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

by

B. G. Barr
Director
Space Technology Center
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E. A. Martinko
Assistant Scientist
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July 1979

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

(April 1, 1978 - March 31, 1979)

THE UNIVERSITY OF KANSAS CENTER FOR RESEARCH, INC.
2291 Irving Hill Drive—Campus West
Lawrence, Kansas 66045

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M. J. Eger
J. Poracsky
K. Rice
V. Sehon
R. V. Shaklee
T. L. Talmon
G. Tappan
T. H. L. Williams

B. G. Barr, Principal Investigator
Kansas Applied Remote Sensing Program

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, 1978, through March 31, 1979.

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

Completed projects during the period include (1) the analysis of fugitive dust source areas in Topeka, Kansas; (2) preparation of a remote sensing response plan for the Kansas Office of Emergency Preparedness Planning; (3) site comparison of five proposed landfill sites in Riley County, Kansas; (4) site analysis for the St. Jacob's Well Natural Landmark. 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 a state demonstration project for 208 planning in conjunction with a coalition of state and federal agencies.

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 seventh year, the KARS program is developing the concepts and methodologies to utilize remote sensing procedures in dealing with sigificant problems in Kansas related to changing urbanization patterns, rapid irrigation growth, changing agricultural needs and environmental quality. This activitiy 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, 1978, through March 31, 1979 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.

The interaction which results from these cooperative projects ensures the continued relevancy of the program and maximizes the transfer of these new and emerging technological systems to operational use.

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 Newsletters*, and (2) numerous talks and presentations to public and professional organizations throughout Kansas. These have included, among others, the Kansas Legislative Research Department, the Kansas Governor's Office, Kansas Department of State Planning and Research, Kansas Museum Associates, Kansas State Water Resources Board, the Lawrence Audobon Society and the Association of American Geographers Annual Meeting.

The quarterly *KARS Newsletter* now reaches over 850 readers with news of current KARS projects and activities (Appendix I). Several new projects have developed from this medium.

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 78-79. 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 Vice Chancellor 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, scheduling and 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.

M. J. Eger, Joseph Poracsky, Keith Rice, Vera Sehon, Ronald Shaklee Gray Tappan and Ted Talmon carry significant responsibilities in the KARS Program and provide considerable professional expertise in the areas of image interpretation, cartography and data analysis.

Projects requiring major scientific effort are staffed primarily by graduate students from the various academic disciplines assisted by

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 Department of Agriculture
- Kansas Department of Economic Development
- Kansas Department of Health and Environment
- Kansas Department of Revenue
- Kansas Department of State Planning and Research
- 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 Conservation Service
- U.S.G.S. 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

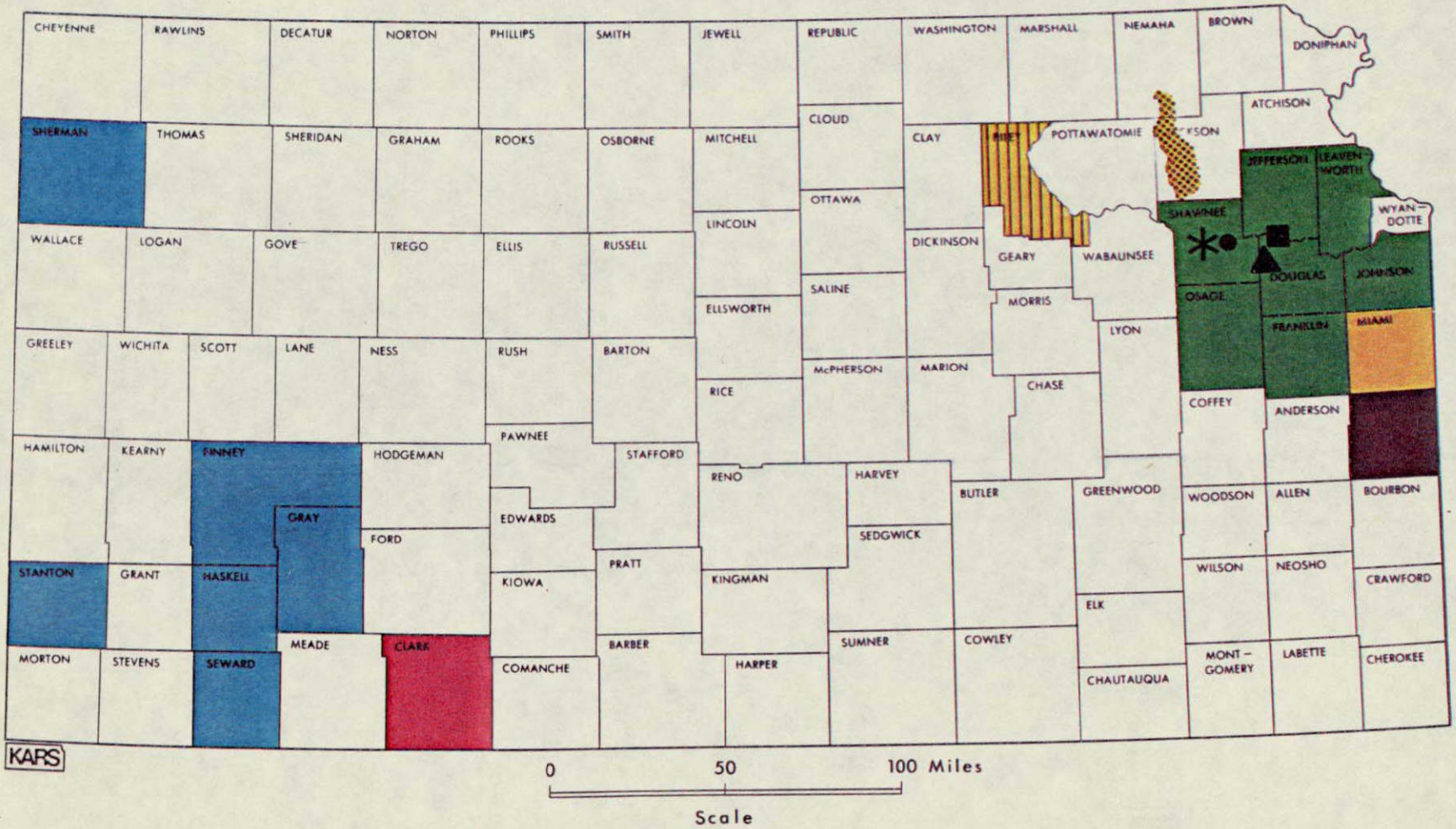
KARS PROGRAM

PROJECTS COMPLETED OR INITIATED

MARCH 1978 - APRIL 1979

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:	Fugitive Dust Source Analysis
COUNTY INVOLVED:	Shawnee
COOPERATING AGENCY:	Kansas Department of Health and Environment
PROJECT:	St. Jacob's Well Natural Landmark
COUNTY INVOLVED:	Clark
COOPERATING AGENCIES:	Kansas State Fish and Game Commission, U.S. National Park Service
PROJECT:	Bald Eagle Habitat
COUNTY INVOLVED:	Douglas
COOPERATING AGENCIES:	Kansas Audubon Society and Kansas State Fish and Game Commission
PROJECT:	Riley County Landfill
COUNTY INVOLVED:	Riley
COOPERATING AGENCY:	Riley County Engineer
PROJECT:	Natural Disaster Response and Analysis
AREA INVOLVED:	Statewide Applications
COOPERATING AGENCY:	Kansas Department of Emergency Preparedness Planning
PROJECT:	Musk Thistle
COUNTIES INVOLVED:	Jefferson, Leavenworth, Shawnee, Douglas, Johnson, Osage, Franklin
COOPERATING AGENCIES:	Environmental Protection Agency, Kansas Department of Agriculture
PROJECT:	Irrigated Land Mapping
COUNTIES INVOLVED:	Sherman, Stanton, Finney, Gray, Haskell, Seward
COOPERATING AGENCY:	State Legislative Research Department
PROJECT:	Clinton Park
COUNTIES INVOLVED:	Douglas, Shawnee
COOPERATING AGENCY:	Kansas State Park and Resources Authority
PROJECT:	Mine Creek Battlefield
COUNTY INVOLVED:	Linn
COOPERATING AGENCY:	State Historical Society
PROJECT:	Louisburg Health Care Facility
COUNTY INVOLVED:	Miami
COOPERATING AGENCY:	Miami County Health Care Consultant

REMOTE SENSING APPLICATIONS PROJECTS



- Musk Thistle
- Riley County Landfill
- Mine Creek Battlefield
- Fugitive Dust
- Emergency Preparedness Planning
- Irrigated Lands Mapping
- St. Jacob's Well Natural Landmark
- Soldier Creek Watershed
- Bald Eagle Habitat
- Clinton Reservoir State Park
- Louisburg Health Facility

April, 1978 - March, 1979

Figure 1.

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 laboratory located on the second floor of the KU Space Technology Center serves 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 photo 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.

The KARS Program has several types of equipment in its laboratory to aid in 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 laboratory and expedite more involved interpretations and image analysis.

Procedures have also been established for more 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 in the KARS laboratory 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.

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

II. PROGRAM OF WORK APRIL 1, 1978 - MARCH 31, 1979

Agricultural and Rural Development

Irrigated Lands

In 1975, 84% of the U.S. water consumption occurred in the 17 western states, where by far the largest single use was for agricultural irrigation. During the same year, 93% of all the water used in Kansas was for irrigation, a figure that is likely to increase as additional irrigation systems are installed. Virtually all of this irrigation water in Kansas is derived from aquifers that, though they are quite extensive, have slow rates of recharge. Very marked declines in ground water levels have been recorded in recent years. In some irrigated areas the ground water table has dropped as much as 100 feet. In other areas, the Arkansas River has been reduced to the status of an intermittent stream as a result of upstream water uses. There is a growing feeling of apprehension among farmers and water resource managers that the continued wholesale use of the available groundwater resources will eventually result in the exhaustion of this essential water resource.

The House Livestock and Agricultural Subcommittee of the Kansas State Legislature is currently very concerned about this situation. A key concern is that large out-of-state corporations with farm holdings in Kansas should not gain unfair advantages in the State, such as a share of the available water resources that is so large it deprives the smaller local farmer of his livelihood. With this problem in mind, the Livestock and Agricultural Subcommittee in 1978 directed the Kansas Legislative Research Department (KLRD) to undertake a study that would provide information on the extent of irrigation on corporate-owned land. The area selected for study included six counties in Western Kansas (Finney, Gray, Haskell, Seward, Sherman and Stanton Counties). Detailed locational data on irrigated land, other than aggregated areal statistics, were not available in Kansas. To assist in collecting data, KLRD contacted the University of Kansas Applied Remote Sensing Program (KARS).

Previous KARS work had established an efficient technique for interpreting center pivot sprinkler irrigation on LANDSAT imagery, based on the characteristic center pivot circular shape. However, approximately 70% of the irrigation in Kansas is of the non-center pivot type and has no characteristic shape; therefore, other identification criterion were developed during the project—a multidate visual interpretation technique for identifying and mapping irrigated lands in Western Kansas from LANDSAT imagery.

A study of the agricultural practices in the six county area was conducted to identify the major crops, their crop calendars and irrigation practices. Wheat, corn and sorghum comprise the primary crops with pasture making up the majority of the remaining agricultural acreage. Approximately 40% of the wheat, 40% of the sorghum and virtually all of the corn is irrigated in the area. The wheat is predominantly winter wheat which is sown in the fall and harvested in June. It 'greens up' early in the spring and remains a vigorous green until ripening in early/mid-June. The corn is planted in May and harvested in September. It presents a fairly dense, green cover from July until after tasseling in August. Dry land sorghum is planted in mid-June while the irrigated sorghum is generally planted in mid-May. Both are harvested in October. Sorghum presents a cover very much like that of corn and in fact, in its early stages is difficult to distinguish from corn, even on the ground. The crop calendars of the three crops indicated that two time windows would be needed to identify the irrigated crops on Landsat imagery. Early May imagery would show the vigorous wheat crop, while early August imagery would serve to identify the corn and sorghum.

The objective was to develop, if possible, a simple visual technique for identifying and mapping irrigated crops. The irrigated data were required for the 1976 growing season, to be congruent with the corporate ownership data. The study was initiated in 1978 and had to rely on ground truth derived from crop records kept by the local agricultural extension officers.

The experience gained in mapping center pivot irrigation indicated that irrigated crops have a characteristically dark tone on LANDSAT Band 5 imagery. A preliminary experiment was conducted to see whether this could serve as a reliable technique for identifying irrigated lands.

The ASCS county extension agents were contacted and asked to provide a listing of a sample of fields (referenced by their legal description) representing various crop/irrigation situations in 1976. Landsat Band 5 1:500,000 scale prints were used for interpretation, from May 6 (Scene I.D. #247016344) and August 4 (Scene I.D. #256016322). For Stanton and Sherman counties, June 3 and August 14 images were used. The images were enlarged 2X on a Saltzmann opaque overhead projector. The sample fields were located on the imagery and a visual estimate made of the gray tone.

initially a five level classification was used (black, medium dark, gray, light gray, white), but gave no better discrimination than using a simpler three level scale (black, gray and white).

