statistics (acreages) were tabulated from the final set of maps by section, subreach, reach and watershed and are contained in Tables 5, 6, and 7). Acreage estimates were measured with a set of dot grids with densities of 225 dots/square inch.

The Soil Conservation Service will use both the map products and the areal statistics in order to identify areas with specific erosion problems. They then plan to implement measures to correct or alleviate the cause of such erosion. These actions include enlisting farmer cooperative land treatment programs, such as terracing and grass waterways, and planning and securing funds for flood water retention structures as well as other appropriate measures.

Table 5

LAND USE SUMMARY

CATEGORY	PONY CREEK	ROY'S CREEK
Large Grain Crop		
Untreated	6,669 acres	4,752 acres
Terraced	15,119 acres	13,210 acres
Grass Waterways	797 acres	945 acres
Small Grain Crop		
Untreated	2,431 acres	1,279 acres
Terraced	4,485 acres	2,413 acres
Grass Waterways	72 acres	63 acres
Forage Crop		
Untreated	1,588 acres	831 acres
Terraced	663 acres	932 acres
Grass Waterways	23 acres	53 acres
Grass		
Untreated	6,535 acres	3,178 acres
Terraced	245 acres	655 acres
Grass Waterways	19 acres	---
Water	173 acres	93 acres
Farmsteads	782 acres	512 acres
Urban/Built-up	320 acres	---
Woodland		
Riparian	2,412 acres	1,272 acres
Upland	73 acres	98 acres
TOTALS	42,406 acres	30,403 acres

Table 6

LAND USE CHANGE: SUMMARY

1970 LAND USE	1979 LAND USE	PONY CREEK	ROY'S CREEK
Untreated Cropland	Terraced Cropland	2,791 acres	912 acres
Untreated Cropland	Cropland with Grass Waterways	339 acres	---
Untreated Cropland	Terraced Grass	---	112 acres
Untreated Cropland	Terraced Forage Crop	57 acres	---
Untreated Cropland	Untreated Grass	649 acres	660 acres
Untreated Cropland	Farmstead	---	3 acres
Untreated Cropland	Water	11 acres	---
Untreated Cropland	Urban/Built-up	14 acres	---
Terraced Crop	Terraced Grains	61 acres	116 acres
Cropland with Grass Waterways	Terraced Cropland	99 acres	48 acres
Untreated Grass	Untreated Cropland	400 acres	319 acres
Untreated Grass	Terraced Cropland	350 acres	53 acres
Untreated Grass	Cropland with Grass Waterways	38 acres	38 acres
Untreated Grass	Untreated Forage Crop	137 acres	9 acres
Untreated Grass	Forage Crop with Grass Waterways	---	23 acres
Untreated Grass	Terraced Grass	18 acres	---
Untreated Grass	Water	28 acres	---
Untreated Grass	Urban/Built-up	9 acres	---
Untreated Grass	Riparian Woodland	38 acres	---
Farmstead	Untreated Grass	4 acres	---
Farmstead	Untreated Cropland	6 acres	---
Riparian Woodland	Untreated Cropland	---	16 acres
Riparian Woodland	Untreated Grass	18 acres	13 acres
Riparian Woodland	Untreated Forage Crop	---	17 acres
Upland Woodland	Untreated Forage Crop	80 acres	---
TOTAL CHANGE		5,147 acres	2,339 acres

Table 7

FLOOD PLAIN SCOUR

PONY CREEK

Scour Area No.	Subarea/Reach	Area (Acres)	Year First Appears on Aerial Photography
1	9B	.17	1970
2	9A	.22	1970
3	8A	.45	1970
4	7E	.16	1970
5	7E	.35	1970
6	7C, 7E	7.28	1970
7*	7A	.48	1970*
8*	7A	.44	1970*
9	7A	.80	1970
10	7A, 6C	3.03	1970
11	6C	1.80	1970
12	6C	.41	1979
13**	6C	4.5	1979**
14	6B	1.02	1979
15	6B	.83	1979
16	6A	.31	1979
17	6B	1.21	1970
18	6A, 4D	6.38	1970
19	4D, 4A	2.63	1970
20	4D	.19	1970
21	4A	1.25	1970
22	3C	2.18	1979
23	3C	4.4	1970
24	3C	1.85	1979
25	3C	1.93	1970
26	3C	.08	1979
27	3C	.05	1979
28	3C	.12	1979
29	3C	4.03	1979
30	3C	1.43	1970
31	2C	.30	1979
32	2A, 2C	3.61	1970
33	2C	.17	1979
34	2C	1.70	1970
35	2C	.61	1970
36	3A	1.13	1970
37	3A, 2C	1.20	1970
38	3A	3.07	1970
39	2A	3.83	1970
40	2A	1.04	1970
41	2A	.34	1979
42	2A	.66	1970
43	1, 2A	3.51	1970
44	1, 2A	.64	1970
45	1	3.74	1970
46	1	.39	1970
47	1	.38	1979

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* Scour areas 7 and 8 for Pony Creek Watershed were shown as cut-off lakes on the 1970 photography. Soils and vegetations differences on the filled-in cut-offs are attributed as the cause for the misinterpretation on the 1979 analysis.

** Scour Area #13 represents an area of plowed-over directed drainage.

ROY'S CREEK

Scour Area No.	Subarea/Reach	Area (Acres)	Year First Appears on Aerial Photography
1	1B	.573	1979
4	1B	1.951	1970
8	1C	1.0	1970
11	1C	11.01	1979
12	1E	.459	1979
13	1E	10.674	1970
14	1E	.344	1970
15	1E, 2A	27.144	1970
16	2A	.401	1970
17	2A, 2B	8.148	1979
18	2B	2,525	1970
19	2B	23.128	1970
20	2B	4.419	1970
21	2C	2.295	1970
22	2C	2.238	1979
23	2E	2.926	1970
24	2E	3.041	1970
25	2E	4.189	1970
26	3A, 3D	9.182	1970
27	3D	6.198	1979
28	3D	3.615	1970
29	3D	10.616	1970
30	4A	5.509	1970

Wildlife Habitat and Environmental Quality

Soldier Creek Watershed 208 Planning

The Federal Water Pollution Control Act of 1972 established a nationwide program to eliminate the discharge of pollutants into the nation's navigable waters by 1985. Intermediate deadlines called for the use of the "best practical technology" by July 1, 1977.

Initially, the provisions of the act were directed against point sources of pollution (e.g., industrial, commercial and municipal outfalls) into streams, lakes and waterways, but Section 208 of the act (which provides for the planning process that will eventually serve as the basis for implementing the programs within the parent act) directs itself to the control of non-point pollutant sources (e.g., cropland). Section 208 requires that pollution be controlled through regional comprehensive land use and land management controls and related regulatory programs. A regional analysis of pollution problems is required which accounts for both immediate and long-range water quality planning. The implementation of Section 208 regional planning is the responsibility of the state and includes both state and local planning in the planning process. One state agency, selected by the governor of each state, oversees the program, providing both an administrative and advisory function.

In Kansas, the State Conservation Commission (SCC) has been assigned the task of administering and implementing the 208 planning process on a statewide basis. Rather than design a statewide program of non-point pollution planning based solely on programs already under way in other states, the State Conservation Commission decided to institute a pilot program for a selected watershed in the state. This would provide SCC officials with an assessment of the problems they might encounter that are unique to the Kansas environment and its farming and governmental institutions.

The site selected for the demonstration project was the Soldier Creek Watershed in Jackson and Nemaha counties. The study site encompasses 100 square miles of rough, hilly terrain. Soils in the area are highly susceptible to erosion and in some areas it is difficult to maintain adequate levels of grass cover. Soil erosion contributes a great deal of silt and sediment to the creek. This has been a factor in periodic flooding in the lower reaches of the watershed. The steeply sloped lands also promote runoff from agricultural land which sends agricultural chemicals and waste to the creek's waters.

A total of nine different state and federal agencies are involved in the Soldier Creek project (Table 8). The study is being supervised by the Jackson County Soil Conservation Service and the Soldier Creek Watershed Board of Directors. The planning process requires that an extensive data base be compiled.

TABLE 8

AGENCIES COOPERATING IN SOLDIER CREEK
WATER QUALITY AND CONSERVATION PROJECT

AGENCY	FUNCTION
Kansas State Conservation Commission	Administration and Coordination
Jackson and Nemaha County Conservation Districts	Program Development, Information Dissemination
Kansas Cooperative Extension Service	Newsletter, Information Dissemination, Erosion Demonstration
USDA/Agricultural Stabilization and Conservation Service	Cost Sharing, Financial Administration
USDA/Soil Conservation Service	Technical assistance to land owners and farm operators
USDI/Bureau of Indian Affairs	Soil erosion control on Indian-owned lands
U.S. Environmental Protection Agency	Grant Program, Aerial Photography
Kansas Department of Health and Environment	Water Quality monitoring, Biological monitoring

Such a data base should include information regarding land use, land cover, land use practices, erosion potential, soils and any other type of activity that acts as a potential water pollution agent. These data are analyzed to determine areas which feature the greatest potential erosion problems. Water quality can be monitored on the streams below these areas to assess the extent of the problem and funds can be allocated for the implementation of control measures on those lands that are the greatest potential pollution sources.

SCC officials contacted the KARS Program to determine the potential that remote sensing might have in the compilation of the maps and statistics required for the data base. Through these discussions, it was determined that the following land use/land cover categories would effectively isolate those areas with the greatest potential erosion and pollution problems:

I. Cropland
   - A. Untreated Cropland
   - B. Cropland utilizing grass waterways as a soil conservation measure
   - C. Cropland utilizing grass waterways and terraces as soil conservation measures

II. Grassland
   - A. Untreated Grassland
   - B. Grassland utilizing directed drainage as a soil conservation measure

III. Woodland

IV. Water Bodies

V. Farmsteads

VI. Quarries

VII. Areas of active erosion

Because no current aerial photography was available for the watershed, the U.S. Environmental Protection Agency agreed to supply aerial coverage of the area. Natural color photography was flown for the watershed in September, 1978 at an acquisition scale of 1:48,000.

Image interpretation was performed by KARS Program staff at the 1:48,000 acquisition scale. The mapped data were reduced to a 1:63,000 scale base map (1" = 1 mile) for compilation of the final map product. In addition to the photo-derived data, Soldier Creek officials requested that a related set of data be supplied to supplement the land use/land cover map. The complexity of the data required that specific elements of the land use/land cover analysis be supplied in an overlay format. The final product included a 1:63,000 scale base map that displayed the following land use and land cover categories.

1. Drainage
2. Roads
3. Cropland
4. Grassland
5. Woodland
6. Water bodies
7. Farmsteads
8. Quarries

A total of four overlays to the base map were provided. These were as follows:

1. Land treated with grass waterways
2. Land treated with grass waterways and terraces
3. Land with active surface erosion
4. Soils Map and point locations for water quality monitoring stations.

The maps and statistical data have been supplied to the Soldier Creek Watershed Board of Directors and are currently being used in planning for pollution abatement. Soldier Creek officials have isolated several areas that are suspected major contributors to the pollutant and sediment load of Soldier Creek. Two areas have been selected for more intense monitoring efforts and water quality monitoring stations have been installed below each of these areas. The land use/land cover maps have, in addition, been an essential component for deciding on where to expend $250,000 that has been allocated for cost sharing programs in land treatment. The maps are aiding officials in identifying the most severely affected lands and areas where land treatment will have the most significant impact on improving the water quality of Soldier Creek Watershed.

During 1979 soil erosion control measures were implemented in 1,583 acres previously untreated. This resulted in an estimated annual soil loss reduction of 7,600 tons. Approximately 35% of the cropland in the watershed is now meeting soil loss requirements. The land use/land cover data provided by the KARS Program aided soil conservation agency personnel in deciding on high priority areas which required treatment.

As noted earlier, Soldier Creek Watershed is the state's pilot watershed program for 208 Water Quality Planning. The expense involved in providing low-altitude coverage and image interpretation of every watershed in the State has led SCC officials to request the investigation of other mechanisms for supplying the necessary land use and surface cover data.

The KARS Program is presently engaged in a two phased project to demonstrate the application of computer processed LANDSAT digital multispectral scanner (MSS) data to non-point pollution abatement planning in the Soldier Creek Watershed. The project is being undertaken with assistance from NASA's Earth Resources Laboratory, National Space Technology Laboratories, Mississippi.

The initial phase of the project will result in production and evaluation of a land use/land cover map of the watershed and its environs. This map is being prepared from digital analysis of a LANDSAT MASS computer compatible tape acquired in May 1978. The 1978 date will allow direct comparison of the results of LANDSAT digital analysis with the map described above prepared by photo interpretation.

The second phase of the demonstration will involve the creation of a computerized geo-data base for the watershed. Soils, slope and precipitation data have been digitized and are being registered with land use/land cover information derived from digital analysis of LANDSAT MSS data. The data base will be used to model soil erosion hazard potential in the Soldier Creek basin. The mode-ling algorithm will be based upon the Universal Soil Loss Equation (USLE).

It is anticipated that work on both phases of the LANDSAT demonstration project will be completed by September 1980. Results of the demonstration project will enable Kansas water quality planners to decide whether LANDSAT data and geo-data bases will meet statewide water quality data needs.

Mapping the Diminishing Sandsage Prairie, Kansas

The Sandsage prairie of southwest Kansas lies primarily adjacent to the Arkansas and Cimarron Rivers. In its unaltered state it is comprised of short grasses, forbs and shrubs growing on sandy soils. Predominant vegetation includes Sandhill Sage (Artemesia filifolia) Sand Bluestem (Andropogon hallii), Little Bluestem (Andropogon scoparius) and Sandreed (Calamovilfa longifolia). Precipitation averages approximately nineteen inches per year.

The sandy soils, rolling sand dune topography and low rainfall discouraged early agricultural use of the Sandsage prairie. High percolation rates and high costs of levelling the land made it unattractive to settlers who tapped surface water supplies for flood irrigation of other surrounding lands. Consequently the prairie remained largely unbroken until the mid-twentieth century.

The innovation of center pivot irrigation and improved pumping technology, which allowed the utilization of vast groundwater resources, brought dramatic changes to the Sandsage prairie beginning in about 1965. Center pivot sprinkler systems, providing light, even and frequent waterings to a crop, can be used economically on sandy soils. Furthermore, these electrically driven rotating systems can be operated over rolling terrain making levelling unnecessary in most instances. Automated pivot systems, usually one-half mile in diameter, allowed a single farmer to farm large acreages and encouraged the planting of large fields of high value cash crops (e.g., corn) in the previously uncultivated Sandsage prairie. Some farmers now run 100 or more systems.

In Finney County, Kansas 11 center pivots were in place in 1965; by 1975, maps and statistics prepared by the KARS Program from LANDSAT multi-spectral

scanner imagery showed that over 700 units had been installed. Nearly all were located on what had formerly been Sandsage prairie. Other counties in southwest Kansas have experienced a similar impact. LANDSAT multispectral scanner imagery shows that the Sandsage prairie in Kearny, Finney and Gray Counties had been reduced by 57% by 1975. Surveys reflect a continuing growth in both center pivot and flood irrigation throughout southwest Kansas, particularly in counties where Sandsage prairie remains.

The Sandsage prairie is a fragile ecosystem and a critical habitat for many wildlife species. The Lesser Prairie Chicken (Tympanuchus pallidicinctus) for example is native to the Sandsage prairie areas of southwest Kansas and nearby areas of Colorado, Texas, Oklahoma and New Mexico. It is thought that Kansas supported the largest Lesser Prairie Chicken population at the end of the 1960's. During the last decade wildlife biologists have noted an alarming decrease in Lesser Prairie Chicken populations in many areas of southwest Kansas. The Lesser Prairie Chicken has been considered for designation as a threatened species. Lee Queal, Wildlife Administrator, Kansas Fish and Wildlife Commission (KF&G), notes, for example, that in a study area southwest of Garden City, Kansas, the Lesser Prairie Chicken population decreased from some 36 chickens/square mile in 1970 to about 6 chickens/square mile in 1979 (Table 9). William Hanzlick, now Director of the Kansas Fish and Game Commission, estimates that the total Lesser Prairie Chicken population in Finney County, Kansas declined from perhaps 23,000 birds in 1974 to 15,000 in 1979. There are estimated to be less than 100,000 breeding birds left in Kansas.

There are strong circumstantial indications that these population declines are related to land cover/land use/habitat disruption and destruction. The Lesser Prairie Chicken is a resident of the Sandsage prairie ecosystem and depends upon the existence of substantial tracts of this prairie for its survival. As noted above, much of this ecosystem has been converted, during the last 10-15 years, to other land cover, primarily as a result of the introduction of center pivot irrigation.