A scatter plot was drawn of the observed gray tones on each date for the sample fields. From the scatter plots it was evident that a simple criterion for identifying irrigated crops was feasible, as irrigated crops appeared in dark tones either in May (wheat) or August (corn and sorghum). Using this criterion, the overall accuracy of correctly identifying the irrigated fields in the test sample was 88 fields out of 95, with 2 out of 47 dryland fields incorrectly classified as irrigated.

The Landsat images were registered to 1:250,000 scale county highway maps, using a technique developed in the earlier center pivot mapping project. Center pivots were precisely located on ASCS and SCS photo mosaics from the early 1970's, transferred to the base map and used as control points for registering the Landsat images. About one complete township (6 x 6 miles) could be registered at a time at the 1:250,000 scale. Areas of dark tone (both individual fields and contiguous groups of fields) were delineated on a mylar map overlay. The May and August images were interpreted onto the same base map, using different colors. The resulting map represented the irrigated land areas for that county.

The ground truth was compared field by field to the original interpretation derived from Landsat. Among the general points noted during the comparison was the good correspondence between the majority of field outlines as seen on LANDSAT and as reported by the ground truth. The precise outline of many of the irregularly-shaped fields was readily discerned on the imagery. In addition, isolated homogeneous irrigated areas of approximately 20 acres, the smallest size fields appearing in the ground truth, were easily identified on the imagery. Note, however, that when adjacent fields appear in a dark tone on the same date, they will be mapped as one, larger, field. Thus, a 'field' as mapped from Landsat may in fact comprise a number of adjacent fields.

On the basis of the field-by-field comparisons of the ASCS data and the LANDSAT interpretation, 383 individual fields were checked for accuracy of interpretation, and acreage figures derived. For each crop there are four different situations possible: areas may have been identified by both ASCS and the LANDSAT interpretation as either (1) irrigated or (2) non-irrigated,

or areas may have been identified (3) by ASCS as irrigated and the LANDSAT interpretation as non-irrigated or (4) by ASCS as non-irrigated and the LANDSAT interpretation as irrigated.

Accuracy for interpretation of irrigation on the three crops varied from 80-100%. Lowest accuracies were obtained on wheat fields where 85% of the irrigated acreage was correctly identified and 80% of the non-irrigated acreage was correctly identified as non-irrigated. In speaking with the ASCS agent, he noted that there were some anomalous variations in the appearance of the wheat crop in 1976. In particular he noted that irrigated wheat in an area north of Garden City was less vigorous than non-irrigated wheat nearer to Garden City and that some fields of irrigated wheat may have suffered frost damage in the preceeding winter due to lack of snow cover. Both these situations would result in a misclassification of irrigated wheat as non-irrigated.

97% of the acreage in corn, which is all irrigated in Finney County, was correctly identified as irrigated. Corresponding high accuracies of 97% for irrigated and 100% for non-irrigated sorghum fields were obtained. The high accuracy levels for sorghum, compared to the poorer results for wheat, can be largely explained in terms of the differences between the irrigated and non-irrigated crops. Irrigated sorghum is planted three weeks earlier than non-irrigated sorghum, and the differences between the two are largely difference in stages of development, whereas both irrigated and non-irrigated wheat are planted at the same time, resulting in differences in vigor, not stage, between the two. In addition, the wheat crop is in the field for a much longer time between planting and harvesting (9 months as compared to 4 months) and there is, therefore, more possibility of variations in the wheat crop.

The above accuracy figures, it should be noted, are not simply for determination of statistics for areas but are accuracies of mapped information. Accuracies for simple areal statistics would be as good or appreciably higher, simply because the errors of omission would be almost balanced by errors of commission. In the case of wheat, the incorrectly identified acreages are approximately equal and would almost cancel each other out. In this particular wheat sample the LANDSAT interpretation gives 6770 acres of irrigated wheat rather than the 6397 acres reported by the ASCS data, an overestimate of acreage of 6%. In terms of total irrigation, 14,863 acres were recorded by

ASCS as irrigated in the sample areas. The Landsat-interpretation gave 15,041 acres, an overestimation of only 1%.

The primary output of the interpretation was a set of six county maps with overlays showing irrigated lands in 1976. However, KLRD was interested in the irrigation data in relation to corporate land ownership. As the most common basic unit of agricultural land ownership in Kansas is the quarter section, it was necessary to deal at the quarter section level in reporting the irrigation/ownership data.

The data for each quarter section were coded into a three-part record consisting of the legal description, type of irrigation (center pivot sprinkler or flood) and approximate number of irrigated acres. The number of irrigated acres was visually estimated as being in one of six approximate-acreage classes- 20, 40, 80, 120, 133 (a "normal" size center pivot) and 160 acres. This range of classes provided a reasonable level of discrimination and proved to be relatively easy to work with in acreage estimation.

Also coded and entered into a computer file were data supplied by KLRD on corporate ownership. In this case each record consisted of the legal description and type of corporation according to one of three classes.

Once on file there were two basic types of output desired, a simple data listing by legal description, and maps. The data listing included individual quarter section data and summary tables showing "Total Irrigated Acres," "Acres of Flood Irrigation," "Acres of Center Pivot Irrigation" and "Total Number of Center Pivot Systems."

Three different maps were produced for each county. All were output on a line printer with each character position representing one quarter section. The first map portrayed the irrigated land, showing the extent of irrigation, in one of the six acreage classes in each quarter section. The second map portrayed the corporate-owned land by class and the third the congruence of the first two data sets, showing the location of irrigated land that was corporate-owned and the type of corporation that owned it.

These maps and statistical data were submitted to KLRD personnel who incorporated the information into a report on corporate land ownership to the House Livestock and Agricultural Committee. The report has been taken under advisement by the committee and will be used to determine the necessary guidelines for introducing legislative actions that will redesign the Kansas corporation laws.

Mapping and Monitoring Musk Thistle

For the past three 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 thistle control is 2-4 Dichlorophenoxyacetic (2-4D). In spite of the heavy 2-4D 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 the 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 between the end of May and mid-June. This summary covers, therefore, results arising from the data acquired primarily during the summer of 1978, and does not cover work to be completed during the 1979 flowering period.

Progress during the past year can be divided into three main phases.

1. Habitat Classification with Satellite Imagery

The purpose of this activity is to use satellite (Landsat) imagery to identify and map preferred musk thistle habitats. Nine broad cover types were selected on the basis of known musk thistle occurrence and detectability on Landsat imagery. They are:

- Rangeland
  - Cool season grasses
  - Warm season grasses
- Cropland
  - Alfalfa
  - Wheat
  - Other
- Forest
  - Riparian
  - Upland
- Urban
- Water

The appropriateness of these categories was determined on the basis of the aerial photographic studies of musk thistle occurrence.

The work on determining the areal extent of infestations on the 1978 photography has been completed. On the basis of the results it was decided that greater attention should be paid to roadside verges and hedgerows, which occur in conjunction with the above categories. However, factors such as the average field size or land-cover unit type size will determine the linear verge distance found per unit area, thus varying the relative importance of the verge as a possible separate category. Consequently a project has been initiated using high altitude aerial photography to determine the variations in linear verge distance per unit area as a function of gross land use patterns.

The habitat preference scores are being re-evaluated based on the 1978 summer flights. This will continue through the 1979 summer season, when the two-year aggregated aerial data will give more accurate preference scores.

2. Aerial Photography

The aerial photography comprises the second stage of the sampling scheme, providing population counts for Selected Unit Areas (SUA's) selected on the basis of the satellite habitat preference mapping.

The aerial photographic population counts for the 1978 summer work were based on the use of very large scale (1:600) photographs to produce flowering head counts for a subsample of the SUA. Problems encountered with this technique were: 1) the variability of the natural backgrounds against which the heads are being counted made it often very difficult to obtain a reliable count; 2) when comparing the aerial head counts with ground counts made on calibration plots visited by the ground crew, a high variability was obtained due to factor (1) above and due to problems of counting flowering heads that lie lower on the plants; 3) the spatial and pattern distribution characteristics of musk thistle result in very high sampling variances when using the extremely small sample areas on the large scale photographs. Due to these above problems, the emphasis in the aerial photographic sampling is being shifted towards using smaller scale (1:2,000 or smaller) photography for the 1979 summer flights. The emphasis will be on area and plant density measurements rather than on individual head counts. The first aerial flights of the 1979 season will use multiple 70 mm cameras to define the best film type and scale for infestation, rather than individual plant detection.

In line with the change in emphasis of the aerial photography, and as a prelude to the first flight, ground-based work is currently in progress to determine the infestation density and areas that can be discerned from various scales and types of photography with the objective of deriving an interpretation key for evaluating infestations.

Work is nearing completion on determining the optimum size of the SUA. Land cover, roadside verge length and field verge length data derived from high-altitude aerial photography are being used to define the optimal length of the SUA in relation to sampling efficiency and cost. This work will be completed in time for the 1979 summer flights.

A further development in the sampling procedure is related to the orientation of the aerial photographic flight lines. The basic method of land subdivision in the study area is the General Land Office plat, whereby the land is divided into one-mile square sections, oriented North-South. Due to the resulting directional periodicity and spatial auto-correlation in the 'population' being sampled (i.e. the landscape), there is a possibility of a particular flight line producing a biased sample. A computer modeling exercise is, therefore, under way to determine the sampling biases associated with various flight directions. The results will be used to define the flight orientation for the 1979 flights.

3. Ground Visits

Several sites studied by the botanists were used as calibration sites for the flowering head count part of the sampling procedure. With the change in sampling emphasis towards an area/density estimation, additional sites are being selected to represent a wider range of infestation types.

St. Jacob's Well

St. Jacob's Well in Clark County, Kansas is a water filled depression (sinkhole) that serves as an important historic landmark in that area of southwest Kansas. The well was a vital watering point on the Fort Dodge to Fort Supply wagon trail. Later the well served in an equally vital capacity for the Texas Cattle drives that culminated at Dodge City some thirty-five miles away from the site. The area is a focal point for local folklore surrounding the settlement of the region. The exact depth of the well has never been measured, and even during periods of extended, severe drought the well has remained full.

In 1973, the Kansas Fish and Game Commission purchased both the well and 1,800 acres of surrounding rangeland in a move to preserve the natural setting of the area and establish an ecological study site for students at Kansas schools and universities.

In January, 1978 St. Jacob's Well and the surrounding rangeland area was chosen as a release site for 50 antelope that had been captured in Wyoming and transported to Kansas. Another 84 antelope were released on the site in January, 1979 as a result of a similar transfer. The increased interest in the area led KF&G officials to consider further

development of the site as a game preserve and landmark and has submitted the site to the National Park Service for consideration as a Natural Landmark.

In December, 1978 KF&G personnel contacted the KARS Program with a request for an updated analysis of the surface cover and adjacent land uses on the 1,800 acre St. Jacob's Well tract and for areas adjoining the tract. The analysis of the quality of the tract's rangeland was considered to be an important factor in the Natural Landmark designation and adjacent land uses would play a role in the area's ability to retain its natural character.

Due to the size of the site and the adjacent area of interest, it was determined that two levels of detail would be required for the analysis; a very intensive analysis of the area immediately adjacent to St. Jacob's Well and a more generalized analysis for remainder of the 1800 acre tract and areas beyond the tract boundary. For the immediate site analysis, the Kansas Fish and Game Commission agreed to supply low-altitude imagery of the site. LANDSAT imagery was employed for the surface cover evaluation of the remaining area.

Prior to the antelope release in 1978, the Kansas Applied Remote Sensing Program compiled a map and statistics that showed the extent of land use changes across the site between 1972 and 1977. Comparable data were supplied for two other proposed release sites. These statistics were derived from the temporal analysis of LANDSAT data beginning with images acquired in 1972, during the Satellite's first year of operation, and then updated for each year of the study period which ended in 1975. The interpretation of the 1972 imagery concentrated on the delineation and identification of cultivated and rangeland areas within the Chase County site. The 1972 interpretation was compared to LANDSAT data for 1973, 1974, 1975, 1976 and 1977 to identify areas where cultivation was being pursued on areas that had formerly been rangeland. These changes were monitored over the course of the five year study period and it was determined that Clark County featured less total change in land use than had the other two proposed antelope release sites.

St. Jacob's Well lies at the heart of the Chase County antelope release site and KF&G officials used the antelope data for their initial analysis of the 1800 acre St. Jacob's Well tract. However, prior to submitting their request to the National Park Service KF&G personnel desired an update of the

analysis with a particular emphasis on the acreage adjacent to the KF&G - owned site. The quality and undisturbed nature of the rangeland contained within the site were considered to be of primary importance in the updated investigation. In consultation with KARS personnel it was determined that a multi-level analysis of the site would provide the necessary data for the Natural Landmark application. Low-altitude imagery was acquired over the well itself to provide a detailed site analysis of vegetation and physical characteristics. LANDSAT data was used to identify land use and surface cover across the majority of the site and for the areas adjacent to the site.

From the maps of land use and land cover on and adjacent to the St. Jacob's Well site, KF&G personnel were able to provide an assessment of the undisturbed character of the land. They were also able to project future land use trends that would affect the site's ability to retain its natural character and setting. These figures have been compiled and submitted with the proposal to the National Park Service which has taken the proposal under advisement and expects to make a decision on the status of the site during the forthcoming year.