It is likely that, at first, the introduction of a few irrigated fields actually benefitted the chickens by increasing the patchiness and interspersion of cover types. This may be reflected in the 1974 and 1975 population statistics reported by Queal (Table 9). Viable populations are believed to exist primarily where at least 30%, and perhaps as much as 60%, of the original short grass prairie habitat remains in good condition. Chickens appear to benefit from the existence of some cultivation which, for example, may provide waste grain for winter feeding. The specific proportions, interspersion, and patchy character of habitat types which are optimal for the chicken are, at present, unknown.

Table 9

Lesser Prairie Chicken Population Status

Finney County Route

Year	Total Grounds	Total Chickens/Sq. Mile
1970	16	36.6
1971	12	28.0
1972	11	23.6
1973	12	10.1
1974	18	36.2
1975	20	36.5
1976	9	16.9
1977	14	17.3
1978	9	10.4
1979	8	6.7

Source: Kansas Fish and Game Commission, 1979

At some point, however, it appears that a threshold occurred beyond which continuing conversion of prairie to cropland adversely impacted on chicken populations. As cultivation spread courtship ("booming") grounds were destroyed, an expanding system of roads dissected the prairie fragmenting the Lesser Prairie Chicken populations and disrupting travel, and large field monoculture crops replaced native range vegetation. Field studies of the Lesser Prairie Chicken populations seem to indicate that the species requires substantial short grass juxtaposed with large units of shrub vegetation. Height and density of grass and the horizontal spatial structure of land cover and land use appear especially important to survival of the species.

The Kansas Fish and Game Commission, in recent years, has been attempting to manage the remnant Sandsage prairie in order to maintain the Lesser Prairie Chicken. The agency has, since 1973, used maps of irrigated lands prepared by the KARS Program from LANDSAT imagery to focus management efforts on rapidly changing areas. Land owners have been urged to retain areas of Sandsage prairie in its original virgin condition.

KF&G has been considering the purchase of tracts of Sandsage prairie in southwest Kansas. Of particular interest is an area of some 5,000 acres in Finney County. In order to document and dramatize the extent of the loss of Sandsage prairie, and to aid in decisions related to prairie preservation and purchase, KF&G biologists believed that more specific, current, and spatially extensive data than those available were required. Consequently, KF&G requested that the KARS Program prepare a map portraying teh potential Sandsage prairie in eighteen southwest Kansas counties and the extent to which it has been converted to other land cover and land uses.

The areal extent of potential Sandsage prairie was derived from A. W. Kuchler's map of "The Potential Natural Vegetation of Kansas." The degree and distribution of land use/land cover change within the potential Sandsage prairie was assessed from interpretation of LANDSAT multispectral scanner imagery. Multidate LANDSAT imagery acquired from 1972-1978 was used for mapping. All interpretation and compilation was accomplished at a scale of 1:500,000 using manual techniques.

At the request of KF&G, KARS Program cartographers prepared the final map product at a scale of 1:800,000 in a format suitable for color printing (see attachment, back cover). Photo-mechanical techniques were employed to produce a set of color separation negatives which were subsequently utilized by the University of Kansas Press to print 400 copies of the final color maps. The KF&G provided funds for final product preparation and printing.

The map, and a set of areal statistics delivered by the KARS Program, show that less than 40% of the potential Sandsage prairie remains intact in southwest Kansas. Both the map and statistical data are being used by KF&G to decide on allocation of management efforts to preserve remaining Sandsage prairie and Lesser Prairie Chicken populations.

The map also provides important baseline information. It is probable that the phenomenon of Sandsage prairie-irrigated cropland conversion will be short-lived because center pivot systems rely on groundwater. As aquifers in southwest Kansas show little recharge, severe drawdowns are occurring in the water table. Water is being mined, and, if not depleted, will likely become too expensive to pump from great depths. As water becomes scarce and more expensive, it appears that by the turn of the century a significant proportion of presently irrigated former Sandsage prairie will be converted to other land uses, perhaps in some cases to rangeland. Since it is likely that irrigated agricultural use of the Sandsage prairie will be a relatively short term phenomenon, KF&G planners wish to decide now how to influence future land use change in order to benefit wildlife populations. The map is serving as a tool for such planning and decisions.

Tallgrass Prairie National Park

When European settlers first arrived in the East Central portion of North America, the area was an enormous sea of tallgrass and wildflowers. Bordered by the extensive deciduous forests on the east and the Great Plains on the west, the area extended from Texas to Canada and from Indiana to Kansas. This tallgrass prairie was maintained in a somewhat steady state by three factors, the lack of enough reliable rainfall to sustain dense stands of trees, a harsh continental climate of extremely cold and windy winters and very hot and often very dry summers, and, perhaps most importantly, periodic fires which swept large areas of the prairie destroying woody vegetation and enccuraging the growth of grasses. The western edge of the tallgrass prairie was the Flint Hills of east central Kansas. West of this region rainfall declines enough that only a shortgrass prairie can be sustained.

Ecologically the prairie is a very rich system. The grassland vegetation produces a large quantity of vegetative matter which is continually returned to the soil either as decomposed organic material or as the ashes of periodic fires. Rainfall is enough to sustain this grassland growth and encourage a moderate rate of decomposition but not so much as to wash the organic matter and nutrients out of the soil. As a result some of the richest and deepest

topsoil layers in the world are found beneath prairie grasses and particularly tallgrass prairie areas in the central U.S.

The richness of the prairie soils, which aid and encourage the persistence of the dense growth of grasses and wildflowers, has ironically been a reason for the destruction of the prairie ecosystem by man. Not only does the soil support grasses but it can also be turned into very rich and productive farmland, producing rich harvests of corn, wheat, sorghum and other grains. Thus the tallgrass prairie, which originally encompassed some 400,000 square miles has been plowed, planted and built on to the point that only about 1% of the total original area remains.

The largest single continuous area of tallgrass prairie that still remains is in the Flint Hills of Kansas and the Osage Hills of Oklahoma. For several years there has been a movement concerned with preserving this last remnant of what was once one of the dominant ecosystems of North America. Support for preservation comes from the National Wildlife Federation, the Isaac Walton League, the World Wildlife Fund and numerous other conservation organizations around the country. Also supporting efforts at preservation is the National Park Service, which has designated preservation of some part of the tallgrass prairie as its number one objective after preservation of portions of the Alaska wilderness.

The drive for preservation has been spearheaded for several years by a Kansas-based group called Save the Tallgrass Prairie, Inc. The efforts have been concentrated in three activities. The first of these is the development of a plan for choosing and preserving a portion of the tallgrass prairie. Their efforts in this area have revolved around the study of three sites in the Flint Hills, one of which overlaps into a portion of Oklahoma. Their final objective is to have one or more of these sites declared a National Park.

The second of their activities has been writing, speaking and organizing public support for the idea of a Prairie National Park. There is a relatively stiff and vocal opposition to the idea of a park, most of which comes from land owners in the area of the three sites who fear having their land "taken over" by the federal government. Thus the park supporters have to not only develop support for, but also overcome opposition to the development of the park.

The third of the group's activities revolves around a scientific advisory panel, made up of well-known researchers and students of the prairie region. Consisting of about 18 experts from such disciplines as biology, botany, ecology, geography, geology and wildlife management, the task of the panel is to collect and analyze information about the environment of the tallgrass prairie, and, in particular, the three sites under consideration for designation as a park.

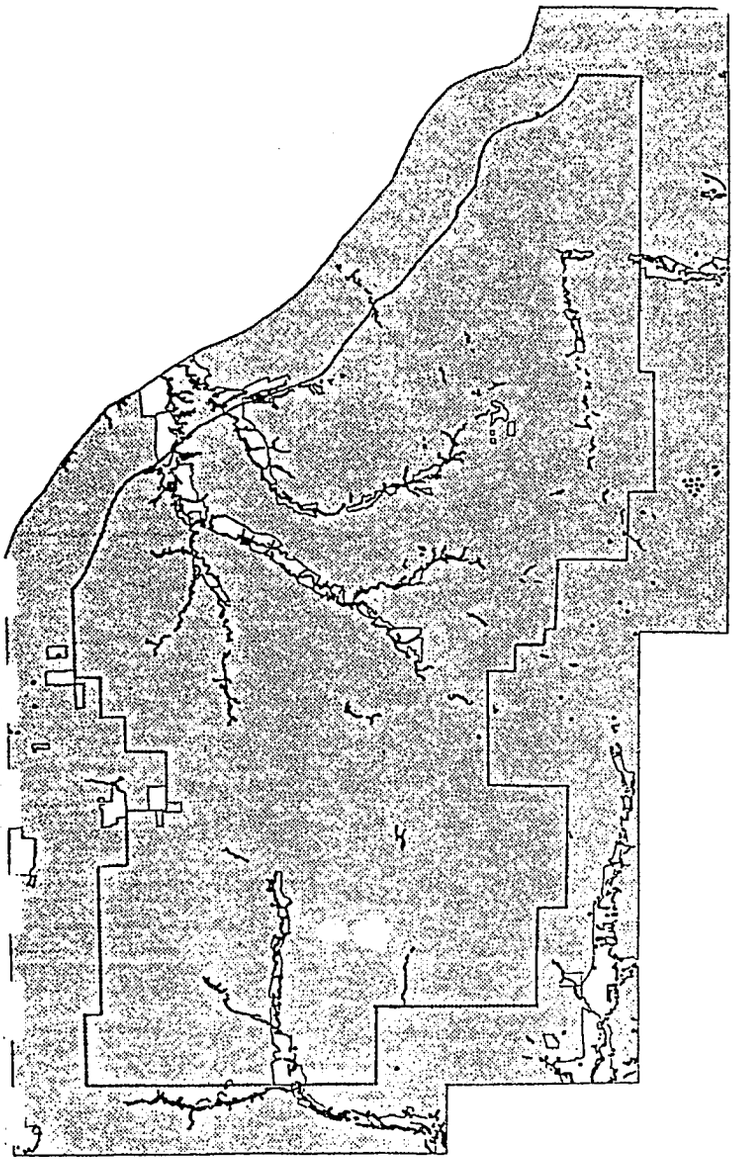
In March of 1979, Professor Dwight Platt, Chairman of the Scientific Advisory Panel, requested the assistance of the KARS Program in developing current land use information for their proposed sites. Information was needed on four major categories of land use -- rangeland, woodland, cropland and water impoundments. KARS personnel added a fifth category of Farmsteads/Residential to provide a more comprehensive land cover analysis.

By prior arrangement, the National Aeronautics and Space Administration (NASA) provided high-altitude color infrared imagery over the proposed sites in July, 1977. The imagery was flown by a U-2 aircraft operating at an altitude of 60,500 feet, providing an image aquisition scale of 1:121,000 (approximately $\frac{1}{2}$" = one mile).

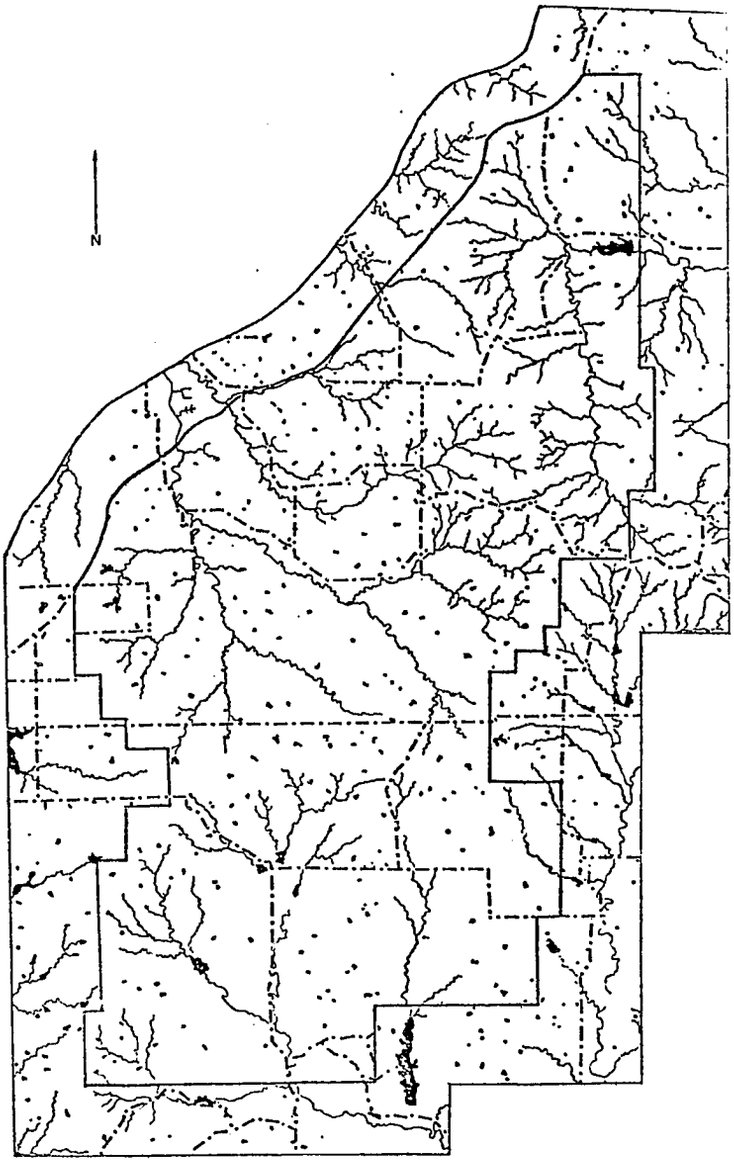
The Panel also requested an analysis of the area five miles beyond the proposed site boundaries for future easement purposes. Due to limits in the photo coverage, the interpretation for areas outside the site boundaries was limited to one mile.

The interpretation was performed using standard image interpretation techniques at the acquisition scale of the photography. Acreage statistics were compiled from the penciled interpretation maps using a Hewlett-Packard 9100B Calculator with a 9107A Digitizer/Planimeter. Statistics were compiled only for the area within the proposed site boundaries.

At a meeting of the Advisory Panel in June of 1979 the KARS Program made a presentation of its findings and distributed maps (see Figure 5) and statistics to members of the panel. This information is being included in a summary report being prepared by the panel for presentation in upcoming congressional hearings on the park. Legislation has been introduced in the U.S. Congress by Rep. Larry Winn of Kansas that would provide for the establishment of national park in the Flint Hills area. It is anticipated that when hearings begin, the KARS Program will be called upon to prepare briefing materials outlining its findings.



CHASE SOUTH -- Land use



CHASE SOUTH -- Streams, ponds, & roads

KEY FOR TALLGRASS PRAIRIE MAPS

BASE DATA

- Streams
- Ponds
- Roads
- Study Area Boundary

LAND USE

- Woodland
- Cropland
- Rangeland
- Rural Dwelling
- Urban Area

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OF POOR QUALITY

Figure 5.

Urban and Regional Planning

Mapping Land Use in Saline County, Kansas

Saline County, Kansas covers an area of approximately 720 square miles (460,000 acres) in the central portion of the State. The western half of the county skirts the eastern edge of the High Plains and consists of steeply rolling hills with narrow and deep stream valleys. In the east the county is characterized by gently rolling hills of low relief. Three major rivers, the Smokey Hill, the Saline and the Solomon, and a small number of intermittent streams drain the county. A 1976 study of land use in Saline County showed cropland to be the predominant land use in Saline County.

A land use plan for Saline County, prepared in 1976 by a firm of consulting engineers and planners (White, Hunsley and Associates) set forth general guidelines for prospective physical development within the county. Because the majority of land within the county is devoted to agriculture, and a large portion of this land lies within floodplain areas, the land use plan placed a strong emphasis on regulations for development of these areas. The plan also covered guidelines for future land use change pertinent to residential, commercial, industrial and institutional areas.

In 1978 the Saline County Department of Planning and Zoning re-evaluated the 1976 land use plan. The members of the department decided that the policies and resolutions that were set forth by the 1976 plan were either insufficent or too flexible to deal with the current problems of uncontrolled residential expansion onto prime agricultural land. In addition to the problem of the loss of prime agricultural land, uncontrolled residential expansion had placed stress on both the groundwater system and the rural sanitation system. As a result, the Saline County Department of Planning and Zoning decided to develop a new land use plan for the county that would institute revised zoning regulations designed to better protect valuable prime agricultural land.

In March, 1979, the Saline County, Kansas Department of Planning and Zoning personnel contacted the KARS Program with a request for an updated analysis of land use and land cover for the county. In order to draft a new land use plan, the Department required maps that depicted the current distribution of land use and the location of prime agricultural land in the county.

Due to the requirements of the Department, it was determined that two maps at a scale of 1:125,000 would have to be prepared, a five category land use/land cover map and a map delineating the distribution of prime agricultural land. Black and white panchromatic aerial photography at a scale of 1:80,000 was purchased by the Department from the U.S. Geological Survey for the time period February 8-10, 1977. Because the aerial coverage for the county was imcomplete,

LANDSAT imagery was used on a supplemental basis. Soil Conservation Service (SCS) soil survey maps were used in the identification of prime agricultural land.