Sandsage Prairie

The sandsage prairie in Kansas occurs mostly in the southwestern part of the state and is characterized by the occurrence of sandy soil with several dominant species including sandhill sage (Artemisia filifolia), sand bluestem (Andropogon hallii), little bluestem (Andropogon scoparius) and sandreed (Calamovilfa longifolia). Although the extent of potential sandsage prairie in southwest Kansas is considerably less (less than 400,000 acres) than the short grass prairie, it is an important habitat for many wildlife and game species.

The recent development and spread of center pivot irrigation in southwest Kansas have resulted in significant changes in land use patterns particularly on the sandsage prairie. Data compiled by the KARS program indicates a growth of center pivot systems on sandsage prairie of about 200 (approx. 26,600 acres) per year since 1975.

Because the growth of the center pivot systems was particularly apparent on maps prepared earlier by the KARS program, the Kansas Fish and Game Commission (KF&G) contacted the KARS program and requested on a

cost sharing basis, information about the replacement of sandsage prairie by cropland. Although KF&G was concerned about the implications of such changes for many wildlife species, of particular concern were populations of the lesser prairie chicken, Tympanuchus pallidicinctus, because they depend heavily on the sandsage prairie and are experiencing significant population declines.

Landsat imagery from various dates spanning the time period 1972-1978 was used as the primary data source for delineating cropland within the potential sandsage prairie. The potential sandsage prairie was drived from the map "The Potential Natural Vegetation of Kansas" by A. W. Küchler. Interpretation and compilation were done at a scale of 1:500,000, and the final mapping product was prepared at a scale of 1:800,000. Areas were measured with a digitizer by category.

On receipt of the map and summary statistics which indicated that less than 40% of the potential sandsage prairie remained in southwest Kansas, KF&G contacted several agencies and corporations, informed them of the problem and urged them to retain blocks of sandsage prairie in areas currently being converted to cropland. KF&G is also considering the purchase of 5,000 acres of sandsage prairie in Finney County in an area where cropland increases are most dramatic.

Wildlife Habitat and Environmental Quality

Soldier Creek Watershed

Under the provisions established in the Federal Water Pollution Control Act of 1972, a nationwide program was initiated with the goal of eliminating the discharge of all 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 industrial, commercial and municipal discharges into streams, lakes and waterways but Section 208 of the act (which provides for the planning process that will eventually serve as the base for implementing the programs within the parent act) directs itself to the control of agricultural pollutants that are washed into the drainage pattern as a result of storm runoff.

Section 208 requires that pollution will be controlled from both point and nonpoint sources through 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 implications of water quality planning.

The implementation of Section 208 regional planning is to be the responsibility of the state and is to include both state and local planning in the planning process. One state agency is to be selected by the governor of each state to oversee the program, providing both an administrative and advisory function.

In Kansas, the State Conservation Commission has been assigned the task of overseeing the implementation of 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 landscape 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 which is drained by Soldier Creek encompasses a 100 square mile area which features a 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 which has been a factor in periodic flooding in the lower reaches of the watershed. The steeply sloped lands promote the runoff from agricultural land contributing agricultural chemicals and waste to the creek's waters.

The 208 planning process requires that an extensive data base be compiled for land use, land cover, land use practices, erosion potential 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 polluters.

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 measures
   - C. Grassland utilizing terraces and directed drainage as a soil conservation measure

III. Woodland

IV. Water Bodies

V. Farmsteads

VI. Quarries

VII. Areas of active erosion

A total of nine different state and federal agencies are involved in the 208 planning process which is being supervised by the Jackson County Soil Conservation Service and the Soldier Creek Watershed Board of Directors. These agencies are participating in the collection and analysis of data of which the land use/land cover data is the primary component. Because no contemporary

aerial photography was available for the watershed, the U.S. Environmental Protection Agency agreed to supply current aerial coverage of the area. Natural color photography was flown for the watershed in September, 1978 at an acquisition scale of 1:48,000.

The interpretation was performed at the 1:48,000 acquisition scale utilizing standard image interpretation techniques. The map data were reduced to a 1:63,000 scale base map (1" = 1 mile) for the 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 as overlays to the land use/land cover map. The complexity of the surface 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 (Figure 2) 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 six overlays to the base map were provided with the following data:

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
5. Location of tribal owned and tribal trust lands of the Pottawatomi Indian Reservation
6. Topographic relief

The maps and statistical data have been supplied to the Soldier Creek Watershed Board of Directors and are currently being used in planning for upstream pollution abatement. Soldier Creek officials have isolated several areas that are suspected as being 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 will be an essential component for the decision on where to expend the $250,000 that has been allocated for cost sharing programs in land treatment. The maps will help officials identify the most severely affected lands and areas where land treatment will have the most sigificant impact on improving the water quality of Soldier Creek Watershed.

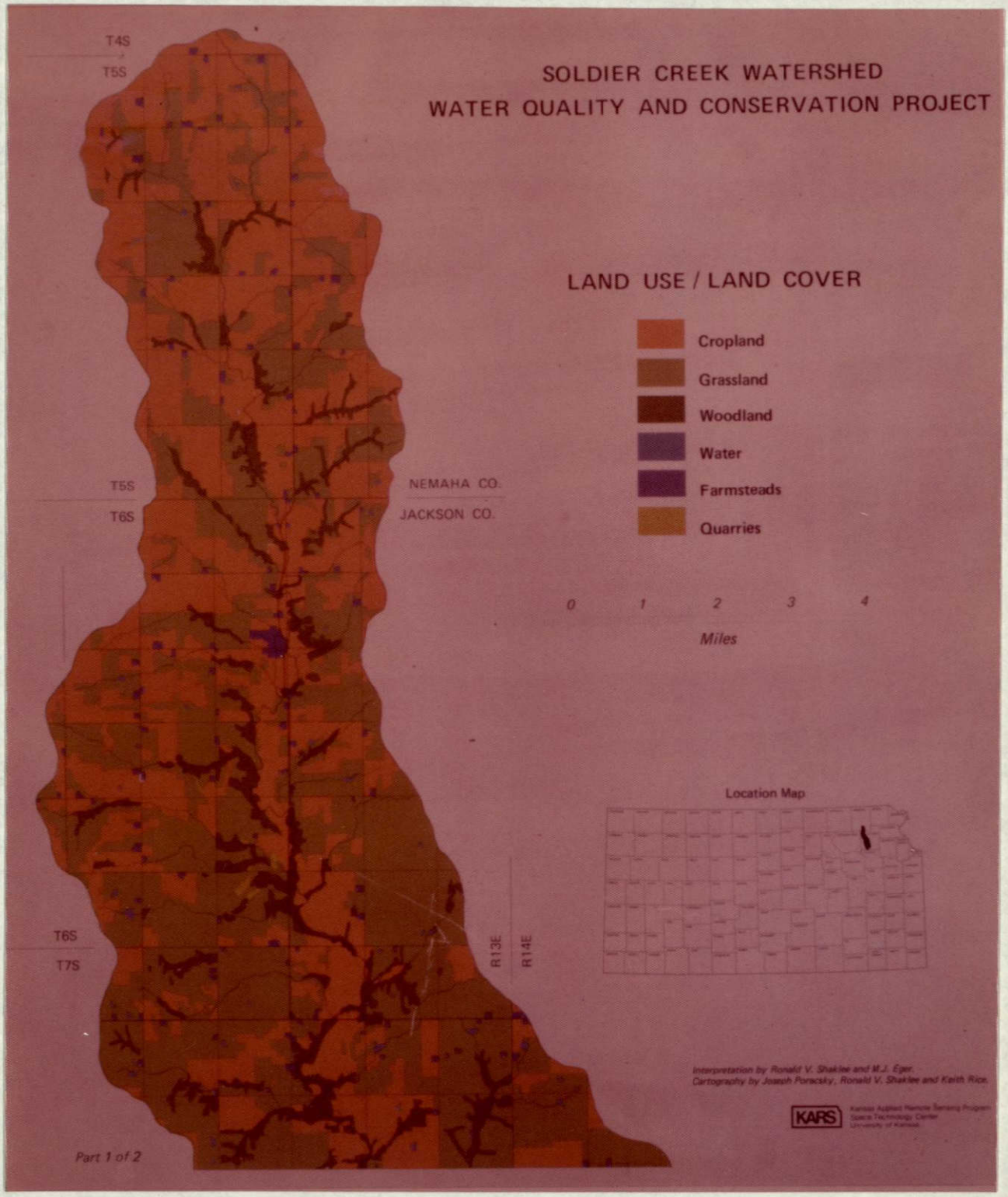


Figure 2

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 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.

A follow-on interpretation program has been planned to test the accuracy and level of detail available from LANDSAT imagery and to test the potential of LANDSAT as a primary data source for 208 water quality planning. Both manual and machine analyses of the LANDSAT data are planned. The results of the LANDSAT interpretation will be compared with the results of the low-altitude analysis to determine the amount and type of data loss that occurs in the transition from one data platform to the other. The results of this comparison will be presented to the SCC for consideration of the use of LANDSAT data for forthcoming 208 planning projects across the state.

Fugitive Dust

Under provisions of the Clean Air Act of 1975, cities that have been identified as exceeding acceptable standards for ozone or particulate concentrations must submit by June 1, 1979 plans that are designed to reduce the concentration of these materials to acceptable levels. These areas have been called non-attainment areas and several areas within the state of Kansas have been identified as non-attainment areas for various airborne particulate and gaseous materials.

State governments have been charged with designating a state agency or authority to direct the planning and evaluation process. In Kansas, the Kansas Department of Health and Environment (KDHE) has been delegated this responsibility. The planning for the control of excessive amounts of airborne pollutants is a very detailed process. The most difficult problem lies with the identification of pollution sources. Industrial sources have been regulated through an Environmental Protection Agency permit system that has in part decreased the industrial generation of airborne pollutants. The basic problem facing the KDHE and the problem cities lies with the identification of non-point and mobile point pollution sources.

The capital city of Topeka is one of the areas in the State that has been identified as a non-attainment area for airborne particulates. The specific problem area lies in a northern extension of the city that is

separated from the city proper by the Kansas River. The area presents a unique problem due in part to the wide range of land use activities that are located in the area. Approximately one half of the area is occupied by urban residential units. The rest of the area features predominantly agricultural land use. A relatively small portion of the area has been converted to a number of commercial and industrial uses.

The area is the site of a large complex of grain storage elevators which contribute a significant amount of particulate matter as a result of the grain storage and transfer activity. A major highway (U.S. 75) bisects North Topeka and acts as a feeder route for commuter traffic from development in rural areas north of the city. The farming activity by its very nature provides a significant amount of dust to the atmosphere during planting, maintenance and the harvest of crops. The final major factor lies with the dust generated by unpaved parking lots, roadways, ball diamonds, etc.

To develop a plan for meeting clean air standards as required in the Clean Air Act, the relative particulate contribution of each of the pollution sources must be analyzed. By determining the degree of particulate emission from each source, the plan can determine which sources can be best brought under control and show the expected decline in particulate emissions in the area as a result of specific control efforts.

For this purpose, a model has been developed to analyze the effectiveness of control measures when applied to any given particulate source. KDHE provided their own data on farming operations, motor vehicle traffic density and emission levels, point source polluters (such as the grain storage complex) and major highway construction projects that were in progress in the North Topeka area. The problem faced by KDHE officials lay with the identification and measurement of the particulate contribution of fugitive dust sources. These sources include any bare ground (other than agricultural land clearance) that could potentially allow unconsolidated dust to be blown into the air. These include, for example, unpaved roads, parking lots, recreational facilities and building sites.

In a meeting with KARS personnel, KDHE inquired about the possible use of remotely sensed data to identify and map the location of fugitive dust sources. A review of KDHE's data needs revealed that remotely sensed

data could provide the necessary data for the emission control model. In April 1978 low altitude color infrared imagery was flown over the site.

Using standard image interpretation techniques, fugitive dust sources were identified and mapped at a 1:12,000 scale and subsequently reduced to a 1:24,000 scale composite map. Field checks were performed at the start and at the conclusion of the interpretation process to determine the accuracy of the mapping effort.

Prior to initiating the image interpretation process, a field survey was taken to find representative source areas for unconsolidated dust. As a result of the field survey and the data requirements of KDHE the following categories were isolated for identification and mapping from the aerial photography:

1. Gravel levee embankments and roads
2. Gravel pits
3. Gravel parking lots
4. Bare ground (includes recreational facilities)
5. Gravel roads and alley's

The initial interpretation was performed at the 1:12,000 photo acquisition scale. Interpretation results and mapping were later reduced and keyed to a 1:24,000 scale base map of North Topeka. A second field survey was conducted at the conclusion of the interpretation and mapping process to assess the relative accuracy of the interpretation effort and to identify the surface composition of several areas that could not be conclusively categorized from the imagery alone.

A statistical analysis of the fugitive dust sources showed that the total area of unconsolidated surfaces accounted for approximately 115.2 acres of surface area. This included 108.8 acres of parking lots, bare ground, gravel pits and exposed embankments, and 6.4 acres of linear features such as roads and alleyways.

KDHE was supplied with the final map product (Figure 3) and the set of areal statistics that showed the overall distribution of each type of fugitive dust source. These statistics were input into the department's particulate emission model.

Methods of controlling fugitive dust emissions (paving roads and parking lots and seeding bare ground areas) were evaluated against the

Figure 3

expected reduction in fugitive dust emissions, and the costs and benefits of fugitive dust source control was weighed against the control of other particulate sources.

KDHE determined that fugitive dust sources in the North Topeka area did not contribute significantly to the overall particulate load. Since control of these sources would not result in a significant improvement in the area's overall air quality, and the department decided to pursue control efforts in other sectors which would have a more immediate and noticeable effect on the reduction of particulate matter in the North Topeka area.

Bald Eagle Winter Refuge

The Kansas River has traditionally provided a winter nesting area for bald eagles. The river provides open water which allows the eagles to prey on fish throughout the winter. Fields and woodlands adjacent to the river provide the eagles with additional food sources.

Of particular concern to wildlife conservationists is a six mile stretch of the river that runs between Lecompton and Lawrence (Figure 4). While the number of eagle sightings has fluctuated tremendously from one year to the next, these records show a general decline in the winter eagle population during the past few years. Causes for the decline have been attributed to increased human activity in the area from building construction, low flying airplanes, off-road vehicles, hikers and general curiosity seekers attempting to spot or photograph the birds.

The general decline in the eagle winter population prompted local wildlife conservationists and the U.S. Fish and Wildlife Service to consider several alternatives designed to protect the habitat from further degradation, to enhance it and perhaps increase future populations of eagles that utilize the habitat. The simplest alternative would be to have the area declared 'critical habitat' for this endangered species. Under the provisions of the Endangered Species Act, critical habitat of endangered species would remain in possession of the current landowners but would restrict the activities that could take place on the land. Any further development of the land would be prohibited as would be any attempt to clear trees from the habitat area. Other types of winter activity would also be limited.

Bald Eagle Critical Habitat Land Cover Map

Legend

F Woodland

s Shrubs

P Pasture

A Cropland

B Built-up

Q Quarry

m Wetland

W Water Bodies

Figure 4

Other alternatives that are being considered are all oriented towards land acquisition by either public or private interests. The city of Lecompton, Douglas County or the state could acquire the land and declare it a wildlife sanctuary for the eagles. This would provide for an immediate protection of the habitat resource. A second alternative lies with federal acquisition and protection of the land, a long and involved process that would leave the habitat unprotected during the interim.

In the absence of any serious city, county or state interest in acquiring and protecting the habitat, local conservationists in conjunction with the Audubon Society and with the support of the Kansas Fish and Game Commission requested the aid of the KARS program in the preparation of a proposal to the U.S. Fish and Wildlife Service to acquire these critical habitat lands.

The proposal will request that the U.S. Fish and Wildlife Service:

1. extend legal protection to the area, especially the six mile stretch that contains the bulk of the eagle nesting area, through the Fish and Wildlife Service's critical habitat program.
2. prohibit hunting and trapping from December 15 to March 15.
3. restrict all access to the area on the north bank of the Kansas River.
4. build observation towers and an observation point on the south bank of the Kansas River to allow observation of the birds without intruding on their habitat.

A survey of existing aerial photography indicated that the U.S. Army Corps of Engineers had flown the area with color film at a scale of 1:24,000 in December 1976. An assessment of the data needs for the Fish and Wildlife Service proposal indicated that the early winter imagery would provide the necessary detail for the evaluation of the bald eagle habitat. The following physical and cultural features comprised the bulk of the detail required for the habitat evaluation:

I. Accessibility
   - A. Hard Surface Roads
   - B. Dirt Roads
   - C. Paths and Trails

II. Vegetation Cover
   - A. Mature Stands of trees

B. Mixed Trees and Shrubs

C. Shrubs

D. Grass

III. Agricultural Production

A. Cultivated Land

B. Pasture

IV. Cultural Features

A. Farmsteads

B. Urban Areas

C. Rural Developments

D. Bridges

V. Kansas River

VI. Sand Bars

VII. Ponds

VIII. Marsh

IX. Quarries

The interpretation and mapping of these categories was performed for a six mile long and one mile wide corridor along the Kansas River basin. A statistical analysis of the data was provided in hectares to show the extent of valuable habitat areas and the proximity and extent of disruptive land use practices.

The Audubon Society has incorporated the maps, air photos and areal statistics in their proposal to the Fish and Wildlife Service. Fish and Wildlife Service personnel are reviewing the data prior to making their recommendations for acquisition of the land as a wildlife refuge or declaring the area to be critical habitat.

Natural Disaster Response and Analysis

Natural and man-made disasters are a perpetual problem in the governmental planning process. The frequency, scale, timing and location of a disaster is unpredictable and when disaster strikes civil defense units must respond immediately in the commitment of material and manpower to the afflicted area. Civil defense authorities are hampered in the planning process by the unpredictable nature of disasters. They must make maximum use of limited funds and materials in preparing a response to a myriad of potential disaster situations. Fires, floods, earthquakes, winds, storms, blizzards, epidemics, air contamination, blight, drought, infestation, explosions, riots and hostile military or para-military actions are the types of disasters that civil defense authorities must face and each requires a slightly different type of response in the form of rescue, relief and recovery activities.

Past experience has shown that there are problems associated with the delivery of rescue, relief and recovery operations in the aftermath of a natural disaster. Initial response is hampered by the disaster's adverse effect on rescue and relief operations. The internal and external communication networks may be impaired or destroyed leading to an informational void about the condition of the afflicted area. Roads that are submerged or which are blocked by debris may inhibit immediate access to the site. Key landmarks may have been destroyed thereby disorienting rescue and relief parties and hampering their efforts, and obsolete maps of the afflicted site may further that disorientation.

In Kansas, the Emergency Preparedness Planning (EPP) Division of the State Adjutant General's Department is responsible for preparing disaster contingency plans at the State level and is charged with coordinating and overseeing similar planning efforts at regional and local levels. EPP officials are cognizant of the past problems associated with the delivery of rescue, relief and recovery operations and have been investigating various mechanisms for improving the response time and efficiency.

EPP officials contacted the Kansas Applied Remote Sensing Program and requested an assessment of the potential of a remote sensing input into both the planning and response phases of disaster management. EPP supplied KARS with a list of the information elements that are gathered

during the initial phase of disaster response operations and from that list KARS personnel identified the following areas where remotely sensed data could supply the informational requirements of the disaster response agencies:

1. Structural Damage

   Community facilities

      Hospitals and medical facilities
      Schools
      Churchs
      Fire Stations
      Police Stations
      Developed recreational areas
      Civil buildings
      Buildings designated as shelters
      Higher education facilities

   Residential

      Single family
      Mobile homes (Trailers)
      Multi-family 1-3 story
      Multi-family - over 3 story

   Commercial

      Office
         highrise
         other
      Retail outlets
      Motels and hotels

   Industrial

      Large manufacturing
      Light industrial
      Wholesale and warehouse
      Storage tanks

   Agriculture

      Farming
      Farm outbuildings

2. Damage to Transportation Routes

   Streets

      Obstructed
         trees/poles
         structural debris

Road washout
Disrupted road surface
Culverts
Collapsed bridges
Collapsed elevated roadways and underpasses
Disrupted railroad lines
Airports
Structural damage
Damage to runways

3. Damage to Utilities/Water Control Facilities

Broken water mains
Contaminated reservoirs or wells*
Damage to pumping stations
Broken sewer lines
Damaged pumps
Damage to treatment plant
Power plant damage (atomic, regular)
Transformer stations
Downed power/phone lines
Damaged/downed utility poles
Dikes/levees
Dams
Drainage channels

4. Areas of inundation

5. Livestock

6. Occurrence of ponded water areas (a potential health hazard)

7. Accumulated rubble and brush

8. Fire damage

9. Safe or shelter areas

10. Facilities under construction

*Visual aspects of the water such as the presence of debris and soil may indicate pollution.

A report outlining the level of detail available for each statistical category given specific altitude and weather limitations was submitted to EPP officials. The advantages of the remote sensing component were seen as:

1. The consistency of the damage assessment (in contrast to assessments made by numerous individuals in the field).
2. A permanent record of the extent of the afflicted area that could be used in both the response and recovery estimates.

3. A concrete measure of the Scope of the disaster that could be used to support requests for federal assistance.
4. The surface status at the time of the disaster (particularly in urban areas where existing maps showing the distribution of development may be obsolete).

The evaluation of the remote sensing potential in the disaster response effort prompted EPP officials to decide that a remote sensing component should be incorporated into the State Emergency Disaster Plan. This action required that a formal contingency plan be developed for the use of remote sensing data in the disaster relief program.

EPP arranged to have KARS personnel assigned to division offices for a two week period to supervise the drafting of the remote sensing response plan and to train EPP personnel in basic air photo interpretation techniques as they apply to disaster situations. The draft plan that was developed set forth the responsibilities of cooperating agencies in the acquisition, development, delivery and interpretation components of remote sensing response. A formal agreement was developed between the State Department of Transportation and EPP for image acquisition and delivery, as a supplement to the State Emergency Disaster Plan.

Louisburg Health Care Facility

In Kansas, the planning for health care delivery systems has become a critical issue during the past decade. The State has experienced some radical demographic shifts that have resulted in a drain of population away from rural areas and a resultant explosion of growth in the major population centers. The consequences of these population shifts have been two-fold. A shortage of health care personnel and facilities has occurred in predominantly rural counties, and rural areas adjacent to major urban centers have been unable to develop health care facilities at a rate that keeps pace with urban build-up at the urban/rural fringe.

Miami County in northeast Kansas has been afflicted with increased growth due to its proximity to the Kansas City metropolitan area. Population projections for the next ten years show that the county can expect to be the scene of additional growth from the continued spillover from the Kansas City area. In August 1976 the Kansas Applied Remote Sensing Program was contacted by the county's health care consultant to determine

if remotely sensed data could be employed in the county's health care planning process which involved the development of demographic and epidemiological indicators for the county.

Usually these indicators would be developed using a variety of data sources; analysis of building permits, household interviews and the compilation of demographic data from numerous other sources and agencies. The unit was working with a very limited budget and time deadline and the use of the previously mentioned data gathering techniques would have required an inordinate committment of time and resources.

A review of existing imagery indicated complete coverage of Miami County had been acquired by a NASA high altitude color infrared mission in May 1974. The first task involved the translation of the demographic and epidimiological factors into land use/land cover characteristics that could be observed on the aerial photography. Through meetings with the health care consultant it was determined that the demographic conditions could be ascertained through the analysis of current population patterns. Population projections and determination of areas of potential residential, business, industrial and agricultural locations could be extrapolated from the imagery via an analysis of the existing road network and the ability of adjacent lands to accommodate these activities.

The original plan had called for a one year planning period that would include data acquisition and processing. Due to delays in processing of the funding request by the federal government, only four months remained in the planning period. The high-altitude photography facilitated the development of the health care plan at a relatively low cost and within the time constraints imposed by the federal government. Without the use of data derived from the high altitude photography as a replacement for traditional data acquisition techniques, the plan would not have been developed within the appropriate time period.

The plan has been used to design ambulance response networks and satellite care facilities for the Louisburg Health Care Center.

Clinton Reservoir State Park

The Kansas Park and Resource Authority (KP&R) is responsible for maintaining nineteen major state parks and recreational areas. An

integral part of the program lies with providing maps and information brochures to over five million yearly visitors and users of park facilities. Officials with KP&R have long recognized the problem that exists in supplying current information to park users. The maps and brochures are outdated and obsolete in some instances, particularly the maps that were compiled during the park development process and which have not been revised to show the changes that have occurred over time. In some cases maps have been revised to show the improvements in capital facilities but not the changes in vegetation at the park sites. At some sites the vegetation changes have been substantial as a result of the abandonment of agricultural cultivation followed by a succession of shrub and woody vegetation.

KP&R officials contacted the KARS program concerning this problem and requested an investigation of the expense that would be required to update park maps using aerial data, particularly in light of the more costly and time consuming method of update embodied in ground surveys. A secondary concern was the redesign of the maps to incorporate the brochure information that is currently supplied in a separate publication.

The scope of the problem as outlined by KP&R was not considered sufficient to allocate normal KARS resources to the project. However, under a new student intern program that had been developed with the Geography Department at the University of Kansas it was agreed that a student intern would be committed to the project as a demonstration project for the Kansas Park and Resources Authority. KP&R agreed to supply the necessary aerial photographs for the demonstration area.

The area selected for the demonstration project was Clinton State Park, adjacent to the Clinton Reservoir in Douglas County, Kansas. The selection of this site would serve a two-fold purpose. The park is still under development and the site analysis would provide additional input in the latter stages of the development process while providing a test of the effectiveness and cost of the aerial photographic input.