The land use categories used were:

1. Cropland -- Any land where grain or forage crops are being produced. Farmsteads were incorporated into this category.

2. Grassland -- Land which is predominantly covered by grasses, either native rangeland or maintained pasture land.

3. Woodland -- Areas that have tree crown closure of 20% or more. Includes everygreen, deciduous and mixed stands.

4. Urban/Built-up Land -- Building density greater than one structure per 10 acres. This does not include individual farmsteads.

5. Water -- Major river and ponds within the county.

The development of the prime agricultural map consisted of three phases: (1) compilation from the SCS soil survey maps, (2) reduction to 1:125,000 scale and (3) drafting of the final product. A list of the county's 222 soil types and associated slopes was provided to the KARS Program by the Soil Conservation Service. SCS identified 122 soil/slope types as prime agricultural. The prime agricultural areas were delineated on copies of the SCS soils maps.

The development of the land use/land cover map consisted of four parts: (1) interpretation of aerial photography, (2) field checking, (3) correction of the interpretation, and (4) drafting of the final map. (See Figure 6). The two mile wide swath along the western boundary of the county that was interpreted from LANDSAT data was registered to the adjoining interpretation and thus, demonstrated the viability of LANDSAT for future investigations of this type.

The Saline Department of Planning and Zoning will use both map products to aid in the development of a new Land Use Plan for Saline County. The information portrayed in the two maps will be helpful in decision-making related to future land use development. It is hoped that the new Land Use Plan will help to preserve valuable prime agricultural land from urban encroachment and avoid urban development in hazardous flood-prone areas of the county.

III. OTHER KARS ACTIVITIES

III. OTHER KARS ACTIVITIES

Wildlife Habitat Inventory for the Proposed Pine Ford Lake, Missouri

Pine Ford Lake is a proposed U.S. Army of Corps of Engineers (Corps) multiple purpose reservoir project. The proposed project site lies on the Big River in the Meramec River Watershed approximately 45 miles southwest of St. Louis, Missouri. The project area covers some 110,000 acres including portions of Jefferson, Franklin, Washington and St. Francois Counties, Missouri. If constructed, the lake, at normal pool, will have a surface area of about 3,700 acres and a shoreline of approximately 60 miles, and will receive drainage from an area of some 613 square miles.

Preconstruction planning for Pine Ford Lake is being coordinated by the St. Louis District of the Corps. An important element of this planning process is the evaluation of the impact that such a reservoir would have on fish and wildlife resources in the project environs. This evaluation is being carried out by the U.S. Fish and Wildlife Service's (FWS) Kansas City Area office.

In January 1980 the University of Kansas Applied Remote Sensing (KARS) Program was commissioned by the FWS to prepare a land use/land cover map of the proposed Pine Ford Lake project area. The map (see Figure 7) was accompanied by areal statistical data summarizing the acreages of the land use/land cover types mapped. Both the map and areal statistics will be used by FWS in an evaluation of wildlife habitat in the project area, and will provide FWS the basic data to decide on the requirements for mitigation of reservoir impacts on fish and wildlife habitat.

The KARS Program provided to the FWS the following products:

1. Two copies of a color land use/land cover map of the proposed Pine Ford Lake project area prepared on a stable-base medium at a scale of 1:63,360 (one inch = one mile);
2. One set of color separation negatives which may be utilized by FWS, at its discretion, to produce additional copies of the land use/land cover map;
3. Acreage statistics for each land use/land cover type mapped derived from measurements taken from the 1:63,360 map; and,
4. A final report documenting map preparation, acreage calculations, field checking and related matters.

Data Sources:

Land use/land cover information was derived, principally, from two sets of aerial photographs. Large scale (1:24,000) natural color stereo aerial photo prints acquired in March and April, 1976 served as the primary data source.

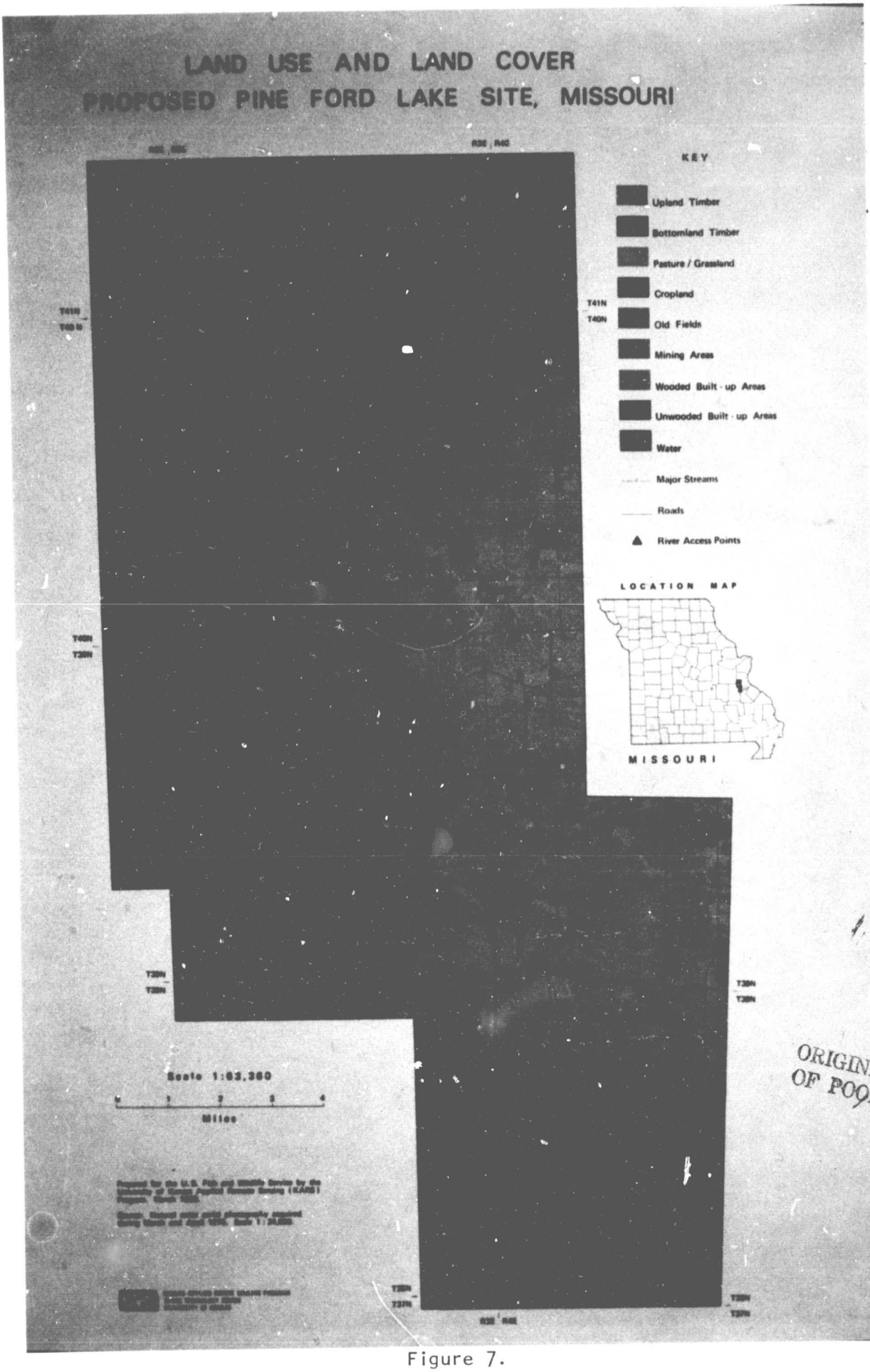
LAND USE AND LAND COVER
PROPOSED PINE FORD LAKE SITE, MISSOURI
KEY
Upland Timber
Bottomland Timber
Pasture / Grassland
Cropland
Old Fields
Mining Areas
Wooded Built - up Areas
Unwooded Built - up Areas
Water
Major Streams
Roads
River Access Points
LOCATION MAP
MISSOURI
T41N
T40N
T39N
T38N
Scale 1:63,360
Miles

Figure 7.

These photos were supplemented by high altitude color infrared aerial photographs (acquisition scale approximately 1:124,000) enlarged to a print scale of approximately 1:62,500. The high altitude photos were acquired during September 1974.

Collateral data sources used included (1) the most recent U.S. Geological Survey (USGS) topographic quadrangels and orthophoto maps available for the project area at the largest scale obtainable; (2) Missouri State Highway Department county road maps of Jefferson, Washington, Franklin and St. Francois Counties (at scales of both ½ inch/mile and 1 inch/mile; (3) U.S. Geological Survey 1:250,000 scale generalized land use/land cover maps prepared in 1974 for the USGS Land Use Data Analysis (LUDA) program (St. Louis and Rolla quadrangles); and (4) selected published material concerning the southeast Missouri site. A field trip to the area conducted subsequent to initial photo interpretation provided additional information.

Land Use/Land Cover Classification:

Land use/land cover classes to be portrayed on the map were defined by mutual agreement of FWS and the KARS Program, and were based upon FWS data requirements and a preliminary analysis by the KARS Program of the capacity for accurately distinguishing the desired cover classes on aerial photography which would constitute the primary source of cover data.

Nine land use/land cover classes were defined. They are as follows:

1. Bottomland Timber -- Riparian and other primarily woody vegetation located on floodplains.

2. Upland Timber -- All other areas of woody vegetation having a crown closure of at least 20% except for wooded areas within the confines of "old fields" or included under the category "wooded built-up areas" (see below).

3. Old Fields -- Fields apparently formerly cultivated or intensively grazed, now abandoned and reverting to woodland cover. Such fields exhibit variable amounts of woody cover depending upon their successional stage; recently abandoned fields may have only a scattered cover of shrubs and conifers, older fields may be nearly completely wooded.

4. Pastures/Grasslands -- Areas primarily covered with grass (with not greater than 20% woody cover). Such areas may be grazed or ungrazed, but in contrast to "Old Fields," are apparently being maintained as, primarily, grassland.

5. Cropped Fields -- Fields exhibiting evidence of annual cultivation of crops.

6. Mining Areas -- Areas currently mined, being prepared for mining, or recently mined. Such sites include mine spoils, sedimentation ponds and associated structures, roads and disturbed areas.

7. Unwooded Built-up Areas -- Urbanized areas or areas of clustered dwellings, with or without other structures, exhibiting less than 50% woodland cover (dwelling unit density 5 per 10 acres or greater); includes yards, roads, gardens and related land uses; excludes individual isolated farmsteads and structures associated with mining areas.

8. Wooded Build-up Areas -- Urbanized areas or areas of clustered dwellings, with or without other structures, exhibiting greater than 50% woodland cover (dwelling unit density 5 per 10 acres or greater); includes yards, roads, gardens and related land uses; excludes individual isolated farmsteads and structures associated with mining areas.

9. Water -- Perennial natural or man-made lakes and ponds.

No area of land use or land cover smaller than twenty acres in extent was depicted on the final 1:63,360 scale map. Bottomland timber occurring along major rivers was excepted from this rule, and was portrayed whenever possible within the constraints imposed by the mapping scale. Smaller units of land use and land cover than could be accurately portrayed at the 1:63,360 map scale were outlined on compilation overlays to the 1:24,000 aerial photographs used as the primary data source. These overlays will be available for subsequent use should FWS desire, at a later date, more detailed information for selected sites within the project area.

Photo Interpretation:

The 1976 natural color aerial photos served as the primary data source because they were the most recent of the two photo sets available and because they were available in a format suitable for stereo viewing. It was believed important to interpret as much of the area as possible using stereo viewing in order to accurately define floodplains/bottomland timber areas, and because certain other land use/land cover types apparently were associated with specific topographic sites (e.g., cropped fields tended to be in flat, low lying areas).

The 1974 high altitude color infrared photos were used to map a small area not covered by the 1976 photos and, in addition, were used to verify and supplement the natural color photos. They were, for example, found to be useful in discriminating between cropped fields and pastures in many instances. This was due partially to the unique manner in which color infrared film images vegetation types. An even greater factor, however, was that the high altitude photos were acquired later in the growing season than were the natural color photos. Fields

which were bare in March or April often contained a standing crop in the September imagery. The appearance of pastures changed also, but not as dramatically since they were vegetated on both dates. Obviously, some changes in land cover and land use had occurred between the 1974 and 1976 dates of photo coverage, but these were found to be of a small number.

Final Map Production:

Negative scribing techniques were used to prepare a 1:63,360 scale base map of the project area. The base map was compiled on a stable material from 1:63,360 Missouri State Highway Department county highway maps. Portrayed on the base map are county boundaries, section lines, major roads and major rivers; the map is annotated with county names, names of major rivers and township and range numbers. In addition, it is fully titled and includes a project area location map, scale and legend.

Following field verification of the photo interpretation, all overlays were reduced in scale and land use/land cover categories were transferred to a frosted acetate overlay registered to the 1:63,360 scale base map. Because cover classes were interpreted (at a scale of 1:24,000) using a five acre minimum areal mapping unit, while the final map (at a scale of 1:63,360) had a twenty acre minimum areal mapping unit, some generalization of cover class boundaries was required. Riparian vegetation was depicted on the final map wherever possible within the constraints of the 1:63,360 map scale. Negative scribing and photo-mechanical techniques were subsequently utilized to generate a set of color separate composite negatives. These negatives were then employed to produce a color proof map in order to check for registration errors and color acceptability. Two final color maps, on which each land use/land cover category is depicted in a separate color, were prepared on stable base Kwik-Proof™ material.

Calculation of Areal Statistics:

Areal statistics (acreages) were tabulated from the final land use/land cover map. Statistics were reported by section and township, and were also totaled for the entire project area.

Acreage estimates were measured with a set of dot grids having densities of 64 dots/square inch, 114 dots/square inch and 256 dots/square inch. All measurements were made by one interpreter and verified by a second. Acreages summarized for the entire project area are tabulated in Table 10.

Table 10

Areal Statistics

Pine Ford Lake Project Area

(in acres)

1.	Agriculture:			
	Pasture/Grassland	27,850		
	Cropland	7,900		
	Old Fields	4,830		
			Sub Total	40,580
2.	Urban and Built-up Areas			
	Wooded Built-up Areas	290		
	Unwooded Built-up Areas	510		
			Sub Total	800
3.	Timber			
	Upland timber	70,000		
	Bottomland timber	2,920		
			Sub Total	72,920
4.	Mining Areas	3,020		3,020
5.	Water	480		480
			Total acres	117,800

Revised April 1980

Conclusion:

The objective of this project was to inventory major categories of wildlife habitat (land use and land cover) in the vicinity of the proposed Pine Ford Lake in southeastern Missouri. In March, 1980 the KARS Program delivered to the U.S. Fish and Wildlife Service (FWS) Kansas City Area Office the final products prepared for this project. These included two copies of a color land use/land cover map of the Pine Ford Lake area, a set of the color separation negatives used to produce the map, a tabulation of areal statistics for each cover type mapped and a final report outlining photo interpretation, cartographic, mensural and field techniques employed. FWS will use these materials during 1980 to evaluate potential reservoir impacts on wildlife in the Pine Ford Lake area and to decide on requirements for mitigation of such impacts.

Abandoned Mined Lands Inventory and Hazard Assessment in Kansas

Under the Surface Mining Control and Reclamation Act of 1977, the Office of Surface Mining Reclamation and Enforcement (OSM) has responsibility for the identification and reclamation of abandoned coal mines and lands or waters affected by coal mining processes. Areas mined since the law was enacted are now reclaimed by the coal operator. Areas mined prior to the Act were often not reclaimed and hence large areas of these abandoned or "orphan" mines exist, presenting potential health and safety hazards as well as a loss of productive land.

To assist in identification, selection and reclamation of these areas, OSM is developing, through cooperative agreements with agencies in each of the coal-mining states, a national inventory of abandoned coal mine lands (AML) and associated problems. The inventory is being conducted in phases, each providing a more detailed data base than the previous phase. Phase I entailed a bibliographic search of existing documentation on AML locations and problems. Phase II, currently in progress, entails collection of more detailed information on AML areas that present problems of health, safety and general welfare.

Although Kansas currently produces a relatively small quantity of coal, the state was a leading coal producer during the late 1880's and early 1900's. Approximately 48,000 acres of surface mine lands have been abandoned in the state, primarily in Cherokee and Crawford counties, although mining has occurred in 39 counties altogether. Coal mining in Kansas falls under the jurisdiction of the Kansas Corporation Commission (KCC) and the Kansas Mine Board.