Black and white imagery acquired on May 8, 1978 was acquired for the site analysis at a 1:24,000 scale. Consultation with KP&R indicated that the following land surface categories were necessary components in the map of the park area:

1. Water bodies
2. Grassland

3. Woodland
    A. Dense Cover
    B. Light Cover
4. Buildings
5. Roads, parking lots, etc.
6. Dam facing and supports
7. Trails
8. Fences
9. Other Park Facilities

Standard aerial photograph interpretation techniques were employed in the interpretation and mapping process. The initial interpretation was field checked and additional information from ground surveys supplemented the photo derived data for final mapping purposes. The field checks provided data on fence locations, stone walls and trails that were not visible on the original photography due to their size and the shadowing effects of the vegetation overstory. In addition to the field verified data, the Kansas Park and Resources authority provided KARS personnel with a listing of all buildings and facilities that have been planned for the park and those which are currently under construction. These sites will also be included in the brochure.

The preparation of the maps for conversion to a brochure format followed the compilation of all the necessary photo, field and planning data. The brochure is to include two maps, one large scale location and orientation map and the detailed map of the park site. In addition to the map data, the brochure will have a list of park facilities, ground and aerial photographs of the park and a written text and tables that provides pertinent data to the map user. The proposed brochure and cost estimates for its publication have been submitted to KP&R for consideration and analysis. The remote sensing procedures used in this project will be compared to the existing methods of park map compilation, production and revision to determine the effectiveness of aerial photography as an aid to park map compilation.

Riley County Landfill

The Federal Resource Conservation and Recovery Act of 1976 (RCRA) represents the continued efforts of the congress to strengthen the environmental policy legislation that has been enacted during the past decade. The RCRA supplements the policy directives incorporated in a number of earlier pieces of legislation. One section of the RCRA has extended the powers originally provided for in the Federal Water Pollution Control Act (FWPCA) by regulating activities that have an indirect influence on water quality, particularly those activities that are within the bounds of the flood plain.

Floodplain land has traditionally been a popular site for the location of municipal landfills for the disposal of the 145 million tons of solid waste materials that are generated annually by America's urban population. The land was cheap, away from developed areas, easily leveled and once leveled provided an additional barrier against possible flooding. But these advantages have been offset by the environmental hazards. The toxic and decaying materials that are concentrated at the landfill site present a threat to water quality when these materials are leeched into the adjacent river systems. The prohibition of open burning on landfills has increased the threat of toxic materials working their way into the river systems and at the same time has shortened the fill capacity at landfill sites with the increased bulk of waste material, bulk that was formerly reduced by the burning process.

Provisions of the RCRA expressly prohibit the use of floodplain land for solid waste disposal sites. The present site of the landfill for Riley County, Kansas (which includes the city of Manhattan and Kansas State University) is located within the floodplain of the Kansas River and is not in compliance with RCRA standards. While these standards are not, as yet, being enforced Riley County officials initiated search procedures for a new landfill site based in part on the RCRA requirements and on the 24-30 months of capacity that remained at the existing site in early 1977.

Selecting a new landfill site involves three stages in the decision-making process. First, an initial survey is made of land that is available or which is expected to be available for purchase by the county for landfill purposes. The county engineer screens these sites for their engineering

properties (drainage, soils, percolation rates, location, access, proximity to developed areas, etc.) to insure that the sites would be compatible with the landfill activity. The county engineer determines which of the sites that meet the engineering and locational constraints would be best suited to the landfill activity and provides his analysis to the County Commission for further consideration.

The second stage in the decision-making process lies with the County Commission that reviews the proposed sites. During this review, public hearings are held for the benefit of local residents who are invited to express their opinions on the relative merits of the sites proposed for landfill development. Following the public hearings, the County Commission selects the site or sites that will be approved for development.

The third stage in the decision-making process lies with state level approval of the proposed landfill sites. The sites that have been approved by the County Commissioners are reviewed by the Kansas Department of Health and Environment. The site analysis that is provided by the county engineer is reviewed to insure that the site conforms to the state and federal regulations that address potential pollution hazards and health hazards to adjacent residents.

Following KDHE's review and approval of the proposed sites, the final selection is made by the county commissioners and the land acquisition process is initiated.

During the first stage of the site selection process the Riley County Engineer identified three potential sites for the county landfill operation. Criteria for this initial search were based on the expected availability of the land, cost of land acquisition, access and the location of the site relative to existing built-up areas. While preparing documentation on the sites for presentation to the County Commissioners, the county engineer contacted the KARS program and requested assistance with the use of remotely-sensed data for evaluating the physical characteristics of the proposed landfill sites. Working with the county engineer, KARS personnel determined that the following classes of land use/land cover were required for the site analysis:

1. Residential (including farmsteads)
2. Non-residential urban
3. Vacant urban

4. Transportation right-of-ways
5. Cropland
6. Pasture and rangeland
7. Rivers and water bodies
8. Deciduous Vegetation
9. Coniferous vegetation
10. Sand bars

Particular importance was placed on the location of continuous belts of coniferous and deciduous vegetation. In particular, coniferous vegetation would provide a year-round windbreak and restrict the excess blowing of trash onto adjacent lands. The vegetation would also provide a screen to shield the landfill from the view of nearby residents and passing motorists.

The Riley County Engineer agreed to provide the KARS program with the necessary imagery which had been acquired by the county in December, 1975 and December, 1976. The 1:24,000 and 1:30,000 scale black and white imagery was analyzed using standard aerial photographic interpretation techniques for each of the landfill sites and for the immediate area within one mile of the site boundaries. The interpreted data were mapped on base maps at a scale of 1:15,800 (four inches to the mile).

An initial set of maps (Figure 5) was prepared and delivered to the Riley County Engineer who used the maps in his presentation of the site analyses to the County Commission. The County Commission reviewed the data and determined that the sites met the physical, financial and locational criteria. However, due to public controversy surrounding the proposed sites the commission decided that additional sites should be considered. The county engineer was directed to select two additional sites for consideration, one of which was adjacent to the existing landfill operation but above the floodplain.

Maps were prepared by the KARS Program for the two supplementary sites and were subsequently submitted to the commissioners. Both sites were approved and then forwarded to KDH&E for final approval. KDH&E will review the design, location and environmental considerations for each site to determine if the proposed sites meet state and federal guidelines. Upon KDH&E approval of the sites, the commissioners will make their final selection and initiate land acquisition procedures.

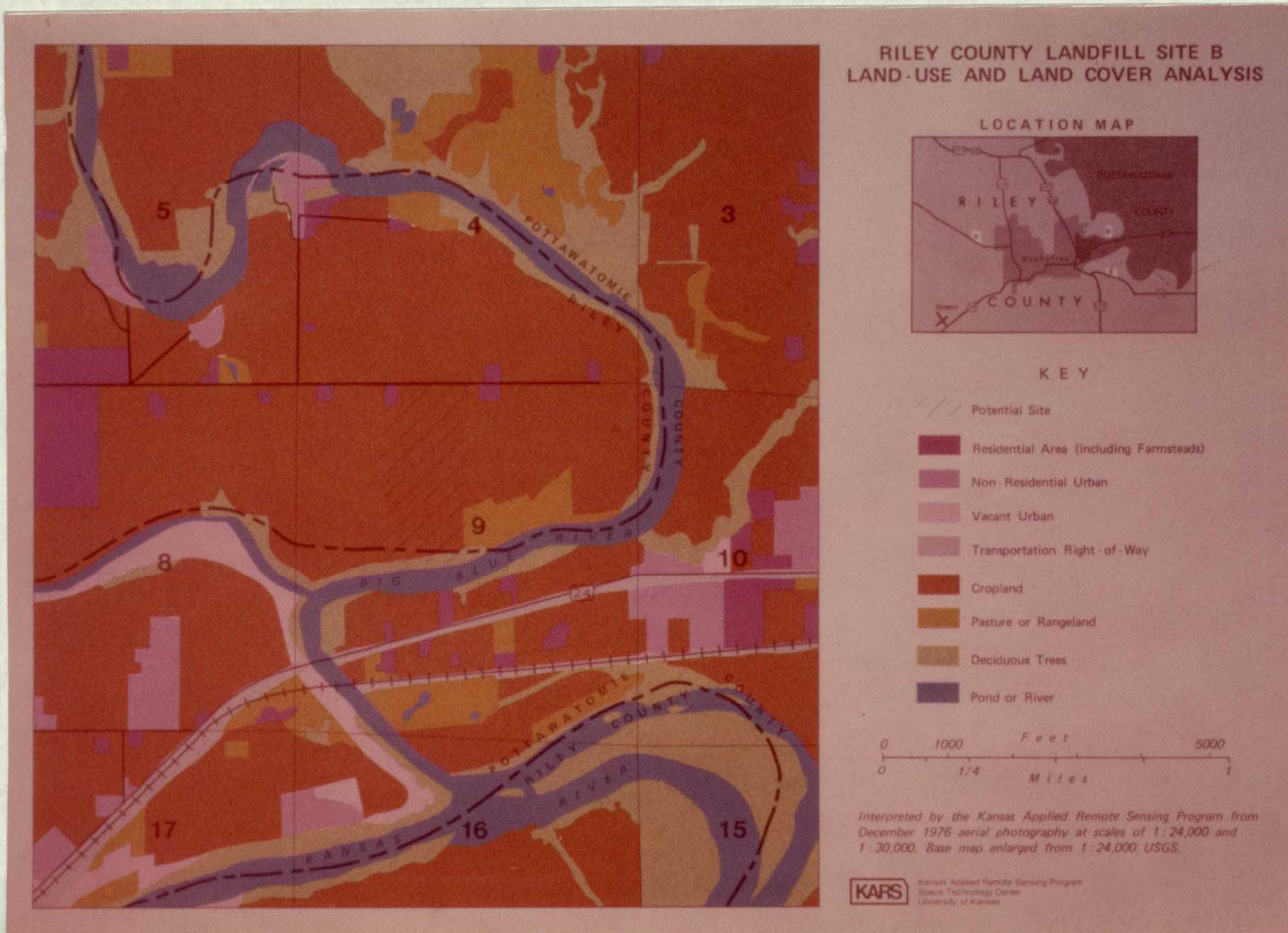


Figure 5

Mine Creek Battlefield

In the early morning hours of October 25, 1864 a 12,000 man confederate force under the leadership of Major General Sterling Price was trapped by Union forces under the command of Major General Samual Curtis while undertaking a complicated creek crossing. The battle lasted but a scant twenty minutes, perhaps the deadliest and most costly twenty minutes of the war. At the end of that period at least three-hundred confederate troops lay dead and another 900 were captured compared to the one-hundred and fifty Union soldiers that lost their lives in the conflict.

Price's troops had been caught unguarded while negotiating a crossing at Mine Creek in Linn County, Kansas. The crossing had acted as a bottleneck for Price's troops who were massing for an assault on Fort Scott, the last planned objective of a raiding and recruiting campaign that had begun two months earlier when Price led his force into Missouri from Confederate strongholds in Arkansas. Mine Creek was actually the last (and most spectacular) in a series of running battles that had begun at Kansas City, Missouri. Union forces had continually forced Price to the South and acquisition of the supplies and munitions at Fort Scott was to be Price's last futile effort before a full-scale retreat into Arkansas. The Mine Creek conflict prevented the attack on Fort Scott as Price lost fully ten percent of his effective fighting force.

Price returned to Arkansas in relative disgrace. He had failed at his major objective, wrestling the state of Missouri from Union control and turning it into a confederate stronghold. His second objective, the recruitment of men for service in the confederate army, had been a disaster. The few that he did recruit returned to their homes during the course of the series of losing battles. And his third objective, the destruction of union supplies, disruption of supply lines and the commitment of resources and troops away from the war in the east, was but a limited success.

The union dead that had fallen at Mine Creek were taken to Mound City for burial while the three-hundred confederate dead were left where they lay. It was some time before the bodies were buried. Most were later buried in a shallow mass grave at the battle site or in single or double graves at the places where they fell.

The Mine Creek Battlefield was the site of the only civil war battle fought in Kansas between regular troops of the Union and Confederate armies. The battlefield is currently carried on the National Register of Historic Sites but has never been formally developed nor maintained as a park or historical monument. The Kansas State Historical Society (KSHS) is planning to develop the site for this purpose and will seek county, state and federal funds for the construction of facilities and the reconstruction of the battlefield site using markers to identify the key landmarks in the battle that occurred one-hundred and fourteen years ago.

The length of time that has elapsed since the battle has hampered KSHS efforts to develop a plan for site reconstruction. Mine Creek winds its way through a swamp at the site and has changed course several times during ensuing years. The road that Union and Confederate forces used to get to the site has been shifted and the intersection and road that once led to Fort Scott has long been abandoned and covered by vegetation. The vegetation that was described by participants in the battle has also changed and as a result of all these changes, KSHS is having problems in identifying the areas mentioned in battlefield accounts.

The Kansas Applied Remote Sensing Program was contacted concerning the challenging nature of the battlefield reconstruction. The vegetation problem was particularly acute. To provide an accurate analysis of the site it was determined that aerial photography would have to be acquired before trees and shrubs leafed out in the spring if the path of the old Fort Scott road and the original path of Mine Creek were to be accurately delineated. The identification of the unmarked gravesites was considered an even more difficult problem. Normal archaeological remote sensing techniques rely on the geometric arrangement of dwellings, fortifications, roads and paths as keys for site reconstruction. The gravesites at Mine Creek are thought to be randomly dispersed across the site with no formal arrangement in the landscape.