The KARS Program and the Institute for Social and Environmental Studies in the Center for Public Affairs (CPA) at the University of Kansas have been working

with the KCC in connection with the AML inventory, and have recently signed a cooperative agreement with OSM to conduct the Phase II inventory. The CPA has been engaged in environmental analysis and public policy projects in Kansas since 1970. The complementary capabilities of KARS and CPA are well suited to this multifaceted environmental analysis study.

The Phase II inventory will be based on data collected from a number of sources. Documented problems, identified during the Phase I inventory, and interviews with federal and state agencies will comprise the initial data collection effort. Existing medium-scale and high altitude color infrared photography will be used to evaluate site conditions and to identify problems resulting from acid spoil conditions and consequent poor re-vegetation.

Interviews with county agency personnel, local officials and area residents will be conducted to identify specific problem areas. On-site visits will be made to evaluate and document the problems.

An important function of the local interviews is to identify the types of problems that are perceived locally to be the most serious. This information will help in future work prioritizing the problem areas for reclamation. KARS and CPA are working closely with the Kansas Mined Land Conservation and Reclamation Office of the KCC, which is developing the state reclamation plan. The data collected during the Phase II inventory will be used in implementing Kansas' reclamation project.

Following the Phase II inventory, a Phase III inventory is planned to refine the data collected under Phase II. The specifications of Phase III will be based on experience gained during Phase II and on the results of a series of prototype studies to be conducted in parallel with the Phase II inventory. One prototype study is planed for each OSM region. The prototype studies are designed to test and refine data collection techniques and to evaluate reclamation cost estimation procedures.

KARS and CPA have been designated to conduct the prototype study for Region IV; Montana, Indiana and Kentucky will conduct the other prototypes. Funding for planning the Kansas prototype commenced in March 1980; the preliminary work plan for the prototype has been submitted and is currently under review by OSM.

APPENDIX I

KARS NEWSLETTER(S)

Kansas Applied Remote Sensing

KARS

Newsletter

The University of Kansas, Lawrence, Kansas | July 1979 | Volume 8, Number 1

PRESENTATIONS AT PECORA

The 5th Annual Pecora Memorial Symposium was held recently at EROS Data Center in Sioux Falls, South Dakota. The conference theme was satellite hydrology, and there were featured sessions on applications of remote sensing to water resources.

Dr. T.H. Lee Williams and Joseph Poracsky of the KARS staff presented a paper entitled "Mapping Irrigated Lands in Western Kansas Using Landsat" at the poster session of water use and management. The session included presentations on irrigation mapping from the USGS High Plains Project and the states of Kansas, Florida and California. It provided a unique opportunity for discussion and comparison of approaches to the study of irrigation mapping.

The KARS irrigation mapping project was conducted during 1978 for the Kansas Legislative Research Department, and it was based on visual interpretation of Landsat imagery (KARS Newsletters, April/July 1978 and October 1978). Continued work on the identification of irrigated lands is being pursued through digital interpretation and analysis. Particular emphasis is being placed on the observation of the effects of local environmental factors on the tonal signature of selected crops.

Dr. Williams and Dr. K.P. Singh of the University of Delhi co-authored a poster presentation entitled "Landsat Ground Water Studies in parts of Haryana and Punjab States, India." The study was conducted earlier this year during Dr. Williams' visit to India. The results demonstrated the utility of Landsat false-color composites in identifying prominent aquifers and areas of recharge, waterlogging and severe salinization in the Indo-Gangetic Plain. There are plans for expansion of this preliminary study.

CURRENT KARS ACTIVITIES ALONG THE ARKANSAS RIVER

On November 15, 1978, representatives of several state and federal government agencies met in Dodge City with a representative of the KARS Program. The meeting was called to discuss current research that each agency had initiated on the Arkansas River in southwest Kansas and possible areas of mutual interest in these studies. Recent low altitude, 1:10,000 scale, color infrared photography flown in July 1978 along the Arkansas River (KARS Newsletter, October 1978) provided the basis for the agencies to exchange ideas concerning their mutual data needs. Those in attendance included representatives from the Kansas Park Authority, Greater Southwestern Regional Planning Commission, U.S. Army Corps of Engineers - Albuquerque, U.S. Geological Survey (USGS) - Garden City, U.S. Fish and Wildlife Service, and Kansas Fish and Game Commission.

As a result of these discussions, the KARS Program has been involved in several new interpretation projects to provide data for three different studies. The Kansas Park Authority and the Greater Southwestern Regional Planning Commission have a joint need for data to be used in selecting six to ten park sites along the river. The U.S. Fish and Wildlife Service and Kansas Fish and Game Commission, both of which allocated funds for the flight, are interested in analyzing wildlife habitat. The USGS is interested in obtaining land cover data for an irrigation project along the Arkansas River in Hamilton and Kearny Counties. The KARS Program is coordinating the data requirements for these studies and will be responsible for producing both tabular data and maps. Any other agency that may have a data need along the Arkansas River should contact M.J. Eger of the KARS Program.

KARS RESEARCH INVESTIGATOR VISITS INDIA

Dr. T.H. Lee Williams, Assistant Professor of Geography and investigator in the KARS Program, recently spent two months in India, advising the development of remote sensing programs at the Center for Soil and Water Management, Haryana Agricultural University. The consultancy visit was conducted under a UNESCO project funded by the United Nations Development Program. A two week national short course on the uses of remote sensing techniques in soil and water resource management was conducted during the visit. Dr. Williams also gave an invited talk at the Indian Space Research Organization (ISRO), Space Applications Center, Ahmedabad, on remote sensing technology transfer, and spoke on remote sensing in soil survey at the Indian Photo-Interpretation Institute, Dehra Dun.

There is currently great interest in India concerning the use of remote sensing techniques, and Haryana Agricultural University is developing a capability in the application of remote sensing for soil and water problems in Haryana. Haryana State is a major agricultural area located in the Indo-Gangetic Plain, and it has undergone extensive irrigation development utilizing a system of canals feeding from rivers originating in the Shivalik Hills. Problems are now occurring from canal seepage and through flow of irrigation water. A rising water table has waterlogged the soils, and this, combined with brackish groundwater, has created soil salinity problems that affect large areas. Another area of current interest in the State lies along the border with Rajasthan where the land is cultivated up to and within the shifting dunes of the Rajasthan Desert.

With the assistance of Dr. Williams, techniques were developed at the Center for using Landsat imagery in mapping and monitoring waterlogging and areas affected by dunes and salinization. Preliminary work was conducted with a Landsat reconnaisance soil survey along the Rajasthan border, and the results were encouraging, since attempts at detecting unstabilized dunes (Torripsamments) were successful. In addition, Landsat imagery proved to be useful in providing groundwater information in the State and aiding in the location of prospective tube well sites and defining aquifer recharge areas.

Dr. Williams is continuing research with Haryana Agricultural University on a soil survey employing Landsat data. In addition, he is working on a joint project with the University and ISRO to map soil moisture from Landsat imagery. In the future, the identification methods derived from this research will be employed by the Indian Earth Resource Satellites, which are scheduled for the mid-1980's.

WATERSHED DEMONSTRATION PROJECT AT SOLDIER CREEK

The Soldier Creek Water Quality and Conservation Project is the first designated rural water quality management area in the state of Kansas. Under the provisions of the 208 Water Quality Planning Program, the states are charged with improving the quality of runoff from agricultural land. The Soldier Creek watershed was selected by the State Conservation Commission as a demonstration project to show the effectiveness of a voluntary water quality control project in implementing Best Management Practices on agriculturally productive land.

The KARS Program is involved with ten other agencies in providing data and technical assistance to the Soldier Creek Water Quality and Conservation Project Steering Committee. The steering committee will incorporate the data and advice from these sources into the general watershed quality plan and use them in developing the strategy for seeking improvements in water quality management practices on individual land parcels.

The KARS Program is providing the steering committee with a series of seven maps showing land use and related factors for the watershed. In addition, a statistical analysis of land use within the watershed is being prepared. Land use data were generated from low altitude, natural color photography of the watershed, which was flown for the Environmental Protection Agency in September 1978. A total of six basic land use categories were incorporated into the base map: cropland, grassland, woodland, residential, water bodies, and quarries. The same photography was also used to map parcels utilizing soil conservation measures (terraces or grass waterways) and those areas exhibiting active surface erosion. Additional map overlays are also being provided to show information derived from non-photographic resources. These include: 1) distribution of soil types; 2) location of water quality monitoring stations; 3) location of tribal and Indian-owned lands; and 4) topographic relief.

These data will be used in conjunction with information supplied by other agencies to isolate those areas with the greatest erosion potential and to designate those areas which currently employ inadequate soil conservation measures.

For further information on this project, contact Ron Shaklee of the KARS Program.

REMOTE SENSING FOR EAGLE HABITAT MAPPING

Within the last several years, wildlife specialists have noticed a resurgence of the winter population of bald eagles along the Kansas River. Hopefully, the combined efforts of the U.S. Fish and Wildlife Service (USF&WS), Dr. James Bee, professor emeritus of mammalogy from the University of Kansas, and the KARS Program will result in a decision to designate a six mile stretch of river as an official winter refuge for bald eagles.

The section of the river under observation extends from the westernmost edge of Lawrence to the point where the Delaware River enters the Kansas River. The confluence of these two rivers usually maintains open water in winter, and the majority of the eagles are observed feeding there.

The KARS Program has completed an aerial documentation of the region in preparation for a joint proposal with Dr. Bee and USF&WS to federally designate the area as a critical habitat. Such legislation would restrict development, access and hunting, especially on the north side of the river, and it would plan for the establishment of public viewing locations.

Information on the bald eagle study is available from M. J. Eger of the KARS Program.

NEW BROCHURE FOR CLINTON STATE PARK

The Kansas Park and Resources Authority (KPRA) is responsible for maintaining nineteen state parks and recreational areas. One of their problems is insuring that current information regarding changes and new developments within the parks is available to the public. The KARS Program is presently working on a demonstration of the use of aerial photography to update park maps as an effective and economical alternative to the more costly and time-consuming method of updating from ground surveys. The demonstration project is being performed by a graduate student intern from the University of Kansas Geography Department, working under the direction of KARS personnel.

The site chosen for the demonstration project is the new Clinton Lake State Park, one of six public use areas currently being developed around Clinton Lake in Douglas County. This site should provide an ideal example of the utility of remote sensing data for updating maps, since it is a rapidly developing park. New facilities are being built such as parking areas, boat ramps, and picnic and camping areas, and it is probable that additional construction will result in a need for map updating.

Although most of the information to be included on the map was derived from recent aerial photographs, field checks were used to verify the interpretation. The field work also provided information on the locations of stone walls and trails. These features are not always visible on aerial photography, since they may be obscured by the canopy of vegetation. The park's proximity to Lawrence greatly facilitated the task of field work.

The proposed design is a brochure format which includes a map and supplementary photographs, a listing of park facilities, and a description of its recreational features. The brochure has been submitted to KPRA for consideration of the effectiveness of aerial photography for updating and improving park maps, and of the desirability of the new format versus the simple park map.

Further information on the Clinton State Park brochure may be obtained by contacting Gray Tappan of the KARS Program.

UPCOMING MEETINGS

10-14 September 1979 SYMPOSIUM ON REMOTE SENSING FOR NATURAL RESOURCES, Moscow, ID. For information, contact Robert C. Heller, College of Forestry, Wildlife, and Range Studies, University of Idaho, Moscow, ID 83843.

17-21 September 1979 ASP-ASCM FALL CONVENTION--OBSERVING AND MEASURING PLANET EARTH, Sioux Falls, SD. Direct inquiries to Fredericka A. Simon, P.O. Box 1837, Sioux Falls, SD 57101.

17-19 October 1979 WESTERN REGIONAL REMOTE SENSING CONFERENCE, King Hall, Naval Postgraduate School, Monterey, CA.

22-26 October 1979 Introductory Course: REMOTE SENSING FOR MINERALS AND MINERAL FUELS, South Dakota School of Mines and Technology, Rapid City, SD. Contact Dr. Charles Thielen, Continuing Education, South Dakota School of Mines and Technology, Rapid City, SD, (605) 394-2480.

23-25 October 1979 THIRD CONFERENCE ON THE ECONOMICS OF REMOTE SENSING INFORMATION SYSTEMS, Lake Tahoe, CA. For details, contact Ms. Terri Wise, 3rd Conference Coordinator, P.O. Box 239, Los Altos, CA 94022, (415) 961-7477.

23-26 October 1979 WATER RESOURCES REMOTE SENSING WORKSHOP, Sioux Falls, SD. Contact Branch of Applications, EROS Data Center, Sioux Falls, SD 57198.

7-9 November 1979 THERMOSENSE II, Albuquerque, NM. For information, contact Stanley A. Morain, Conference Director, Technical Applications Center, University of New Mexico, Albuquerque, NM 87131.

KARS ASSISTS IN COAL SLURRY DEBATE

An item of longstanding controversy in the Kansas State Legislature is that of granting Energy Transportation Systems, Inc. the power of condemnation over sections of Kansas railroad for a coal slurry pipeline. When the bill reappeared before the judiciary committee in February, the KARS Program was asked to prepare a map showing the direct and alternative routes for the proposed pipeline. The 1973 KARS land use map of Kansas was used to delineate routes for the pipeline and also served as a basis for statistical information regarding the types of land use that the pipeline would traverse.

Although the disagreement between the railroads and Energy Transportation Systems, Inc. was settled "out of court" for other political reasons, the KARS Program was informed by Congressman Joseph J. Hoagland of the map's usefulness. The map was used as a visual aid during committee discussions and also served as a reference in the preparation of press releases.

For further information, contact M. J. Eger of the KARS Program.

REMOTE SENSING COURSES AT KU

During the Fall 1979 semester, several academic departments at the University of Kansas will offer coursework in remote sensing. These courses include the following: Geography 426 - "Air Photo Interpretation for Environmental Analysis," Electrical Engineering 766 - "Radar Remote Sensing," and Civil Engineering 785 - "Terrain Analysis" (a course utilizing aerial photography). For further information, please consult the appropriate department or the University of Kansas Bulletin.

INVITATION TO SUBMIT NEWS

The KARS Newsletter encourages its readers to submit news items pertinent to applications of remote sensing in Kansas and the Midwest. Such communication would be a means for persons in the remote sensing field to be kept informed of each others' current work. All contributions will be acknowledged.

The black and white Landsat Mosaic of Kansas is being republished and will soon be available. The accompanying narrative has been updated to include pertinent information on the Landsat satellite and its applications.

The KARS Newsletter is published in January, April, July and October by the University of Kansas Applied Remote Sensing (KARS) Program, located in the Space Technology Center, Raymond Nichols Hall, The University of Kansas. Publication of the KARS Newsletter is supported by NASA Office of University Affairs Grant No. 17-004-024. Contributions of research findings, meeting announcements, publications, and information germane to remote sensing applications in Kansas and the Midwest/Great Plains region are welcome. Inquiries and contributions should be directed to Martha Jean E. Eger, Editor, KARS Newsletter. Phone: (913)864-4775 or KANS-A-N 564-4775.

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Kansas Applied Remote Sensing

KARS Newsletter

The University of Kansas, Lawrence, Kansas October 1979 Volume 8, Number 2

KANSAS LANDSAT DEMONSTRATION PROJECTS NEAR COMPLETION

During August 1979, KARS staff members Jim Merchant and Joe Poracsky worked with ERL personnel Fred Patterson and Greg Burns to evaluate preliminary classified LANDSAT data and to conduct fieldwork on the southwest Kansas test site. Aiding in the work were Gordon O'Dell (Finney County USDA/Agricultural Stabilization and Conservation Service Agent), Ed Jenkins and Mike Dealy (Southwest Kansas Groundwater Management District #3), and, Lee Queal, Bill Hanzlick and Mark Sexson (Kansas Fish and Game Commission). Each of these agency representatives provided unique insights into the agricultural, hydrologic, and natural resource conditions in southwest Kansas, and each discussed his agency's particular data needs and interests which might be met through analysis of LANDSAT data.

Following the work in southwest Kansas, KARS and ERL staff returned to the Space Technology Center in Lawrence to review progress on the demonstration projects and to discuss future efforts. The ERL representatives and KARS staff members Ron Shaklee and Jim Merchant also conducted a field reconnaissance of the Soldier Creek Watershed test site near Topeka.

In order to demonstrate the capability of computer processed LANDSAT data in meeting informational needs of state agencies, NASA's Earth Resources Laboratory (ERL) is analyzing LANDSAT data acquired over two Kansas test sites. One is in the vicinity of Garden City and the other is in the Topeka area. ERL will also provide technical assistance in implementing a state-of-the-art LANDSAT processing system in Kansas.

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In October, Jim Merchant, Joe Poracsky and Kit Gunn will be traveling to ERL to continue work on the Kansas demonstration projects. It is anticipated that the initial products will be available for agency evaluation in late fall of 1979.