Consultations with KSHS personnel indicated that the only possible factors that might aide the gravesite detection lay with the moisture retention characteristics of the disturbed soils and with possible variations in the chemical composition of the soils at the burial sites. With these being the only factors available for gravesite identification, it was judged that the timing of air-photo acquisition was of vital importance.

The imagery would have to be acquired at an early point in the spring after the grasses had started to green (based on the assumption that grasses over the old gravesites would turn green at a different rate than would grasses on undisturbed soils), and before the leaves had emerged on shrubs and trees.

In April 1978 KARS personnel acquired low-altitude color infrared imagery over the battlefield site. This imagery satisfied the pre-emergence requirements for leaves on shrubs and trees and followed the greening of grasses in the area. Using stereoscopic analysis techniques, the path of the former Fort Scott road was delineated as was the former path of the Kansas City road. The former path of Mine Creek was also delineated through the mapping of old meander scars.

Several areas that exhibited variations in the health, distribution and density of grassy vegetation were identified as potential gravesite locations. These sites were then investigated by field checks to determine if they were actual burial sites and to test the validity of the interpretation techniques.

As a result of this interpretation, KSHS has been able to begin a partial reconstruction of the battlefield and will continue to utilize the imagery to identify additional landmarks associated with the battle. The Daughters of the Confederacy have committed funds for the erection of a monument to the Confederate dead at the site. The KSHS is soliciting funds from the Linn County Commission for the development of the site as a park. KSHS has also requested that the site be declared a National Landmark which will free additional state and federal funds for site development.

Kansas Applied Remote Sensing

KARS Newsletter

The University of Kansas Lawrence, Kansas January 1978 Volume 7, Number 1

WYOMING ANTELOPE FIND NEW HOMES IN KANSAS

The State of Kansas is richer by a hundred antelope this year after the Kansas Fish and Game Commission (KF&G) introduced them to two new areas in the state The two releases were the culmination of a six month planning effort by KF&G and KARS personnel (KARS NEWSLETTER, Vol. 5, No. 4)

At the request of KF&G, the KARS program staff evaluated three potential release sites to determine the extent of agricultural encroachment onto rangeland. LANDSAT imagery was used by KARS personnel to map changes in land-use for a five year period from 1972-1976. This information was then used by KF&G biologists to determine those sites in which the antelope will have the greatest chance of becoming established.

In early January of this year, KF&G personnel traveled to Wyoming, trapped the 100 antelope, and returned with them to Kansas One group of 63 antelope was released at a site in south central Kansas (Clark County), while the other 37 were released in the Flint Hills (Chase County) Combined with previously established herds in western (Wallace and Logan Counties) and south central Kansas (Barber County), these two releases bring the population of pronghorn antelope in the state up to about 1200 distributed in four different locales

(Ted Talmon)

KANSAS ACADEMY OF SCIENCE MEETING

On Friday and Saturday, April 14 and 15, the Kansas Academy of Science, the oldest Academy of Science west of the Mississippi, will be holding its 110th Annual Meeting in the University of Kansas Union Building on the Lawrence campus. General paper sessions will be held both mornings on a variety of subjects The largest number of papers deal with Biology and Agriculture but also included are "Earth and Environmental" sessions, a "Special Session on Land Use" and sessions concerning at least ten other subject areas

Friday afternoon features two special symposia. One deals with methods for teaching about the environment and environmental problems. The other concerns "Remote Sensing in Environmental Analysis and Planning in Kansas" and was organized by the KARS Program. Several Universities and state agencies will be represented in the Remote Sensing Symposium (see program inside this newsletter) and it is hoped that the interchange of ideas that occurs during the symposium will serve to further expand understanding about remote sensing within both the academic community and state agencies.

The Academy's Annual Meeting is open to everyone and non-members are welcome to attend. For further information contact:

Eugene C. Bovee
Division of Biological Sciences
University of Kansas
Lawrence, Kansas 66045

SAND HILLS STATE PARK MASTER PLAN COMPLETED

During the late spring and early summer of 1977, KARS personnel used aerial photos to map land use/land cover in the newly acquired Sand Hills State Park site (Reno County) for the Kansas Park and Resources Authority (KPRA) The land use/land cover map delineated eleven different categories of features. high dunes, low dunes, bare sand (blowout) areas, grassland, agricultural areas, roads, fences, wooded areas, marshes, water bodies and utilities. This 1.9,600 scale map was intensively used by the park planners in the preparation of the park master plan.

The first and most immediate result of the interpretation was the identification of several short-term development projects within the park area. These were undertaken and completed by a group of Youth Conservation Corps workers during the summer of 1977 (KARS Newsletter, July, 1977.) The second result of the interpretation came about late in the Fall when the Master Plan for the park was completed by KPRA.

The focal point of the park area is a series of very striking sand dunes, some of which are 40 feet high These are very delicate ecological areas, only partially stabilized by a thin cover of vegetation. In dune areas where vegetation is damaged or destroyed, wind erosion may rapidly extract its toll, creating a "blowout." The key long-range concern of the park planners was to develop a master plan that would maximize scenic access to these dunes while minimizing physical contact with the ecologically delicate areas.

By compositing selected combinations of KARS delineated features with collateral information, areas appropriate to specific kinds of development were distinguished from areas inappropriate to such development and a Master Plan was developed. The adopted plan includes development of six nature study areas, six camping areas, seven picnic areas, several maintenance areas, location of service entrances, hiking trails and parking areas. In addition, a large Interpretive Center is designed to describe and interpret the unique character of the Sand Hills Park area.

The master plan estimates park usage at more than 100,000 visitors annually. In the future the master plan, developed through the use of the remote sensing data, will continue to guide the development of this scenic natural area

(Joe Poracsky)

THE TAUY CREEK WATERSHED

Under Public Law 566, Watershed Protection and Flood Prevention Act, federal funds will be available for the construction of major flood water retardation structures within watersheds provided that the watersheds meet specified federal criteria. The Tauy Creek Watershed Planning District No. 82, located in Southern Douglas County and Northern Franklin County, is in the process of planning and implementing flood prevention and soil conservation measures for the watershed that will enable it to qualify for the federal funds.

One portion of the federal guidelines specifies that floodwater detention structures of a lesser scale than the P.L. 566 structures must be built above the proposed P.L. 566 structures. To comply with this, a total of 22 flood detention structures have been planned in the Tauy Creek District.

Another portion of the criteria specifies that at least 75% of the area above each of these detention structures must be treated with soil conservation practices. To insure conformity with the federal requirements, the Board of Directors of the Tauy Creek Watershed Planning District requested KARS assistance in compiling the necessary land use information for the watershed Using existing aerial photography, land use in 10 of the 22 flood retardation dam sites was mapped into categories that classified degree of land treatment in the area above the structures. The 12 remaining sites were not mapped at this time due to engineering problems which will require special study before these sites can be considered.

The aerial photography showed that in two of the proposed dam sites an insufficient amount of land had the necessary treatment. These two sites, therefore, were eliminated from consideration for immediate funding. The photography also showed the existence of farm ponds near two additional sites, thus necessitating additional study before funding can be considered A fifth area was shown to have an extensive area of shrub and tree vegetation lying within the proposed dam site. It too was not considered for initial funding, subject to discussions with the landowners concerning the clearance of the vegetation from the dam area.

From the maps, data on land treatment was compiled for the five remaining sites and presented by KARS to the Tauy Creek Watershed Board of Directors From this data priorities were assigned to the construction of the five remaining structures. The Board of Directors is now in the process of contacting landowners in the five proposed sites and securing their approval before the final allocation of funds will be made and construction begins.

(Ron Shaklee)

A Symposium on

REMOTE SENSING IN ENVIRONMENTAL ANALYSIS AND PLANNING IN KANSAS

to be held during the 110th Annual Meeting of
The Kansas Academy of Science
at the Kansas Union Building, University of Kansas
Friday, April 14, 1978, 1:30-4:00 p.m.

Remote sensing commonly refers to the collecting of information from some kind of airborne or spacecraft borne sensor The earliest of these sensors, the aerial camera, has in recent years been joined by other instruments such as the multi-spectral scanner, thermal infrared scanner and radar Each of these sensors is capable of providing unique kinds of data about the environment.

Since a number of the sensors and techniques available in remote sensing are quite new, many workers in the environmental and planning fields are unfamiliar with them The Symposium is intended to help overcome this unfamiliarity The papers to be presented in the first portion of the program will address the questions what is remote sensing and what are some of the ways that it is currently being used in environmental analysis and planning in Kansas? The panel discussion in the second portion of the program is intended as a forum for exchanging ideas about applications of remote sensing that may exist now or that may emerge in the near future.

* * * * * * * * *

Paper Presentations: CURRENT APPLICATIONS

Remote Sensing An Overview of the State of the Art and Its Applications in Kansas
T. H. Lee Williams, Department of Geography and KARS Program, University of Kansas

Aerial Photography in Highway Site Analysis
Lewis Myers, Environmental Support Section, Engineering Services Department, Kansas Department of Transportation

Aerial Photography of Archeological Sites in Kansas
Thomas Witty, State Archeologist, Kansas State Historical Society

Thermal Infrared Scanning for Surveying Heat Loss in the City of Wichita
K. Sam Shanmugam, Department of Electrical Engineering, Wichita State University

Panel Discussion: EMERGING NEEDS AND CAPABILITIES

Moderator B.G Barr, Director, Space Technology Center, University of Kansas

Janét Bare, Assistant Director, Remote Sensing Laboratory, University of Kansas

Claude Keithley, Department of Regional and Community Planning , Kansas State University

Chris McKenzie, Policy Analyst, Division of State Planning and Research

Rolfe Mandel, Research Associate, Institute for Social and Environmental Studies, University of Kansas

Ed Martinko, Project Coordinator, Kansas Applied Remote Sensing Program, University of Kansas

* * * * * * * * *

For further information, contact Joseph Poracsky
Space Technology Center
University of Kansas
Lawrence, Kansas 66045
(913) 864-4776 or KANS-A-N 564-4776

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NEW RESEARCH ASSOCIATE JOINS KARS STAFF

Dr T. H. Lee Williams recently joined the KARS Program staff as a Research Associate. Dr. Williams is a remote sensing specialist with a background in agricultural land use studies. His research has included work in the problems of collecting contemporaneous ground truth information for satellite and aircraft land use studies and work with techniques of image enhancement. Dr. Williams holds a PhD in Geography from the University of Bristol (England) and is currently an Assistant Professor of Geography at the University of Kansas where he offers several courses in remote sensing. Prior to coming to Lawrence in the Fall of 1977 he was a Visiting Research Associate in the Department of Geography at the University of Oklahoma.

KARS REPRESENTED AT REMOTE SENSING SOCIETY CONFERENCE

The range of applied remote sensing projects carried out in the KARS program was the theme of a display presentation given at the Remote Sensing Society Conference held in Sheffield, England, in December. The conference theme was "Third World Applications of Remote Sensing" and resulted in a general discussion of the problems and approaches to transferring remote sensing technology to the user, both in developing and developed countries.

Dr T. H. Lee Williams of the KARS staff presented a paper at the conference entitled "Low Cost Image Enhancement Using Color TV System," co-authored with Dr. Jim Goodman of the University of Oklahoma. The paper dealt with the use of a color TV system for enhancement of LANDSAT false color composite images in terrain type mapping.

The KARS 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. Publication 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 Joseph Poracsky, Editor, KARS Newsletter. Phone: 913/864-4775 or KANS-A-N 564-4775.

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The University of Kansas Center For Research, Inc.
2291 Irving Hill Drive—Campus West
Lawrence, Kansas 66045

Kansas Applied Remote Sensing

KARS

Newsletter

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REMOTE SENSING IN MUSK THISTLE RESEARCH

1978-79 is the first year of a three-year interdisciplinary EPA-funded project to study musk thistle (Carduus nutans), a noxious weed in Kansas (KARS NEWSLETTER, October 1977). Part of the research is concerned with detecting and monitoring musk thistle infestations through the use of remote sensing.

Remote sensing activities in the summer of 1978 have been directed towards developing techniques for obtaining information about the pattern, density and site characteristics of musk thistle infestations. Specific activity has concentrated in two areas, refinement of the sensing techniques for identifying musk thistle and definition of an appropriate survey procedure.

A theoretical study based on previous work (KARS NEWSLETTER, July 1976) indicated that detection of individual musk thistle plants could be obtained through recognition of the characteristic purple flower head during the three week flowering season in early June, using very large scale photography. Consequently during the month of June several test flights were made over flowering populations using 35mm Nikon and 70mm Hasselblad cameras equipped with 250mm telephoto lenses, at a height of 500 ft. above ground level (AGL). At such a low altitude and using long focal length lenses it was anticipated that a problem would be encountered due to ground motion during the film exposure. Review of the test flight imagery indicated that musk thistle flower heads could be identified on photographs from both cameras. It was subsequently decided that the disadvantage of greater image motion on the 70mm images due to the slower maximun shutter speed (1/500 second vs. 1/1000 second on the Nikon) was offset by the superior quality and larger area coverage of the 70mm images over the 35mm images.

Both aerial color and aerial infrared color film were used and compared: the natural color film was selected as giving better discrimination of flower heads. Subsequent flights, therefore, utilized Hasselblad cameras and Aerochrome MS(2448) aerial color film at a flying height of 500 feet AGL. A two-camera array was used, using a 250mm and a 100mm lens. The second camera with 100mm lens provides a larger-area image to aid in ground location of the 250mm lens photos.

The small area coverage of the large scale photographs required to identify musk thistle plants precludes total coverage in an aerial survey, since approximately 2500 frames would be required per square mile. This fact dictates adoption of a sampling approach to any musk thistle survey. In order to derive a suitable sampling scheme, a series of flights was made parallel to, and at various distances from, section lines in crop and rangeland areas. The results from the flights will be used to (a) examine habitat preferences; (b) evaluate the biasing effect of sample traverses located with respect to section lines; and (c) derive preliminary estimates of population size and distribution. To derive the relationship between actual plant population and population figures obtained from the aerial photography, a series of representative calibration sites were marked out on the ground and flown at intervals during the flowering season. The results will be compared to a series of contemporaneous measurements made in the field.

As part of the design of a suitable sampling scheme, a 12 mile traverse was studied by (a) a windshield survey, (b) aerial sketch mapping, and (c) aerial photographic sampling. The results are still being analyzed but thus far it appears that a simple aerial sketch map survey is the best means of locating moderate to heavy infestations, while the aerial photographic sampling procedure is the most suitable for deriving population estimates.

The next phase of the study is to design a suitable sampling scheme to derive musk thistle population estimates. A multistage sampling procedure will be adopted, based on the habitat preference information derived from this year's work and on the characteristics of the low level aerial photography coverage. The procedure will be tested and refined during the 1979 flowering period.

MAPPING OF IRRIGATED LANDS IN SELECTED COUNTIES OF WESTERN KANSAS

The KARS Program has done extensive mapping of center-pivot irrigation in Southwest Kansas (KARS Newsletters, October 1976, January 1977) and has been very interested in building on and extending its expertise in this area to include mapping of all forms of irrigation. Near the end of 1977 the KARS Program began discussing with the Kansas Legislative Research Department (KLRD) the possibility of mapping irrigated lands in Western Kansas and since the Spring of this year has been involved in mapping irrigation in six Western counties for KLRD. The LANDSAT-derived irrigation data will be a part of a KLRD report on corporate farming in Kansas being prepared for the interim Agriculture and Livestock Committee of the State Legislature

The purpose of the report is to assist the committee in deciding whether or not to consider revision of the present corporate farming laws. The mapped irrigation data is required in order to determine if the proportion of corporately-owned land that is irrigated is greater than that of privately-owned land that is irrigated. This determination will be made by comparing the irrigation data with data that KLRD has on corporate ownership.

The KARS Program's portion of the project involved using LANDSAT imagery for the mapping of all forms of irrigation in the six sample counties under study by KLRD The multidate interpretation was performed manually at a scale of 1:250,000. Registration was maintained through use of a technique developed during earlier center-pivot research.

The data were then coded, keypunched and input to a computer file, resulting in a highly flexible data base. The number of records for each county varied from about 1100 to over 2000, depending on the intensity of irrigation in the county. Special input, verification and retrieval programs were written by KARS to allow easy handling of this data. One output format lists number of acres of irrigated land in each quarter section in a county and identifies whether the irrigation is flood or center-pivot. The same program provides a statistical summary for the county, listing total number of flood-irrigated acres, total number of center-pivot irrigated acres, and total number of center-pivot irrigated fields. The quarter-section legal description lists for all six counties have been delivered to KLRD and are presently being compared with their ownership data. Additional data retrieval procedures are currently being developed by KARS in order to provide even greater analytical capability.

KANSAS ACADEMY OF SCIENCE SYMPOSIUM ON REMOTE SENSING

On Friday, April 14 a very successful "Symposium on Remote Sensing in Environmental Analysis and Planning in Kansas" was held at the Annual Meeting of the Kansas Academy of Science. The session was well attended, having more than 70 people on hand. The program included ten people from various academic, research and state agency groups. The complete program for the symposium, organized by the KARS Program, appeared in the January 1978 KARS NEWSLETTER.

A series of four invited papers were presented in the first part of the symposium, "Current Applications" The first presentation, by Lee Williams, provided a succinct introduction to the most common types of remote sensors and some of their applications to environmental analysis. Specifically aimed at those people who knew little or nothing about remote sensing, the talk provided a conceptual framework for understanding the presentation and discussion which followed.

The three other papers which followed presented specific examples of remote sensing uses in Kansas. Lewis Myers from the Department of Transportation discussed the application of aerial photography to transportation site analysis. Thomas Witty of the Kansas State Historical Society discussed his use of aerial photography in work at various archeological sites in Kansas. K. Sam Shanmugam from Wichita State University described his recent work in thermal sensing for heat loss in Wichita.

All four of the papers were well-received and in total provided a good sample of the range of applications in the state. An exciting array of slides was shown and served both to assist in communicating the large amount of information that was presented and to stimulate the thinking of those present about other uses and capabilities of remote sensing.

The second portion of the Symposium program was a panel discussion on "Emerging Needs and Capabilities". The panel consisted of Janet Bare from KU's Remote Sensing Laboratory, Claude Keithley from KSU's Department of Regional and Community Planning, Chris McKenzie from the Division of State Planning and Research, Rolfe Mandel from KU's Institute for Social and Environmental Studies, and Ed Martinko from the KARS Program. Moderator for the panel was B. G. Barr, Director of KU's Space Technology Center. Following some brief introductory remarks from the panel several different questions were discussed, largely as a result of queries to the panel from the audience.

Though a number of specific points were made by the panel, they may be summarized in three general areas. The first area dealt with problems of technology transfer, that is, making people aware of what remote sensing can do and actually getting environmental analysts and planners to use the vast amount of technology that does exist.

The second area concerned the need for some kind

of statewide coordination effort for remote sensing projects. Much of the available data could be serving multiple uses if, for instance, a flight covered just a few more miles or some imagery was of a slightly different scale. The cost of setting up such a coordination effort would be far out-weighed by the benefits that would result.

The third area concerned the possibility of regular meetings among the various remote sensing interest groups. It was the general feeling of those present that such regular meetings would be most useful and would serve as a catalyst for greater interaction between the basic researchers, the applied researchers and the users of remote sensing technology in Kansas.

MAPPING POTENTIAL FUGITIVE DUST SOURCE AREAS FOR KDHE

The KARS Program has recently begun a cooperative project with the Kansas Department of Health and Environment-Bureau of Air Quality and Occupational Health (KDHE-BAQOH) to provide maps and statistics on suspected source areas of "fugitive dust" "Fugitive dust" is particulate emmission made airborne by the forces of wind, man's activity, or both. Potential source areas include unpaved roads and parking lots, construction sites, baseball diamonds and virtually any other bare ground surfaces.

Color infrared aerial photography at a scale of 1:8,000 was acquired on June 28 over a "test site" in North Topeka. Interpretation of this photography will be the basis for compiling maps depicting various categories of bare ground and for deriving area measurements of the bare ground surfaces. The maps and the measurement statistics will then be input by KDHE-BAQOH to a diffusion model which will be used to determine if fugitive dust sources are in need of control.

REMOTE SENSING AT A CIVIL WAR BATTLE SITE

Mine Creek in Linn County, Kansas was the site of the most important Civil War battle fought in Kansas. Fought on October 25, 1864, the battle involved about 25,000 men and resulted in a victory for the Union over the Confederate force of Maj. Gen. Sterling Price. There are believed to be between 200 and 500 Confederate dead buried in unmarked single and mass grave plots on the site. As part of the development of a state historic site and park at Mine Creek, KARS personnel are cooperating with the Kansas State Historical Society in an attempt to locate the burial plots.

Archaeologists have had great success in locating physical remnants of past cultures using aerial photography. In identifying such remnants the key factor is simply that disturbed ground will often bear the scars of a disturbance for a long time after the disturbance has occurred Thus it is that features such as roads and building foundations that were in existence centuries ago have been identified using aerial photography.

The premise of this investigation is that the ground disturbances due to the graves may be visible as differences in the ground vegetation Such differences should be at a maximum in early Spring. This time of year offers the additional advantage that the ground vegetation will not be obscured by tree canopies. Color infrared aerial stereo photography at a scale of 1:2,700 was acquired over the site in April of this year using the 9 inch format cartographic camera of the University of Kansas Center for Research, Inc. flown in a Cessna 180 equipped with a camera port

Interpretation of the photography is still in progress; problems were encountered due to patterns on the photography caused by earlier tree-felling activities in the area. A number of suspect areas have been identified on the photography but field checking is being hampered by the now-dense undergrowth in the area.

LANDSAT 1 RETIRED, LANDSAT 3 LAUNCHED

On January 6, 1978, LANDSAT 1 was officially retired. Progressive orbital degradation had caused the satellite to see almost constant sunlight, resulting in severe and uncorrectable overheating problems. Launched on July 23, 1972, LANDSAT 1 had a planned orbital life of one year, but continued to function well for over five years. During its period of service it returned data for 300,000 images of the Earth from space and helped usher in a new era in monitoring and analysis of earth resources. LANDSAT 1 was joined on January 20, 1975 by an identical satellite, LANDSAT 2. From the time of LANDSAT 2's launch until the recent retirement of LANDSAT 1, the two satellites provided twice-every-18-day coverage of the earth's surface.

On March 5 of this year, LANDAST 3 was launched. After orbital adjustments, the sensor systems were turned on, and data from LANDSAT 3 are now being received and processed. Although LANDSAT 3 is similar in design to the two preceding LANDSATs the sensor systems carried onboard have been modified. The multispectral scanners (MSS) on LANDSATs 1 and 2 operated in four different spectral bands in the 0.5-1.1 micrometer range. The LANDSAT 3 MSS has an additional band that responds to emitted thermal infrared radiation in the range of 10.4 to 12.6 micrometers. This additional thermal band, band 8, will sense temperatures from - 13°C to 67°C with a temperature resolution of 1.5°C. The instantaneous field of view is nominally 237 x 237 meters. Band 8 will acquire nighttime thermal data during the satellites's ascending node.

The return-beam vidicon (RBV) camera system on LANDSAT 3 is significantly different from the RBV systems on the previous satellites Two panchromatic cameras produce two side-by-side images rather than three overlapping multispectral images of the same scene. Each RBV camera covers a 99 x 99 km area, with a total swath width of approximately 185 km. Four RBV images will coincide approximately with one MSS frame. A focal length of 23.6 cm (9.3 in.), or nearly twice that of the LANDSAT 1 and 2 RBV, will nearly double the resolution for ground area mapping.

NSF CONFERENCE ON LONG-TERM ECOLOGICAL MEASUREMENTS

During the week of February 6-10, 1978, the National Science Foundation (NSF) sponsored a "Conference on Long-Term Ecological Measurements" at the Marine Biological Laboratory in Woods Hole, Massachusetts. The conference was the second such meeting on Long-Term Measurements and concluded with a statement of specific and detailed recommendations concerning selection of sites for pilot projects, integration of activities among pilot sites, standardization and calibration of measurements, storage and retrieval of the data, manpower requirements and availability, and coordination with Federal agencies involved in data acquisition. The recommendations addressed terrestrial, fresh-water and marine sites as well as the possibility of linked sites.

Dr. Edward Martinko, KARS Project Coordinator, was invited to speak during the conference on "Remote Sensing Applications in Long-Term Ecological Measurements." He also served as Chairman of the Committee on Initial Conditions for Pilot Studies. Dr. Martinko was joined on this committee by Dr. A. W. Küchler, University of Kansas Department of Geography-Meteorology. Dr Küchler spoke at the conference on "International Programs."

The conference was attended by approximately forty invited ecologists from the United States and Canada. A report of the conference is now in preparation.

INVITATION TO SUBMIT NEWS ITEMS

One of the points discussed by the panel at the recent Kansas Academy of Science Symposium on Remote Sensing was the need for a means by which various workers in the remote sensing field in Kansas could be kept informed of each others current work. One vehicle for communicating such information is this Newsletter. The KARS Newsletter would welcome contributions of an applied remote sensing nature and encourages remote sensing workers in Kansas to submit news notes of this type. All contributions will be acknowledged.

UPCOMING MEETINGS

12-17 August 1978 SIXTH NORTH AMERICAN PRAIRIE CONFERENCE, Fawcett Center for Tomorrow, The Ohio State University, 2400 Olentangy River Road, Columbus, OH 43210. For further information contact: Charles C. King, Ohio Biological Survey, 484 W. 12th Ave., Columbus, OH 43210, (614) 422-9645.

10-12 October 1978 4TH WILLIAM T. PECORA MEMORIAL SYMPOSIUM-REMOTE SENSING AND WILDLIFE MANAGEMENT, EROS Data Center, Sioux Falls, S.D.

Contributors to this issue of the KARS Newsletter included Ed Martinko, Joe Poracsky, Ted Talmon and Lee Williams. The article concerning LANDSAT was modified from LANDSAT DATA USERS NOTES, Issue No. 2.

The KARS 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. Publication 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 Joseph Poracsky, Editor, KARS Newsletter. Phone: 913/864-4775 or KANS-A-N 564-4775.