(Jim Merchant)

Personnel collecting field data for the southwest Kansas demonstration project. Present are, from left, Fred Patterson, NASA, Jim Merchant, KARS, Bill Hanzlick, Mark Sexson, and Lee Queal, Kansas Fish and Game.

KARS EXHIBIT AT THE FAIR

The Kansas Applied Remote Sensing Program, along with the Remote Sensing Laboratory, provided feature displays at the State Fair in Hutchinson, Kansas on September 11th and 12th. The displays were part of a K.U. booth located in the Commercial Building. Both displays summarized the University's remote sensing research and applications programs, especially as they relate to Kansas agriculture.

(Robert L. Walters, Manager of Research Facilities)

CURRENT KARS PERSONNEL

Because of recent additions and changes in KARS personnel, a list of the current KARS Staff members and their associated interests is presented below. Their varied backgrounds are indicators of the interdisciplinary nature of this remote sensing program.

Prof. B. G. Barr is the director of the KARS Program. He is a professor of mechanical engineering, with interests in the applications of remote sensing and the transfer of new technologies.

The project coordinator is Dr. Ed Martinko. A professor of environmental studies, his interests lie in the applications of remote sensing to vegetation and habitat evaluation.

Dr. Lee Williams, Assistant Professor of Geography, is a research investigator with the KARS Program. His research emphasis is in LANDSAT applications to agriculture, and he has been involved in irrigation and ground water studies. (See KARS Newsletter, July 1979)

Jim Merchant recently returned to the program after a year's work with the integrated natural resources inventory in Maryland. His current emphasis is in developing an operational system of computer analysis and classification of remote sensing data.

Joe Poracsky has extensive background in interpretation and cartographic production techniques. He has done considerable research in the applications of computer classification to irrigation mapping in southwest Kansas.

Ron Shaklee's primary interests are directed toward urban and regional planning. He has conducted several projects with local planning departments, which he has recently initiated.

Martha Jean Eger has a special interest in remote sensing's applications to geology. She recently graduated from Dartmouth College, where she did her undergraduate degree in geology and gained knowledge and experience with LANDSAT interpretation.

A graduate of the University of Kansas, Gray Tappan has worked with remote sensing in mapping projects. During spring and summer 1979, he worked on a demonstration project which utilized remote sensing to update state park maps. (See KARS Newsletter, July 1979).

Tim Fast emphasizes cartographic design and products as his specialty. Along with Joe Poracsky, he will be responsible for many KARS final products. A 1977 graduate of Beloit College, Tim joined the KARS Program in September.

Kit Gunn, also new to the program, is interested in the role of the computer in remote sensing work, especially on a small scale (specific zoning and demographics). Prior to coming to Lawrence, Kit worked as a reporter for the Salina Journal.

Several months ago, the KARS Program added several undergraduate assistants to the staff to assist in KARS activities while they increase their knowledge of remote sensing. Lisa Abrams, of Overland Park, Kansas, is working on a B.A. in economics. Liz Kipp of Delaware, is completing her B.S. in plant science from the University of Delaware. Emily Roth, from Slidell, Louisiana, is a senior majoring in biology, with a secondary interest in cartography.

KARS ASSISTS DEVELOPMENT OF SALINE COUNTY PLAN

The KARS Program is currently working with the Saline County Department of Planning and Zoning to assist in the development of a new comprehensive county land use plan. In a recent evaluation, the planning department decided that the current guidelines were inadequate for the county's needs.

Saline County is presently experiencing uncontrolled rural residential development, especially in the peripheral areas around Salina. Such expansion is resulting in physical and cultural problems. Haphazard development is usurping valuable prime agricultural land, particularly along major rural roads, and there is added stress on the groundwater system, since the rural sanitation systems are not as well developed as those in urban areas. Urban fringe dwellers also create tax burdens on adjacent communities, because they utilize municipal facilities for which they do not pay taxes. Finally, the unplanned partial development has degraded the land value and reduced its desirability for total development in the future.

The KARS Program will provide the planning department with a land cover map and an accompanying overlay. Six land use categories will be incorporated into the map: cropland, grassland, range, woodland, urban areas, and water bodies. The categories will be interpreted from LANDSAT and USGS aerial photography. The overlay, registered to the map, will delineate all land designated as prime agricultural, according to SCS soil maps of Saline County.

The data provided will be used to design a system to manage and preserve prime agricultural land and to develop and enforce the new plan, which will be tailored to the needs of Saline County.

(M. J. Eger)

GRADUATE EXCHANGE STUDENT AT KARS

Mr. Rainer Kleinmann, a graduate student studying geodesy at the University of Bonn, Germany, worked in the KARS Program during the period July-September as part of an exchange agreement between the University of Bonn and the University of Kansas. During that period, Rainer worked on a variety of KARS activities including musk thistle detection, prime agricultural land determination and development of computer programs for manipulating LANDSAT digital data. Rainer will be returning to the University of Bonn in October to complete work on his graduate degree.

KARS PARTICIPATION IN PROFESSIONAL ACTIVITIES

During recent months, KARS staff have participated in a wide variety of professional meetings, workshops, and short courses. These activities have provided opportunities for staff members to present accomplishments of KARS research and applications projects, receive advanced training in new research tools, and discuss with colleagues new trends and possibilities in remote sensing.

In June, Dr. Ed Martinko, KARS Project Coordinator, was an invited participant in the Faculty Institute on the Environmental Impact Statement held at Argonne National Laboratories, Chicago, Illinois. This institute, sponsored by the Department of Energy, presented a detailed analysis of the entire environmental impact preparation process.

Also in June, KARS staff members Joe Poracsky and Dr. Lee Williams presented results from their research on "Mapping Irrigated Lands in Western Kansas from LANDSAT" at the Fifth Annual William T. Pecora Symposium/American Water Resources Association International Symposium on Satellite Hydrology, Sioux Falls, S. D. Joe spoke at the June 22 meeting of the Save The Tall Grass Prairie, Inc. Scientific Advisory Panel held at Bethel College in Newton, Kansas. At this meeting he presented land cover maps and areal statistics for three proposed Tall Grass Prairie National Park sites evaluated by the KARS Program, and discussed remote sensing techniques used to acquire the information.

From July 11-13, Joe Poracsky attended the "Land Use Mapping Seminar/Workshop" at the USGS National Cartographic Information Center in Rolla, Missouri.

On July 16, Dr. Martinko and Jim Merchant attended the annual meeting of the National Association of Counties in Kansas. Dr. Martinko, an invited participant in a session on Remote Sensing Applied to Local Government's Needs, presented a review of KARS projects undertaken with county and regional governments. Jim Merchant and Joe Poracsky, on July 24, presented a poster on the KARS Program and remote sensing applications in Kansas at a special session "Applications of Remote Sensing in the Great Plains," held at the annual meeting of the Great Plains Agricultural Council in Amarillo, Texas.

Dr. Lee Williams and Joe Poracsky spoke, in August, at a meeting of the Kansas Ground Water Management Districts held in Halstead, Kansas. Their topic was the ongoing KARS research to accurately map irrigated lands using remote sensing techniques.

During the week of September 10-14, Jim Merchant and Dr. Martinko represented the KARS Program at the Symposium on Remote Sensing for Natural Resources held at the University of Idaho, Moscow, Idaho. Further information regarding this conference, or any others noted above, may be obtained by contacting the KARS staff person involved.

MEETINGS AND WORKSHOPS

4-8 November 1979 FOURTH INTERNATIONAL SYMPOSIUM ON COMPUTER ASSISTED CARTOGRAPHY, Reston, VA. For information, contact Robert T. Aangeenbrug, Department of Geography-Meteorology, University of Kansas, Lawrence, KS 66045, (913) 864-4546.

5-9 November 1979 APPLIED REMOTE SENSING FOR SOIL INVENTORY AND ASSESSMENT, Pleasant Hill, CA. Contact: Sharon Arce', UCB Extension, (415) 642-1061.

7-9 November 1979 THERMOSENSE II, Albuquerque, NM. Direct inquiries to Stanley A. Morain, Technical Applications Center, University of New Mexico, Albuquerque, NM 87131.

14-15 November 1979 LANDSAT/GEOBASED INFORMATION SYSTEMS SYMPOSIUM, Biloxi, Mississippi. Contact: Bob Barlow, Earth Resources Laboratory, (601) 688-2042.

15-16 November 1979 SYMPOSIUM ON THE IDENTIFICATION OF IRRIGATED LANDS USING REMOTE SENSING TECHNIQUES, Sioux Falls, SD. Contact: Missouri River Basin Commission, Suite 403, 10050 Regency Circle, Omaha, NE 68114, (402) 397-5714.

25-29 February 1980 EIGHTH ALBERTA REMOTE SENSING COURSE, Edmonton, Alberta. Contact: The Alberta Remote Sensing Center, 11th Floor Oxbridge Place, 9820-106 Street, Edmonton, Alberta, Canada.

17-21 March 1980 THE APPLICATION OF REMOTE SENSING TECHNIQUES TO ENVIRONMENTAL RESOURCE PROBLEMS, Terre Haute, IN. For information contact Dr. Paul W. Mausel, Director, ISURSL, Department of Geography and Geology, Indiana State University, Terre Haute, IN 47809, (812) 232-6311, ext. 2444.

KARS TO MAP TWO KANSAS WATERSHEDS

The KARS Program has recently entered into a contractual agreement with the Soil Conservation Service to provide land use and land cover information for Pony Creek and Roy's Creek in Northeast Kansas. The combined watersheds encompass an area of 104 square miles in Brown County. The analysis will include the interpretation and mapping of mixed land use and land cover categories. Land conservation practices, gully patterns and flood plain scour will be incorporated into the analysis in addition to the general land use and land cover analysis. Low altitude black and white imagery of varying scales will be used for the interpretation procedure.

A comparison will be made between 1970 and 1979 image sources to provide a temporal analysis of land use changes and the changes in gully formation and flood plain scour. At the conclusion of the interpretation and mapping efforts, SCS will be provided with a series of map overlays that depict land use and land cover in the watershed. Statistical summaries will also be provided.

(Ron Shaklee)

MAPPING RANGE CONDITION IN CIMARRON NATIONAL GRASSLAND

The KARS Program has initiated a project with the U.S. Forest Service (USFS) to evaluate LANDSAT's capability to provide information on vegetation and range condition in and around the Cimarron National Grassland, Morton County, Kansas. Computer processed LANDSAT digital data will be used to study the distribution of sagebrush and yucca, to analyze grassland conditions, and to map other cover types. Accurate maps of such information will assist Don Mecklenburg in deciding where to implement sage and yucca control measures, where to focus re-seeding and species composition improvement efforts, and how to allocate grazing leases more effectively.

An initial field reconnaissance was carried out during August by USFS Range Conservationist Jim Cresap and KARS staff members Jim Merchant and Joe Poracsky. The project's first phase is scheduled for completion by early 1980.

(Jim Merchant)

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KARS Newsletter
Space Technology Center
2291 Irving Hill Drive--Campus West
Lawrence, Kansas 66044

KARS Newsletter

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LEGISLATORS BRIEFED ON REMOTE SENSING APPLICATIONS IN KANSAS

On January 16, 1980 representatives of the KARS Program were privileged to present to state legislators an overview of remote sensing, the LANDSAT program and remote sensing applications projects which have been carried out by the KARS Program with Kansas agencies. The KARS Program has been funded by NASA since 1972 to assist Kansas public agencies in utilizing satellite and aerial remote sensing technology. Cooperative demonstration projects have been undertaken with more than forty state, federal, regional and local agencies.

Following an introduction by Representative Vogel of the Kansas House, Professor B. G. Barr presents an overview of the KARS Program and the Space Technology Center for State legislators.

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Professor B. G. Barr, Director of the KU Space Technology Center, and Dr. Edward A. Martinko, KARS Project Coordinator, spoke before a joint session of the House and Senate Committees on Agriculture and Livestock at the invitation of Representative John H. Vogel, Chairperson of the House Committee. Also in attendance were members of the House and Senate Committee on Energy and Natural Resources, and representatives of other legislative committees. Approximately 75 legislators, aides and state agency representatives attended the presentation at the State Capitol in Topeka.

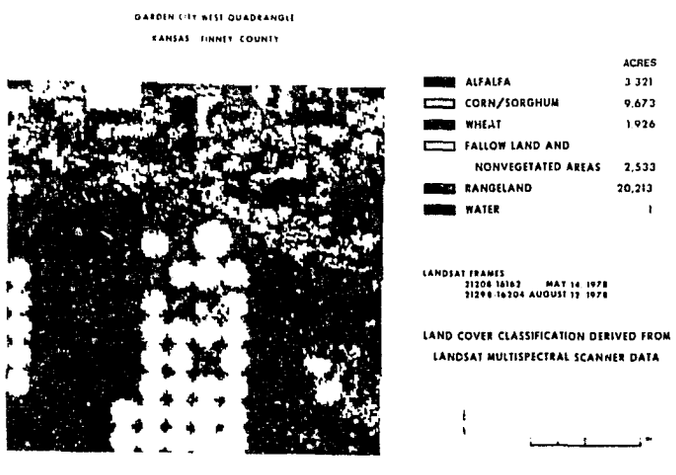
LAND COVER MAPS OF SOUTHWEST KANSAS LANDSAT DEMONSTRATION PROJECT AREA COMPLETED

NASA's Earth Resources Laboratory (ERL) has delivered to the KARS Program three maps portraying land cover in portions of southwest Kansas. The maps were prepared from computer processed LANDSAT data under a cooperative KARS/NASA project designed to demonstrate LANDSAT's digital capabilities for meeting the information needs of state agencies. KARS staff used the maps in briefing state legislators on the LANDSAT program during a presentation on January 16, 1980.

Crop types, irrigated lands, rangelands and other cover classes are portrayed on the maps in a variety of colors. One of the maps shows the entire nine county study area at a scale of 1:250,000. The two other maps, at a scale of 1:24,000, depict land cover near Lowe and near Holcomb in Finney County. On these two maps areas of land cover as small as 1.1 acre are shown. KARS staff and agency personnel are evaluating the land cover classifications and the utility of the maps for a variety of agency applications.

Jim Merchant, KARS Program, (foreground) and Greg Burns, NASA/ERL, identify land cover types on a computer classified LANDSAT scene of southwest Kansas.

NASA is providing continuing technical assistance and training to enable the KARS Program to implement advanced LANDSAT computer processing in Kansas. In October, KARS staff members Jim Merchant, Joe Poracsky and Kit Gunn spent a week at the Earth Resources Laboratory near Bay St. Louis, Mississippi. During the visit they received training in using state-of-the-art NASA computer software, worked with ERL staff on the southwest Kansas demonstration project and discussed plans for, and possible problems which might be encountered in, upgrading existing LANDSAT processing capabilities at the University of Kansas Space Technology Center.



Land cover near Garden City, Kansas was classified by computer processing LANDSAT digital data. Note the center pivot irrigation systems.

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NATIONAL CONFERENCE ON REMOTE SENSING FOR RESOURCE MANAGEMENT TO BE HELD IN KANSAS CITY

"Remote Sensing for Resource Management" will be the theme of a national conference, October 28-30, 1980, at the Radisson Muehlebach Hotel in Kansas City, Missouri. The conference will be sponsored by the Soil Conservation Society of America (SCSA) in cooperation with the National Aeronautics and Space Administration (NASA).

The conference will bring together leaders in remote sensing and natural resource management to discuss the practical application of remote sensing technologies to natural resources management. The program will feature numerous case histories and examples of how information collected by remote sensing can be used to solve natural resource management-related problems. Chris J. Johannsen, state extension specialist in land use at the University of Missouri, Columbia, has been named chairman of the program committee for the conference.

In addition to general sessions on remote sensing and its application to natural resources management, the conference will feature concurrent sessions arranged according to resource problem areas and user disciplines. "Most people involved with cultural and natural resources, such as planners, conservationists, extension specialists, agricultural producers, representatives of industry and federal, state and local government personnel, will find topics and applications pertaining to their fields of interest," Johannsen said.

Over 75 exhibits of applications results and remote sensing equipment are planned. Field trips will be designed to augment the conference theme, and will include among others, a tour of KARS laboratories at the University of Kansas Space Technology Center, and tours of agricultural and natural resources points of interest in the Kansas City area. Additional details may be obtained from Mr. James Sanders, Soil Conservation Society of America, 7515 Northeast Ankeny Road, Ankeny, Iowa 50021.

NOAA TO MANAGE LANDSAT

On November 20, President Carter announced that the National Oceanic and Atmospheric Administration of the Department of Commerce (NOAA) will manage all civilian remote sensing activities, including the LANDSAT program. This step will provide the means to transform LANDSAT from its current experimental and developmental state to an operational system for gathering land and water resource data. This significant decision will ensure the continuity of resource data

(NOAA-Continued on page 4)

to be available around July 1. For more information contact:

Missouri River Basin Commission
10050 Regency Circle, Suite 403
Omaha, Nebraska 68114
Attention: Mr. Don Ohnstad
(402) 397-5714 (FTS) 864-9351

UPCOMING EVENTS

9-14 March 1980 AMERICAN CONGRESS FOR SURVEYING AND MAPPING-AMERICAN SOCIETY OF PHOTOGRAMMETRY CONVENTION, St. Louis, Missouri. For further information contact: Dr. Gerald M. Elphingstone, ASP Technical Program Chairman, 2576 Pioneer Drive, St. Louis, Missouri 63129, 314-263-4368.

17-21 March 1980 SHORT COURSE: THE APPLICATIONS OF REMOTE SENSING TECHNIQUES TO ENVIRONMENTAL RESOURCE PROBLEMS. For further information contact: Dr. Paul Mausel, ISURSL, Department of Geography and Geology, Indiana State Univ. Terre Haute, Indiana 47809. 812-232-6311.

28 March 1980 ANNUAL MEETING OF THE KANSAS ACADEMY OF SCIENCE, Fort Hays State University, Hays, Kansas. Contact: Gaylen Neufeid, Secretary, Kansas Academy of Science, Emporia State University, Emporia, Kansas 66801.

2-30 April 1980 SHORT COURSES: AN OVERVIEW OF REMOTE SENSING, Various cities throughout Kansas. Contact: James Merchant, KARS Program, KU Space Technology Center, 2291 Irving Hill Drive, Lawrence, Kansas 66045. 913-864-4775.

23-30 April 1980 FOURTEENTH INTERNATIONAL SYMPOSIUM ON REMOTE SENSING OF THE ENVIRONMENT, San Jose, Costa Rica. Contact: Dr. Jerald Cook, Environmental Research Institute of Michigan, P.O. Box 8618, Ann Arbor, MI 48107, 313-994-1200.

21-23 May 1980 SIXTH CANADIAN SYMPOSIUM ON REMOTE SENSING, Halifax, Nova Scotia. Contact: Mr. Graham Doyle, c/o CBCL Ltd., P.O. Box 1269 N, Halifax, N.S., B3K 5H4, Canada. 902-749-7241.

3-6 June 1980 SYMPOSIUM ON MACHINE PROCESSING OF REMOTELY SENSED DATA, Sponsored jointly by the International Soil Science Society and Purdue University. Contact: Professor Marion F. Baumgardner, Purdue University, LARS, 1220 Potter Drive, West Lafayette, Indiana 47906. 317-749-2052.

11-15 August and 8-12 September 1980 SHORT COURSES: FUNDAMENTALS OF APPLIED REMOTE SENSING, Lawrence, Kansas. Contact: James Merchant, KARS Program, KU Space Technology Center, 2291 Irving Hill Drive, Lawrence, Kansas 66045. 913-864-4775.

28-30 October 1980 SYMPOSIUM ON REMOTE SENSING FOR RESOURCE MANAGEMENT, Soil Conservation Society of America, Kansas City, Missouri. Contact: Mr. James Sanders, Soil Conservation Society of America, 7515 Northeast Ankeny Road, Ankeny, Iowa 50021.

LANDSAT SYSTEMS UPDATE

(Condensed and reprinted with permission of ERRSAC's REFLECTIONS)

The multispectral scanner (MSS) on Landsat 2 is operating well. One tape recorder is functioning routinely although it has exceeded by 300 hours its designed lifetime of about 1,000 hours. However, the satellite is starting to run out of attitude control gas. On November 5 a gas conservation plan was begun. Landsat 2 will take data on only five or six consecutive orbits per day. These data collection orbits will probably cover foreign agricultural areas of U.S. interest. Thus there will no longer be 9-day coverage of the United States using both Landsats, but will have 18-day coverage using only Landsat 3.

Both Landsats 2 and 3 have an intermittent line start delay problem that has affected a small percentage of the data. This occurs sporadically, and is caused by a failure of the MSS to receive a line start pulse from the light-emitting diode system. If this pulse is not received, it is automatically generated in the MSS some 9 milli-seconds later, but this delay results in about a 25 percent loss of data along that line. Since the problem is rare, it is not yet considered serious. However, if it gets worse, some ground fix software will be used to try to recover as much of the data as possible.

All data taken prior to February 1979 have now been processed as film. MSS data taken after February 1, 1979 are being processed as high density digital tapes (HDTs) from which computer compatible tapes (CCTs) can be produced. It was expected to produce Return Beam Vidicon (RBV) data taken after February 1, 1979 as HDTs. However, because Goddard's Image Processing Facility cannot presently process those data, they are going to revert to film for RBV data temporarily, and will start digital processing of those data as soon as the digital system for RBV is operable. Currently, it is possible to process about 60 to 70 percent of the MSS data on the first run through the Image Processing Facility. These data get through the system in about a week. The other 30 to 40 percent do not pass through the first time. These must be re-run, and take longer to process.

Data taken between November 1976 and February 1979 will be available as CCTs through the indefinite future since those data can also be run through the Image Processing Facility. But because of the change to the new processing system, the Image Processing Facility will soon be unable to produce CCTs from pre-November 1976 data. Any of these data which have not already been converted to CCTs and retained in the EROS Data Center files will not be available after March 1, 1980. Before the system changeover is complete, EROS wants to obtain optimum CCT coverage for these early data for their files. The priority of scenes to be retained will be based on users' anticipated needs. Keep in mind that this refers to CCTs only; pre-November 1976

(NOAA-Continued from page 2)

gathered by satellite remote sensing. While LANDSAT data have been widely used, the program's experimental status has hindered large scale, operational applications by many state and local users. Many agencies hesitated to make personnel and equipment commitments to a system whose future was unclear. An operational program should lead to greater operational use of this unique data gathering system.

Symposia are being planned to present the operational procedures of the LANDSAT program under its new administration. These symposia will be presented at various locations throughout the country in March, 1980.

MAPS OF CAPE HATTERAS NATIONAL SEASHORE PREPARED FOR NATIONAL PARK SERVICE

Dr. T. H. Lee Williams and Ron Shaklee, KARS Program, in collaboration with Professor Robert Aangeenbrug of the Geography Department at KU, have completed a project for the National Park Service in the Cape Hatteras National Seashore on the Outer Banks of North Carolina. The project involved analysis of urban development of wetlands and non-wetlands areas in seven villages that lie within the Seashore. Maps showing wetlands, non-wetlands and transitional areas were prepared from interpretation of 1:20,000 scale color infrared and 1:6,000 scale black and white panchromatic aerial photography.

The color infrared photography was obtained from the Chesapeake Bay Regional Ecological Assessment Program. Residential and commercial developments were mapped using the panchromatic photography; high density, medium density, low density and undeveloped areas were portrayed. The wetlands and development data were than used to derive population growth projections under a range of possible development planning alternatives.

The wetlands mapping component of the project provided a diverse set of interpretation problems. In several areas the boundary between the wetlands and landward scrub thicket was precisely defined, having a width of only a few feet, and was accentuated by its coincidence with a storm rack line. In other areas the boundary was extremely vague, especially where the area was undergoing a transition from wetlands to non-wetlands due to residential and commercial development.

Marsh plant species found along the Pamlico Sound-side of the seashore include Spartina alterniflora, Spartina patens, Juncus romerianus, Iva frutescens and Distichlis spicata, in a range of mixes and densities. Identification of pure stands of the various marsh plants was possible on the color infrared photography. The finer spatial resolution of the black and white imagery often provided valuable textural information which enhanced the information derived from the color infrared photography. For example, since Spartina alterniflora occurs only in very moist locations, its presence proved to be a reliable wetlands indicator. However, Spartina patens was of little use as an indicator, since it was found in a wide range of moisture regimes from wetlands to the arid fore-dune slopes. Contact Dr. T. H. Lee Williams, KARS Program, for further information.

NASA LANDSAT/GEO-BASED INFORMATION SYSTEMS SYMPOSIUM

On November 14-15, 1979 Professor B. G. Barr and Dr. Ed Martinko attended the Landsat/Geo-based Information Systems Symposium in Biloxi, Mississippi. The Symposium was sponsored by NASA's National Space Technology Laboratories in conjunction with the Earth Resources Laboratory's Regional Applications Program. Dr. Martinko delivered an invited paper entitled "State Experiences in Kansas." Representatives from 17 other states, industrial firms, NASA and other national organizations also presented papers on remote sensing applications. The symposium was designed to provide an interchange of ideas and review the development of LANDSAT capabilities in the Earth Resources Regional Application Program.

MISSOURI RIVER BASIN COMMISSION IRRIGATED LANDS SYMPOSIUM

On November 15-16, 1979, the Missouri River Basin Commission held a "Symposium on Identifying Irrigated Lands Using Remote Sensing Techniques" in Sioux Falls, South Dakota. The program was attended by about 80 persons from all over the United States and one attendee from Great Britain.

The program consisted of two major sessions. The first session dealt with "Emerging Needs and Capabilities" and included four speakers representing the EROS Data Center, the Environmental Research Institute of Michigan, NASA and the Missouri River Basin Commission. The second session was concerned with "State-of-the-Art in Current Applications." Two members of the KARS Program were invited to present papers in the second session on their recent work in mapping irrigated lands in western Kansas. Dr. Lee Williams spoke on "Techniques and Characteristics" and Joe Poracsky spoke on "Key Parameters." A total of eight presentations were made in this session including discussions of work in Nebraska, California, the Columbia River Basin (Washington), the Klamath River Basin (Oregon), and the Ogallala Aquifer portion of the High Plains.

A volume of Symposium Proceedings is anticipated

KARS PROGRAM TO OFFER REMOTE SENSING SHORT COURSES

The University of Kansas Applied Remote Sensing (KARS) Program will offer, during 1980, a series of short courses covering the fundamentals of remote sensing, and the interpretation and application of information derived through remote sensing. The courses are being offered through a grant from the National Aeronautics and Space Administration (NASA).

"Remote sensing" refers to the gathering of data about the extent and condition of features on the Earth's surface (land use, crops, woodlands, settlement, etc.) with cameras, scanners and other sensors mounted aboard aircraft and satellites. Such data may be used in land use planning, water resources management, conservation needs assessment, crop and range land inventories and many other applications areas. The courses will be of particular interest to college and university professors and federal, state and local agency personnel. None of the courses will have a prerequisite or require prior training.

Two different courses will be offered. During April a free introductory one-half day course, "Remote Sensing: An Overview," will be offered at eleven cities across Kansas. Dates and locations are as follows:

Kansas City - April 2 (Wednesday)

Salina - April 9 (Wednesday)

Wichita - April 10 (Thursday)

Emporia - April 14 (Monday)

Topeka - April 16 (Wednesday)

Hays - April 21 (Monday)

Colby - April 22 (Tuesday)

Lawrence - April 23 (Wednesday)

Garden City - April 24 (Thursday)

Manhattan - April 28 (Monday)

Pittsburg - April 30 (Wednesday)

Persons wishing to acquire further training and hands-on experience in image interpretation and digital processing of LANDSAT data will be interested in participating in one of two five-day courses on "Fundamentals of Applied Remote Sensing" to be offered August 11-15 and September 8-12, 1980 at the University of Kansas Space Technology Center in Lawrence. These courses will have sessions devoted to the special interests of those attending (for example, college and university teaching, management of natural resources, regional planning, map production). A $25.00 registration fee will be charged to cover costs of materials : all materials will be retained by participants.

Anyone wishing further details on the courses is invited to mail the form below to James Merchant, KARS Program, KU Space Technology Center, 2291 Irving Hill Drive, Lawrence, Kansas 66045 (Telephone 913-864-4775, KANS-A-N 564-4775).

KANSAS APPLIED REMOTE SENSING PROGRAM

Short Courses

I am interested in obtaining further details concerning the following short course(s):

One half day short courses

Kansas City - April 2 (Wed) _____
Salina - April 9 (Wed) _____
Wichita - April 10 (Thur) _____
Emporia - April 14 (Mon) _____
Topeka - April 16 (Wed) _____
Hays - April 21 (Mon) _____
Colby - April 22 (Tue) _____
Lawrence - April 23 (Wed) _____
Garden City - April 24 (Thur) _____
Manhattan - April 28 - (Mon) _____
Pittsburg - April 30 (Wed) _____

Five day short course

Lawrence STC - August 11-15, 1980 _____
Lawrence STC - September 8-12, 1980 _____

Name: _____
Affiliation: _____
Address: _____
_____
_____
Telephone: _____

photographic data will always be available.

The ground control point library for the 48 lower United States is now complete except for 13 scenes for which either maps do not exist or sufficient ground control points cannot be located. Hence nearly all data of these 48 states will be registered geodetically to ground control points.

To keep up to date on these data issues, refer to Landsat Data Users' NOTES, available free from EROS Data Center, Sioux Falls, South Dakota 57198.

LAND COVER MAPPING OF PROPOSED PINE FORD LAKE SITE, MISSOURI

The KARS Program is preparing a land use/land cover map of the proposed Pine Ford Lake project area in southeastern Missouri under contract to the U.S. Fish and Wildlife Service (FWS) Kansas City Area Office. The study area encompasses about 110,000 acres and includes parts of Jefferson, Franklin, Washington and St. Francois counties. The 1:63,360 scale map and accompanying acreage statistics will be used by FWS in the evaluation of the proposed project's impact on wildlife habitat. Land cover/land use information is being interpreted from enlarged high altitude color infrared (acquisition scale 1:124,000) and low altitude natural color aerial photography (scale 1:24,000). The maps and tabular data will be completed and delivered to FWS in March, 1980. Contact Jim Merchant, KARS Project, for further details.

KARS PROGRAM 1980

The University of Kansas Applied Remote Sensing (KARS) Program is funded by the National Aeronautics and Space Administration (NASA) Office of University Affairs to assist local, state, regional and federal agencies in the application of remote sensing techniques to their problems and activities. Persons working in Kansas who believe that they may be able to use remote sensing in a decision-making capacity are invited to contact the KARS Program at the University of Kansas in c/o:

Space Technology Center
University of Kansas
Lawrence, Kansas 66045

913/864-4775 or KANS-A-N 564-4775

Contributors to this issue of the KARS Newsletter included Ed Martinko, Jim Merchant, Joe Poracsky and Gene McCall. The article "LANDSAT SYSTEMS UPDATE" was condensed from an article in "Reflections" by Stanley C. Freden, Chief, Missions Utilization Office, NASA, Goddard Space Flight Center, Greenbelt, Maryland.

The Kansas Applied Remote Sensing Newsletter is published in January, April, July and October by the University of Kansas Applied Remote Sensing (KARS) Program having facilities located in the Space Technology Center, Nichols Hall, The University of Kansas. Publications of the KARS Newsletter is supported by NASA Office of University Affairs Grant No. 17-004-024. Contributions of research findings, announcements of meetings, publications and information pertinent to remote sensing applications in Kansas or the Midwest/Great Plains region are encouraged. Inquiries and contributions should be addressed to Editor, KARS Newsletter. All correspondence related to specific projects should be addressed to the person indicated.

Kansas Applied Remote Sensing Program
Space Technology Center
2291 Irving Hill Drive
Lawrence, Kansas 66045

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APPENDIX II

AGENCY LETTERS OF SUPPORT

United States Department of the Interior

GEOLOGICAL SURVEY
Water Resources Division
206 Fulton Terrace
Garden City, Kansas 67846
June 27, 1980

Mr. James W. Merchant
Kansas Applied Remote Sensing Program
Space Technology Center
The University of Kansas
Lawrence, Kansas 66045

Dear Jim:

The map prepared by your organization "Land use along the Arkansas River (Hamilton and western Kearny Counties)" has proven to be valuable to our project staff studying the geohydrology of the Arkansas River in these two Kansas counties.

The map has been included in a preliminary draft of a report on the Arkansas River alluvial aquifer upstream from the Bear Creek fault zone. The report has not been through our colleague review process and, thus, is several months away from official release. However, the delineation of irrigated croplands shown on the land use map assisted the project staff in simulation of recent ground-water conditions.

An important factor in this simulation was the definition of the spatial distribution of ground-water recharge. Since part of the water applied to irrigated lands in this area recharges the aquifer, the land use map was used to delineate that part of the area where ground-water recharge from applied irrigation water can occur. The accurate delineation of these areas, which was made possible by use of the land use map, was very suitable for the finite-element ground-water flow model used by our staff.

We look forward to additional developments in the use of remote sensing which have application in our water-resources investigative efforts.

Sincerely yours,

Hayes F. Grubb

Hayes F. Grubb
Subdistrict Chief

HFG:lh

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Box 70 Holton, Kansas 66436

June 25, 1980

James W. Merchant
Senior Renote Sensing Applications Specialist
University of Kansas Space Technology Center
2291 Irving Hill Drive - Campus West
Lawrence, Kansas 66045

Dear Jim:

In response to your request about our use of the overlays your group prepared, we have been putting them to good use.

When we received the overlays, we were conducting public meetings to inform the local people the purpose and intent of the project. The overlays served as a visual to show the people the area involved, an idea of what the land uses are within the project, and some of the sources of critical erosion.

As time permits later this year, we want to follow up on the information and identify and list those individuals who have waterways established but haven't yet completed their terraces. We also want to take a close look at the areas identified as critical erosion areas and see what can be done to protect this land.

I hope this answers your questions concerning our use of the overlays. We appreciate your assistance in the past and I hope we can continue to work together in the future on this project.

Sincerely,

Tom Badger

Thomas W. Badger
District Conservationist

cc: Kenneth E. Noonan, Topeka

Kansas Fish & Game

BOX 54A, RURAL ROUTE 2, PRATT, KANSAS 67124
(316) 672-5911

REGIONAL OFFICES:

Northwest Regional Office
Box 366, 190 N. Franklin
Colby, Kansas 67701

Northcentral Regional Office
Box 489, 511 Cedar
Concordia, Kansas 66901

Northeast Regional Office
Forbes AFB, Box 19086
Topeka, Kansas 66619

Southwest Regional Office
808 Highway 56
Dodge City, Kansas 67801

Southcentral Regional Office
Box 764, 204 West Sixth
Newton, Kansas 67114

Southeast Regional Office
222 West Main Building
Suite C & D
Chanute, Kansas 66720

June 12, 1980

Mr. Jim Merchant
Space Technology Center
Nichols Hall
West Campus, Kansas University
Lawrence, KS 66044

Dear Jim:

The following paragraph should suffice to describe use of the sand sage map. Feel free to modify it as you see fit.

> "The Kansas Fish and Game Commission cost-shared development of a map depicting original and current limits of sand sage prairie based on LANDSAT imagery and data. This reproduction has enabled the agency to focus attention on the rapid depletion of the sand sage prairie due to extensive conversion to crop production under center-pivot irrigation. With the status of the sand sage prairie more adequately documented, more logical approaches to pr servation of the remaining segments of this unique ecosyste.."

I conveyed your good wishes to Bill.

Sincerely,

Leland M. Queal
Wildlife Administrator

LMQ/hsm

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SALINE COUNTY DEPARTMENT
OF PLANNING AND ZONING

Government Center, 300 West Ash, Salina, Kansas 67401
Telephone (913) 825-4396

March 14, 1979

Mr. B.G. Barr
Director of Space Technology Center
University of Kansas
Lawrence, KS 66045

Dear Mr. Barr:

The Saline County Department of Planning and Zoning is requesting the aid of the personnel in the Kansas Applied Remote Sensing (KARS) program. Our conversations with Keith Rice have assured us of the ability of the KARS personnel to provide maps detailing Saline County's prime agricultural land, areas of hazardous erosion, general land use, and existing housing. By interpreting aerial photographs the KARS personnel will be able to adapt the information to the series of maps we require.

Our interest in these maps stems from a current project of developing a Comprehensive Plan for Saline County in keeping with Kansas Planning Law 19-2916 a. The information obtained from KARS will be invaluable to us for purposes of preserving prime agricultural land, avoiding development in areas of hazardous erosion, and in decision-making for future land use and housing needs. As part of our overall Comprehensive Plan, the maps developed by the KARS program will also aid in the creation of future zoning regulations to secure orderly, controlled growth in Saline County. Any consideration you may extend to our project will be greatly appreciated.

Sincerely,

Dana Morse

Dana Morse, Zoning Administrator
SALINE COUNTY PLANNING AND
ZONING COMMISSION

DM:nm

SALINE COUNTY DEPARTMENT OF PLANNING AND ZONING

Government Center, 300 West Ash, Salina, Kansas 67401
Telephone (913) 825-4396

July 8, 1980

Kansas applied Remote Sensing Program
Mr. Edward A. Martinko
Raymond Nichols Hall
2291 Irving Hill Dr. - Campus West
Lawrence, KS 66045

Dear Mr. Martinko:

This letter is to inform you of the help given us by the personnel in the KARS program who have provided Saline County with a Prime Agricultural and a Current Land Use map. We have been working on a Comprehensive Development Plan for Saline County and these maps will play an important part of the Planning Commission's decision-making process. As a result of the Prime Agricultural Land map Saline County can now design a system and adopt policies which will prevent prime agricultural land from being used as development sites or from otherwise being permanently lost for agricultural purposes. For example, the Planning Commission's denial of the Prairie Acres development in the northwest part of the county was based mainly on prime agricultural land designations obtained from the KARS map. In addition to aiding in local decisions, the identification of prime agricultural land in Saline County has created enough interest so that a state-wide Kansas Prime Ag Land Symposium will be held here in October of this year.

The Current Land Use map provided by KARS was useful as an aid in developing our Future Land Use map. By being able to distinguish areas of cropland, grassland and urbanization we could get a much better idea of which areas needed to be expanded and which needed to be reduced. For example, since much of the land formerly designated industrial, particularly the area northwest of Mentor, was actually being used as cropland it was decided that these areas be re-designated agricultural. In much the same way we expanded the residential designation north of Salina where we could see urban growth was occuring, while decreasing the same designation southeast of Salina where several hundreds of residentially designated acres were being used for cropland. In essence, the Current Land Use map provided by KARS allowed us to re-adjust our plans for Saline County's future development based on current land use trends.

Although these maps are completed, I know Saline County's association with KARS program is not ended. After attending a KARS short course in Salina last April I can see their value in a much clearer light. I would like to take this opportunity to express Saline County's appreciation to all the members of the KARS program and especially those who worked so closely with me on my recent projects.

Sincerely,

Doug Oakes, Planning Technician

DO:nm

Bethel College North Newton, Kansas 67117 (316) AT3-2500

March 12, 1979

Ed Martinko
Space Technology Center
University of Kansas
Lawrence, Kansas 66045

Dear Ed Martinko:

As per our telephone conversation, I would like to request you for land use information on the Wabaunsee West, Chase South and Osage sites for a proposed Tallgrass Prairie National Park. We need information on land under cultivation, in rangeland, in forest and in water impoundments. We did not discuss the form of such information. Would it be possible to provide us with a map of each study area and a summary of the amount of land area under each use?

I am asking Elaine Shea of Save the Tallgrass Prairie to send you the boundary descriptions of the sites for which we need information. We appreciate your willingness to help in this matter.

Sincerely,

Dwight Platt
Chairman
Scientific Advisory Panel
Save the Tallgrass Prairie

P.S.: If you need further information, please contact me at:
Dwight Platt
Department of Biology
Bethel College
North Newton, Kansas 67117
Phone: (316) 283-6708 or (316) 283-2500 Ext. 367

cc: Elaine Shea

Department of Biology

82

United States Department of the Interior

OFFICE OF SURFACE MINING
Reclamation and Enforcement
818 Grand Avenue, Scarritt Building
KANSAS CITY, MISSOURI 64106

November 13, 1979

Mr. Lee Williams, Professor
Kansas Applied Remote Sensing Program
Space Technology Center
University of Kansas
Lawrence, Kansas 66045

Dear Mr. Williams:

I would like to take this opportunity to inform you of the selection of your proposal for an AML Inventory Prototype study. The primary goal of the Prototype studies is to test the AML Inventory design concept. Specifically, the prototype study should indicate the usefulness and capability of the Inventory data collection effort planned for the next two years.

Prototype studies also will be conducted in the following areas:

Region I	Cambria County, Pennsylvania
Region II	South Fork Drainage Basin, Kentucky
Region III	Vicinity of Terre Haute, Indiana
Region V	Carbon County, Montana

I am looking forward to working with you and Rolfe Mandel on this project. Additional information concerning the prototype study will be forthcoming.

Sincerely,

Ralph Zampogna

RALPH V. ZAMPOGNA

APPENDIX III

AGENCIES WITH WHICH CONTACTS ARE MAINTAINED

AGENCIES WITH WHICH CONTACTS ARE MAINTAINED
BY THE KANSAS APPLIED REMOTE SENSING PROGRAM *

Municipal:

CONCORDIA, KANSAS CHAMBER OF COMMERCE
KANSAS CITY, KANSAS CITY COMMISSION
KANSAS CITY, KANSAS DEPARTMENT OF PLANNING AND DEVELOPMENT
KANSAS CITY, KANSAS MAYOR'S OFFICE
LAWRENCE, KANSAS CITY ENGINEER
LAWRENCE, KANSAS CITY COMMISSION
LAWRENCE, KANSAS PLANNING DEPARTMENT
Salina, Kansas Planning Department
OTTAWA, KANSAS PLANNING DEPARTMENT

County:

ATCHISON COUNTY, KANSAS COMMISSIONERS
CHEROKEE, KANSAS BOARD OF COMMISSIONERS
CLOUD COUNTY, KANSAS COMMISSIONERS
DOUGLAS COUNTY, KANSAS EXTENSION AGENT
DOUGLAS COUNTY, KANSAS PLANNING DEPARTMENT
FRANKLIN COUNTY, KANSAS PLANNING COMMISSIONERS
JACKSON COUNTY, KANSAS DISTRICT CONSERVATIONIST
NEMAHA COUNTY, KANSAS DISTRICT CONSERVATIONIST
RILEY COUNTY, KANSAS ENGINEER
SALINE COUNTY, KANSAS PLANNING DEPARTMENT
SUMNER COUNTY COMMISSIONERS

State:

Kansas Agricultural Extension Service
KANSAS ATTORNEY GENERAL'S OFFICE
KANSAS CORPORATION COMMISSION
KANSAS STATE BOARD OF AGRICULTURE
KANSAS DEPARTMENT OF ECONOMIC DEVELOPMENT
KANSAS DEPARTMENT OF HEALTH AND ENVIRONMENT
KANSAS DEPARTMENT OF REVENUE
Kansas Department of Transportation
Kansas Department of Energy
KANSAS ADJUTANT GENERAL, Division EMERGENCY PREPAREDNESS
Kansas State Biological Survey
KANSAS BUREAU OF AIR QUALITY AND OCCUPATIONAL HEALTH
KANSAS STATE HISTORICAL SOCIETY
KANSAS STATE CONSERVATION COMMISSION
KANSAS FISH AND GAME COMMISSION
Kansas Geological Survey
KANSAS GOVERNOR'S OFFICE
KANSAS LEGISLATIVE RESEARCH DEPARTMENT
Kansas Mined Land Conservation & Reclamation Board
KANSAS PARKS AND RESOURCES AUTHORITY
KANSAS WATER RESOURCES BOARD
MISSOURI WATER RESOURCES BOARD
MISSOURI DEPARTMENT OF NATURAL RESOURCES
MISSOURI GOVERNOR'S OFFICE

Regional:

Big Lakes Regional Planning Commission (Pottawatomie, Riley, Geary)
CHIKASKIA-INDIAN HILLS REGIONAL PLANNING COMMISSION (SUMNER, HARPER, KINGMAN)
Flint Hills Resource Conservation and Development Project (Morris, Chase, Marion and Lyon Counties, Kansas)
FOUR RIVERS RESOURCE CONSERVATION AND DEVELOPMENT DISTRICT (JEWELL, REPUBLIC, MITCHELL, CLOUD, OTTAWA, LINCOLN, ELLSWORTH AND SALINE COUNTIES, KANSAS)
MID-AMERICA REGIONAL COUNCIL
Northwest Kansas Planning and Development Commission (Cheyenne, Sherman, Wallace, Rawlins, Thomas, Logan, Decatur, Sheridan, Gove, Norton, Graham, Trego, Phillips, Rooks, Ellis, Smith, Osborne, and Russell Counties, Kansas)
Ozark Regional Commission
SOLDIER CREEK WATERSHED BOARD OF DIRECTORS
SUNFLOWER RESOURCE CONSERVATION AND DEVELOPMENT DISTRICT (SUMNER, HARPER, KINGMAN, BARBER, COMANCHE AND KIOWA COUNTIES, KANSAS)

Regional (cont'd.):

GREATER SOUTHWEST REGIONAL PLANNING COMMISSION
Groundwater Management Districts

TAUY CREEK WATERSHED PLANNING DISTRICT BOARD OF DIRECTORS
Missouri River Basin Commission

Federal:

U,S. ARMY CORPS OF ENGINEERS, KANSAS CITY AND ALBUQUERQUE OFFICES
U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE (SCS)
U.S. DEPARTMENT OF AGRICULTURE, AGRICULTURAL STABILIZATION AND CONSERVATION SERVICE (ASCS)
U.S. GEOLOGICAL SURVEY WATER RESOURCES DIVISION - LAWRENCE/GARDEN CITY, KANSAS
U.S. Bureau of Reclamation, Denver and Topeka Offices

U.S. ENVIRONMENTAL PROTECTION AGENCY, KANSAS CITY AND WASHINGTON, D. C. OFFICES
U.S. FISH AND WILDLIFE SERVICE, KANSAS CITY, DENVER, AND WASHINGTON, D. C. OFFICES
U.S. BUREAU OF INDIAN AFFAIRS, HORTON, KANSAS AGENCY
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
U.S. DEPARTMENT OF THE INTERIOR, OFFICE OF SURFACE MINING, KANSAS CITY REGIONAL OFFICE

* All agencies that are capitalized represent demonstration projects that have been completed or are being developed.

KARS PROGRAM STAFF

	1972	1973	1974	1975	1976	1977	1978	1979
Faculty	3	3	3	3	2	2	3	3
Graduate Research Assistant	2	4	4	4	9	5	3	10
Staff	2	2	2	2	2	2	4	2
Total	7	9	9	9	13	9	10	

CONFERENCES AND WORKSHOPS

Governor's Conference and Space Technology Center Dedication - September 28-30, 1972 - University of Kansas, Lawrence 200 attended.

Seminar on Agricultural Applications of Remote Sensing - December 7, 1972 - Hays, Kansas 30 attended.

Governor's Conference on the Application of Space Technology to Resource Management and Environment Quality - March 29, 1973 - University of Kansas, Lawrence 200 attended.

Image Interpretation Workshop for State Agency Personnel - October 2-4, 1974 - Garden City, Kansas 25 attended.

Short-Course on Remote Sensing/Aerial Photo Interpretation and Terrain Analysis - March 15-19, 1976 - Dr. Douglas Way, Instructor - University of Kansas, Lawrence 35 attended.

Kansas Noxious Weed Workshop - March, 1977 - University of Kansas Space Technology Center, Lawrence, sponsored by the Kansas State Biological Survey and the Kansas Department of Agriculture - Weed and Pesticide Division, 75 attended.

Symposium on Mapping in Kansas - April 12, 1977 - University of Kansas, Lawrence 75 attended.

State Uses of Satellite Remote Sensing - National Conference of State Legislators - September 23-24, 1977 - Snowmass, Colorado 150 attended.

University of Kansas Continuing Education Program, Geography 598, Introduction of Remote Sensing Technology - October 28-29, 1977 - Garden City, Kansas 13 attended.

A Symposium on Remote Sensing in Environmental Analysis and Planning in Kansas - 110th Annual Kansas Academy of Science Meeting - April 14, 1978 - University of Kansas, Lawrence 50 attended.

Remote Sensing Workshop for the Kansas Adjutant General's Office of Emergency Preparedness Planning - July 31 - August 11, 1978, Topeka, Kansas 7 attended.

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APPENDIX IV

DESCRIPTIONS & LOCATION OF PROJECTS

COMMERCIAL CONTRACTORS THAT HAVE BENEFITTED BY THE KARS PROGRAM PROJECTS

	Project	Agency	Contractor	Contract Amount
1.	Arkansas River Vegetation Analysis (CIR Aerial Photography	Kansas Fish and Game Commission U.S. Fish and Wildlife Service	Wilson Engineers, Inc. Salina, Kansas	$ 5,000
2.	Monitoring of Cheyenne Bottoms Waterfowl Management Area Habitat (CIR Aerial Photography)	Kansas Fish and Game Commission	Wilson Engineers, Inc. Salina, Kansas	2,000
3.	Mapping Jamestown Waterfowl Management Area Habitat (CIR Aerial Photography)	Kansas Fish and Game Commission	Wilson Engineers, Inc. Salina, Kansas	400
4.	Landsat Computer Identification of Wildlife Habitat in Kansas (Landsat Computer Compatible Tapes)	Kansas Fish and Game Commission	Bendix Corporation Ann Arbor, Michigan	5,000
5.	Soldier Creek Watershed "208" Planning Project (Color Aerial Photography)	Environmental Protection Agency	Wilson Engineers, Inc. Salina, Kansas	1,500
6.	County Line Lake, Missouri (Color Aerial Photography)	Missouri Natural Resources Department	M.J. Harden's Associates Kansas City, Missouri	800
7.	Musk Thistle Project (CIR Aerial Photography)	Kansas Department of Agriculture Weed and Pesticide Division	Wilson Engineers, Inc. Salina, Kansas	500
8.	Sand Hills State Park (Black and White Aerial Photography)	Kansas Applied Remote Sensing Program	Wilson Engineers, Inc. Salina, Kansas	300
9.	Several KARS Projects April 1972-March 1978	Kansas Applied Remote Sensing Program	Center For Research, Inc. Photographic Laboratory	14,000
			Total	$29,500

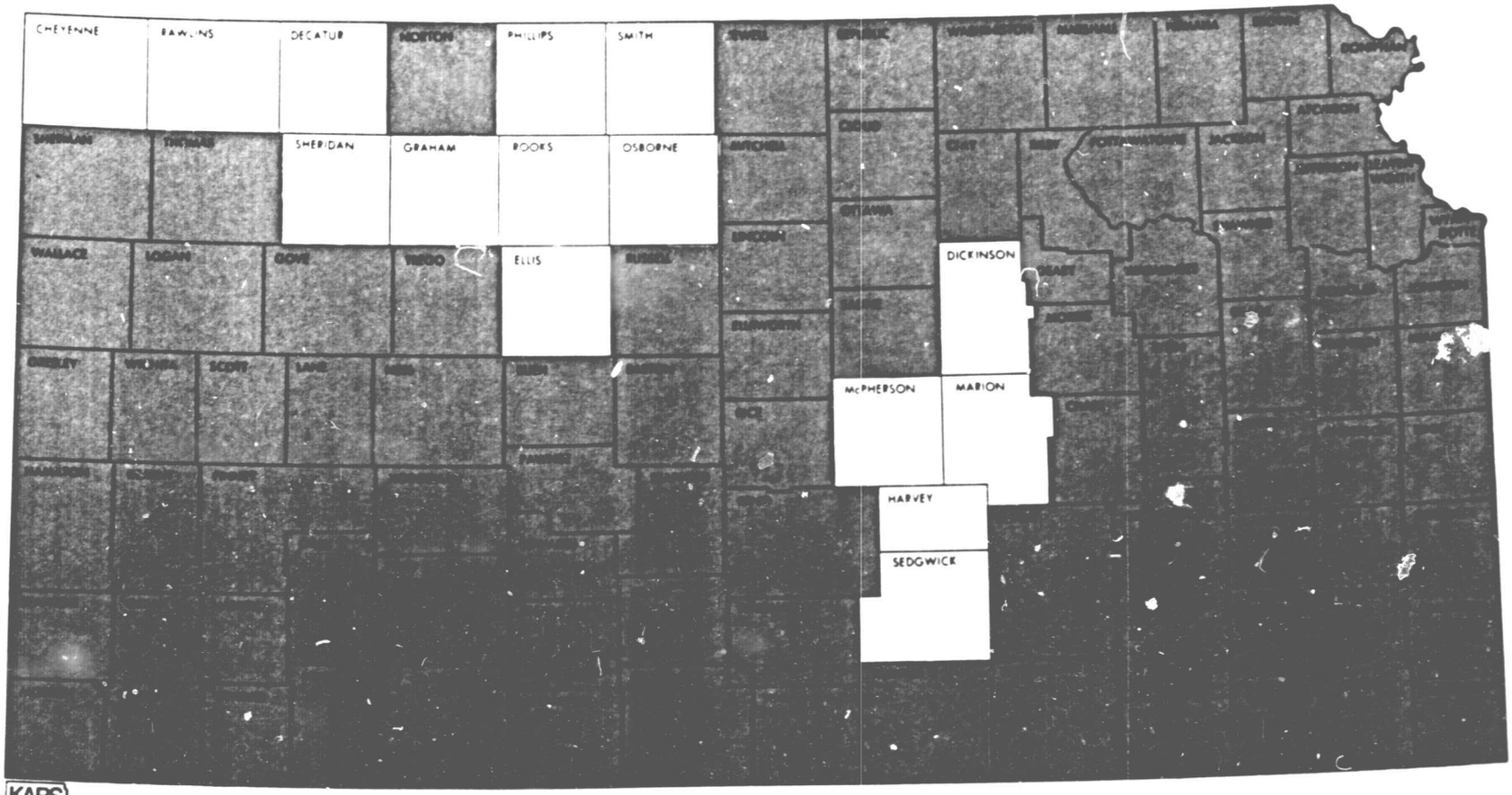
KANSAS APPLIED REMOTE SENSING PROJECTS
April, 1972 to March, 1978

Project Number	Project Title	Cooperating Agency	Type of Governmental Organization						Data Source				
			Federal	State	Regional	County	Municipal	Private	Landsat	Skylab	High Altitude	Medium Altitude	Low Altitude
1.	Developmental Planning on Clinton Dam and Reservoir	Lawrence/Douglas County Planning Department				X	X						X
2.	Decision on Completion of I-35 and Pattonsburg Reserv	Governor's Office - State of Missouri Missouri Department of Natural Resources		X					X				X
3.	Kansas City, Kansas Flooding Disaster	Mayor's Office, Kansas City, Kansas Civil Defense Office, Kansas City, Kansas					X						X
4.	Using Remote Sensing for Wildlife Habitat Inventory in Kansas	Kansas Fish & Game Commission		X					X		X		
5.	Regional Land Use Map for the Four Rivers Resource Conservation and Development Project	Four Rivers Resource Conservation and Development District U.S. Department of Agriculture - Soil Conservation Service	X		X				X				
6.	Land Use Map of Cherokee County, Kansas	Cherokee County Commissioners Kansas Department of Economic Development Kansas Geological Survey		X		X					X		
7.	Sanitation Route Allocation in Kansas City, Kansas	Kansas City, Kansas Department of Planning and Development					X				X		
8.	Evaluating Environmental Impact on Road Construction in Kansas City, Kansas	Kansas Department of Transportation Kansas City, Kansas Planning and Development Department		X			X						X
9.	Census Tract Division: Mid-America Regional Council	Mid-America Regional Council			X						X		
10.	Mapping Center Pivot Irrigation in Southwest Kansas	Kansas Fish & Game Commission		X					X				
11.	Habitat and Stream Order Mapping of The Chikaskia River Basin	Kansas Fish & Game Commission U.S. Fish & Wildlife Service Kansas City Area Office Sunflower Resource Conservation and Development District	X	X	X				X	X			
12.	Mapping and Monitoring of Vegetation in Cheyenne Bottoms Waterfowl Management Area	Kansas Fish & Game Commission		X					X		X		X
13.	Republican River Canoe Trail and Campsite Planning	Cloud County Commissioners Concordia, Kansas Chamber of Commerce Four Rivers Resource Conservation and Development District Kansas State Park and Resources Authority U.S. Department of Agriculture-Soil Conservation Service	X	X	X	X	X						X
14.	County Line Lake Missouri Project	Governor's Office Missouri Missouri Department of Natural Resources		X									X
15.	Mapping Aquatic Vegetation at Douglas County State Lake	Kansas Fish & Game Commission		X									X
16.	Delineation of Drainage Patterns in Strip Mined Areas of Southeast Kansas	Kansas Fish & Game Commission Kansas Department of Health & Environment Kansas Attorney General's Office		X							X		
17.	Conversion of Prime Agricultural Land to Urbanized Land Use	Mid-America Regional Council			X						X		

Project Number	Project Title	Cooperating Agency	Type of Governmental Organization						Data Source				
			Federal	State	Regional	County	Municipal	Private	Landsat	Skylab	High Altitude	Medium Altitude	Low Altitude
18.	Barber County Sage and Cedar Infestations	U.S.D.A.-Soil Conservation Service, Barber County Sunflower Resource, Conservation and Development District	X		X				X	X			X
19.	Mapping and Monitoring Musk Thistle Infestations of Kansas Rangeland	Kansas Department of Agriculture Weed and Pesticide Division		X					X		X		X
20.	Assessment of Distributional Change in Eastern Red Cedar	Kansas Department of Agriculture Weed and Pesticide Division		X					X	X	X		X
21.	Development of Wildlife Habitat Areas in Southeast Kansas Strip-Mined Region	Kansas Fish & Game Commission		X									X
22.	Land Use Mapping For Planning and Zoning in Sumner County	Chikaskia, Golden Belt and Indian Hills Regional Planning Commission Sumner County Commission			X	X				X			
23.	Law Enforcement Planning for the Republican National Convention	Kansas City, Kansas Police Department Johnson, Wyandotte and Leavenworth Law Officials				X	X				X		
24.	Using LANDSAT to Select a Pronghorn Antelope Release Site in Kansas	Kansas Fish & Game Commission		X					X				
25.	Lawrence-Douglas County Zoning Decisions	Lawrence-Douglas County Planning Commission				X	X						X
26.	Planning for the Sand Hills State Park, Kansas	Kansas Park and Resources Authority		X									X
27.	Total Irrigation Mapping	Legislative Research Department		X					X				
28.	Tauy Creek Watershed Planning	Tauy Creek Watershed Board of Directors U.S.D.A. Soil Conservation Service	X			X							X
29.	Kansas Land Use Patterns Map	Kansas Department of Economic Development		X					X				
30.	Soldier Creek Watershed 208 Planning	U.S.D.A. - Soil Conservation Service, Soldier Creek Watershed Steering Committee, Kansas Department of Health and Environment	X	X	X	X							X
31.	Fugitive Dust Source Analysis	Kansas Department of Health and Environment	X										X
32.	St. Jacob's Well Natural Landmark	Kansas State Fish and Game Commission, U.S. National Park Service	X	X					X				
33.	Bald Eagle Habitat	Douglas County Audubon Society, U.S. Fish and Wildlife Service	X					X					X
34.	Riley County Landfill	Riley County Engineer				X							X
35.	Natural Disaster Response and Analysis	Emergency Preparedness Planning		X									X
36.	Clinton Park	Kansas State Park and Resources Authority		X									X
37.	Mine Creek Battlefield	Kansas State Historical Society		X									X
38.	Louisburg Health Care Facility	Miami County Health Care Consultant						X			X		

Project Number	Project Title	Cooperating Agency	Type of Governmental Organization						Data Source				
			Federal	State	Regional	County	Municipal	Private	Landsat	Skylab	High Altitude	Medium Altitude	Low Altitude
39.	Mapping The Diminishing Sandsage Prairie	Kansas Fish and Game Commission		X				X	X				
40.	Tallgrass Prairie National Park	Save the Tallgrass Prairie, Inc.						X			X		
41.	Mapping of Land Use/Land Cover and Prpime Agricultural Land in Saline County, Kansas	Saline County Department of Planning and Zoning				X			X		X		
42.	Arkansas River Irrigation Moratorium	U.S. Geological Survey - Water Resources Division; Kansas State Board of Agriculture - Division of Water Resources	X	X					X				X
43.	Land Use, Land Cover, Land Use Change, Flood Plain Scour, Gully and Stream Channel Inventory of Pony Creek and Roy's Creek Watersheds, Kansas and Nebraska	U.S. Department of Agriculture Soil Conservation Service	X									X	X
44.	Wildlife Habitat Inventory for the Proposed Pine Ford Lake, Missouri	U.S. Fish and Wildlife Service	X								X		X
45.	Abandoned Mined Lands Inventory and Hazard Assessment	U.S. Department of the Interior - Office of Surface Mining	X								X	X	X
	TOTAL		11	26	8	9	7	3	16	4	15	2	27

Kansas Applied Remote Sensing



Project Areas 1972 - 1980

APPENDIX V

PROGRAM STATISTICAL DATA

INQUIRIES AND VISITATIONS TO THE

KANSAS APPLIED REMOTE SENSING PROGRAM

	1972	1973	1974	1975	1976	1977	1978	1979
Inquiries	60	96	96	96	108	120	120	200
Visitations	*320	*350	120	150	200	*330	175	175

* Several remote sensing meetings occurred during these years at the Space Technology Center.

NEWSLETTER DISTRIBUTION **

	1972	1973	1974	1975	1976	1977	1978	1979
Number of Recipients	--	220	325	377	695	865	900	1,250

** Newsletters are sent only to those indidividuals who are involved with Kansas Applied Remote Sensing Program projects or who have expressed a need to be continually informed about remote sensing efforts. The newsletter is responsible for many of the inquiries and visitations listed above.

EXTERNAL FUNDING FROM AGENCIES BY YEAR

	PROJECT	AGENCY	1972	1973	1974	1975	1976	1977	1978	1979	1980	
1.	Kansas Land Use Map	Kansas Department of Economic Development		$5,000								
2.	Cheyenne Bottoms Waterfowl Management Area	Kansas Fish and Game Commission			$ 550							
3.	An Investigation of the Feasibility to Automatically Develop a Land Use Map of Kansas	Kansas Department of Economic Development			6,000							
4.	Evaluations of the Utilization of Remote Sensing by the U.S. Fish and Wildlife Service	U.S. Fish and Wildlife Service				$18,000						
5.	County Line Lake, Missouri	Missouri Department of Natural Resources				800						
6.	Douglas County Land Use Mapping	Lawrence-Douglas County Planning Commission					$8,800					
7.	Land Use Map of North Central Regional Planning Commission District, Kansas	North Central Regional Planning Commission					3,000					
8.	Conversion of Prime Agricultural Land to Urban Land Use	Mid-America Regional Council					1,500					
9.	Musk Thistle Mapping	Kansas Department of Agriculture - Weed and Pesticide Division					500	$ 500	$ 500	$ 500		
10.	Reclamation Program in South Kansas Strip Mine Areas	U.S. Geological Survey - Water Resources Division					370					
11.	Musk Thistle Project	U.S. Environmental Protection Agency - Kansas Department of Agriculture						70,000	75,000	75,000		
12.	Total Irrigation Mapping	Legislative Research Department							500			
13.	Sandsage Prairie	Kansas Fish and Game Commission								130		
14.	Wildlife Habitat Inventory for the Proposed Pine Ford Lake, Missouri	U.S. Fish and Wildlife Service										$ 4,931

	PROJECT	AGENCY	1972	1973	1974	1975	1976	1977	1978	1979	1980
15.	Land Use, Land Cover, Land Use Change, Flood Plain Scour, Gully and Stream Channel Inventory of Pony Creek and Roy's Creek Watersheds, Kansas and Nebraska	U.S. Department of Agriculture - Soil Conservation Service									$ 6,487
16.	Kansas Remote Sensing Short Courses	National Aeronautics and Space Aministration									25,000
	TOTAL			$5,000	$6,550	$18,800	$14,170	$70,500	$76,000	$75,630	$36,418

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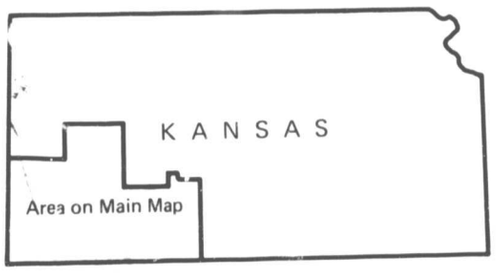
REMOTE SENSING COURSES OFFERED BY THE UNIVERSITY OF KANSAS

	Course Title	Enrollment
*EE 681 and GEOL 756	Remote Sensing	20
EE 785	Pattern Recognition	20
EE 766	Radar Remote Sensing	9
EE 870	Radiometric Remote Sensing	10
CE 785	Terrain Analysis	20
GEOG 426	Air Photo Interpretation for Environmental Analysis	20
*GEOG 526	Remote Sensing I	10
*GEOG 626	Practicum in Remote Sensing	2
*GEOG 726	Remote Sensing II	10
*GEOG 826	Topics in Remote Sensing	3
*GEOG 926	Seminar in Remote Sensing	6
*GEOL 410	Introduction to Field Geology	35

*Courses offered every school year.

FOLDOUT FRAME

VEGETATION COVER WITHIN THE POTENTIAL SANDSA



FOLDOUT FRAME

ORIGINAL PAGE IS
OF POOR QUALITY

NDSAGE PRAIRIE AREAS OF SOUTHWEST KANSAS, 1978

KEY

Area Outside of Potential Sandsage Prairie

Potential Sandsage Prairie *(Andropogon - Artemisia - Calamovilfa)*
(as delineated by Küchler)

Actual Sandsage Prairie

Cropland

Scale 1: 800,000

0 10 20 30 40

Miles

DOUT FRAME 2

Interpreted by the Kansas Applied Remote Sensing Program from LANDSAT imagery. Sandsage Prairie areas taken from A.W. Küchler, "The Potential Natural Vegetation of Kansas," 1974.

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KARS Kansas Applied Remote Sensing Program
Space Technology Center
University of Kansas