KARS Newsletter
The University of Kansas Center For Research, Inc.
2291 Irving Hill Drive—Campus West
Lawrence, Kansas 66045

Kansas Applied Remote Sensing Newsletter

The University of Kansas, Lawrence, Kansas | October 1978 | Volume 7, Number 4

MAPPING OF IRRIGATED LANDS IN SIX WESTERN KANSAS COUNTIES IS COMPLETED

The KARS Program recently completed its irrigated lands mapping project for the Kansas Legislative Research Department. The first two phases of this three-part KARS project involved the visual interpretation of LANDSAT images to map irrigated lands and the preparation of a computerized data base keyed to quarter-section descriptions of the irrigated lands. These phases were completed in early summer with the delivery to KLRD of a set of listings and statistical summaries of the data for each county.

The third and final phase involved the development of a set of programs to allow maps of the data to be prepared directly by the computer. In order to do this the data had to be transformed from a legal description of quarter sections to a grid or matrix location system in which each cell of the matrix represented one quarter section. Once the data was transformed, maps were produced on the standard line printer of KU's Honeywell 66/60 computer. Each cell which contained irrigated land was displayed on the map with a symbol corresponding to the data category for that cell. The symbols were produced by either a single or group of overprinted characters.

For each of the six counties, three different maps were prepared. One map, prepared from data supplied by the KLRD, showed the corporate-owned land within the county and identified the kind of corporation by one of three classes: non-absentee, semi-absentee and absentee. A second map, prepared from the LANDSAT data interpreted by KARS, showed the irrigated land by quarter sections and the amount of land irrigated in each quarter section. A third map combined the information from the first two, portraying corporate-owned land that is irrigated, and again identifying the kind of corporation.

All of the maps and statistical data have been delivered to KLRD and form an important part of their report on corporate farming in Kansas. The final report is to be delivered to the interim Agriculture and Livestock Committee sometime in the spring. The study will be used to assist the committee in deciding whether or not a revision of the state's corporate farming laws is needed.

CONFERENCE ON THERMAL INFRARED SENSING FOR HEAT LOSS

Over 200 people attended "Thermonsense I. The First National Conference on the Capabilities and Limitations of Thermal Infrared Sensing Technology in Energy Conservation Programs," held on September 20-21, in Chattanooga, Tennessee.

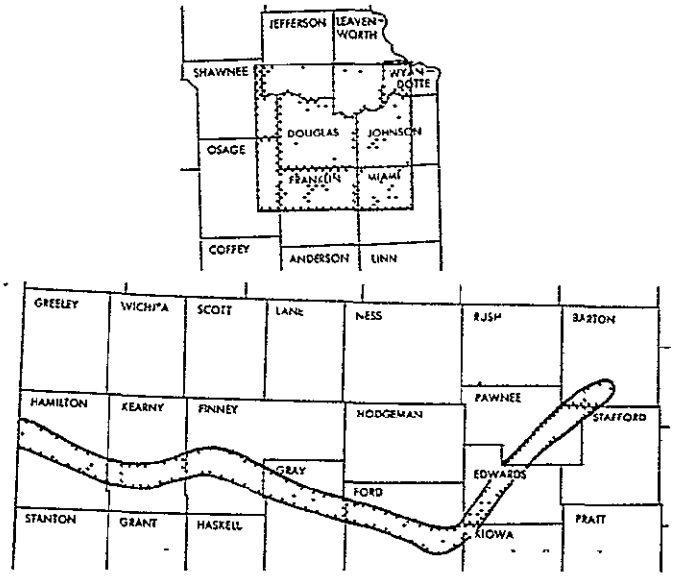
Sixteen different papers were presented during the course of the meeting. There was a session dealing with "Basic Principles of Detecting Building Heat Loss via Thermal Infrared Sensing," one on "Case Studies in the Use of Thermal Infrared Sensing in Energy Conservation Programs," and finally a session on "Progress, Pitfalls and Potentials of Applying Infrared Sensing Technology." Several times in the paper presentations a speaker touched on an aspect of the subject that had already been dealt with, but from a different viewpoint. The result was a thorough, clear and balanced presentation of both the fundamentals and many of the subtleties of thermal infrared sensing.

The major negative point made about the technique had to do not with the remote sensing aspect directly but rather with the problems involved in understanding and applying the basic heat-loss equation. There are several variables involved in the equation, and as a result problems arise in two areas. First, because of the numerous atmosphere-related variables,

there are important restrictions on the weather conditions under which thermal infrared data may be obtained. Second, because of the numerous surface-related variables, an interpreter cannot always be certain, except in a relative sense, what the data means after it is collected. Although qualitative analysis of thermal data is rather straight-forward, most speakers seemed to feel that accurate and reliable quantitative assessment must await further development.

On the positive side, thermal infrared surveys do, at the present time, provide a great deal of useful qualitative information at a relatively low per unit cost (40¢ and 75¢ per dwelling were given as figures for two of the case studies presented). All of the speakers agreed that, if used correctly, thermal infrared sensing can be an invaluable diagnostic tool for indicating areas of heat loss. Several case studies were presented that demonstrated this usefulness. The final sense of the meeting was that thermal infrared sensing, which has seen some increased use recently, will, after some further research and refinement, become even more widely employed.

RECENT AERIAL PHOTOGRAPHY



The above maps indicate aerial photographic coverage recently obtained in connection with KARS projects. In June 1978 NASA flew the indicated portion of eastern Kansas with color infrared film at scales of 1·60,000 and 1.125,000. A commercial firm made a flight along the Arkansas River from the Colorado/Kansas state line to Great Bend, Kansas in July 1978 for the U.S. Fish and Wildlife Service and the Kansas Fish and Game Commission. The photography acquired was color infrared positive film at a scale of 1·10,000. For further information on these two flights, contact Ted Talmon at the KARS Program.

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KARS Newsletter
The University of Kansas Center For Research, Inc.
2291 Irving Hill Drive—Campus West
Lawrence, Kansas 66045

State of Kansas . . . ROBERT F BENNETT, *Governor*

DEPARTMENT OF HEALTH AND ENVIRONMENT

DWIGHT F METZLER, *Secretary*

Topeka, Kansas 66620

April 28, 1978

Ted Talmon
KARS Program
Space Technology Center
University of Kansas
Lawrence, Kansas 66045

Dear Ted:

After our meeting last Thursday; Howard Saiger, the Director of the Bureau of Air Quality and Occupational Health, and I discussed how information you could provide would assist us in the development of particulate inventories for the Topeka and Kansas City non-attainment areas. We agreed that your assistance in determining the number of acres, and their distribution, for the various land use categories would be beneficial and provide us with more precise information than we would be able to develop. The land use analysis of North Topeka could be considered as a demonstration project for a similar analysis in Kansas City. However, as I mentioned last week, the Kansas City non-attainment area is a more complicated issue since there are two states, local air pollution control agencies and a private contractor involved.

The number of acres will be used in equations developed by the Environmental Protection Agency to calculate emissions for each land use category. These emissions, called fugitive dust, will be incorporated into a inventory of particulate emissions which includes mobile, industrial, and other stationary sources. After taking growth and land use changes into account to project the inventory to 1982, the inventory will be input into a diffusion model. This model estimates particulate concentrations at various locations and identifies the contribution of each emission source to the concentrations.

For a non-attainment area, we are required by recent federal legislation to adopt control strategies designed to reduce emissions from the major contributing sources in the area. We must demonstrate that the control strategies will decrease the particulate concentrations to the level necessary to attain the national standards. Since the industrial sources in the area are already controlled, it is possible the diffusion model will indicate that emissions from

fugitive dust sources will need to be controlled. If this occurs, we will be required to develop schedules for the implementation of control strategies for fugitive dust sources. The schedules will include provisions for special projects to be conducted to evaluate the impact of a given strategy, a social and economic impact analysis, and commitments from local government to implement necessary control measures. The schedules will be submitted to the E.P.A. as part of our State Implementation Plan Revision by January 1, 1979.

This should clarify for you how we will use the information you develop. If you have any questions or need additional information, please contact us. As you requested, enclosed is a map of the non-attainment area in Topeka. We are looking forward to hearing from you.

Sincerely,

Division of Environment

Donna Mikols

Donna Mikols
Air Pollution Control Engineer
Bureau of Air Quality & Occupational Health

DM:bc
Enclosure

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

December 5, 1978

Mr. Ted Talmon
Research Scientist
Raymond Nichols Hall
2291 Irving Hill Drive - Campus West
Lawrence, KS 66045

Dear Ted:

Could you please send your latest information on the antelope release site in Clark County and surrounding areas. Our St. Jacob's Well-Big Basin project lies in this area, and I need updated information to be presented at a meeting with the National Park Service, Heritage Division, later on this month. This information will be used to determine whether the St. Jacob's Well project will be designated as a natural landmark and placed on the appropriate federal register. I have been requested to attend this meeting.

Anything you could send me in this regard would be appreciated.

Sincerely,

Bill Hanzlick (ck)

Bill Hanzlick
Regional Management Supervisor

BH:ck

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

January 19, 1979

Ted Talmon
Space Technology Center
University of Kansas
Lawrence, Ks. 66044

Dear Ted:

The Soldier Creek Work Plan is almost complete. The wheels have started to move on funding for application of conservation practices. The Steering Committee and other agencies are very interested in the status of the material you are preparing for us. Please contact us at your earliest convenience.

Sincerely,

Terry L. Buettgenbach

Kansas
DEPARTMENT OF REVENUE

State Office Building
TOPEKA, KANSAS 66612

May 22, 1978

Mr. Ted Talmon
University of Kansas
2291 Irving Hill Drive
Lawrence, Kansas 66045

Dear Mr. Talmon:

Identification of homogeneous regions as it relates to agricultural property is equally important whether estimating market value using current statutes or in estimating values using some form of the "Use Value" concept. Therefore, a program to locate these homogeneous regions would be most welcome.

Generally, agricultural land values will follow a definite pattern if the land is located in an area which has the same amount of rainfall, the topography is the same and the soil characteristics are the same. The availability of underground water supply would also be important when dealing with irrigated land or land which has the potential for irrigation.

We believe the above factors are the most important when establishing the boundaries for homogeneous regions as they relate to agricultural property; however, you may discover others as you proceed with the project.

If we can be of further assistance, please call on us.

Sincerely,

Robert C. Walters

Robert C. Walters, M. A. I.
Supervisor, Real Estate Section
Division of Property Valuation
(913) 296-2365

RCW:aw

cc: Director

STATE OF KANSAS

PHILLIP E JONES,
DIRECTOR
RICHARD W. RYAN,
ASSOCIATE DIRECTOR
MARLIN L. REIN,
CHIEF FISCAL ANALYST

STAFF—
LEGISLATIVE COORDINATING COUNCIL
INTERIM COMMITTEES
STANDING COMMITTEES
LEGISLATIVE INQUIRIES

THE LEGISLATIVE RESEARCH DEPARTMENT
ROOM 545-N STATEHOUSE
PHONE (913) 296-3181
TOPEKA, KANSAS 66612

November 15, 1977

Ed Martinko
Kansas Applied Remote Sensing
2291 Irving Hill Drive
Campus West
University of Kansas
Lawrence, Kansas 66045

Dear Mr. Martinko:

At the request of several legislators, the Kansas Legislative Research Department is undertaking a study on corporative farming within the state. A portion of the study is to identify those counties with high levels of non-absentee and absentee corporation farms and study the relationship between corporate farms that irrigate and those non-corporate farms in the same county that irrigate. In order to determine the level of irrigation by both corporate and non-corporate farms in a given county, the study will utilize existing data in county ASCS files and the Division of Water Resources. However, as a secondary data source and verification mechanism, I would like to use LANDSTAT imagery of center pivots by county road maps to facilitate locating the land by legal description.

The counties we are interested in obtaining maps of with center pivot locations are. (1) Finney, (2) Haskell, (3) Seward, (4) Grant, (5) Grey, (6) Stanton, (7) Sherman, (8) Kearny, (9) Hamilton, (10) Greeley, and (11) Wallace. I have been in contact with Joe Porascky about the project and the mapping information needed. It is desirable to have the imagery updated through 1976. The 1976 year will correspond with the year of corporation farm reporting forms being investigated.

It has been indicated by the legislators requesting the study, that a request for an interim study on this topic will be made in 1978. The information contained in this study will be used as a basis to review the present agricultural corporation farming laws and determine if they are in need of revision.

Your assistance in this phase of the study will be appreciated. If you have any questions, please call.

Sincerely yours,

Ronald D. Smith
Research Assistant

RDS/jsf

December 6, 1978

Dr. Edward Martinko
Kansas Applied Remote Sensing Program
University of Kansas
Center for Research Inc.
Lawrence, Kansas 66045

Attn: Ted Talmon

Dear Sir:

The Soldier Creek Steering Committee requests the assistance of your department in developing data for the Soldier Creek Conservation and Water Quality Project.

The information we require will involve total acres and current land use, critical erosion areas, and water bodies.

This will be the first project of its type in the State. It will help determine the effectiveness of select conservation practices and Best Management Practices on water quality.

Sincerely,

Farrel Holliday

Farrel Holliday, Chairman
Soldier Creek Steering Committee

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
P.O. Box 70, Holton, Ks. 66436

December 14, 1978

Dr. Edward Martinko
Kansas Applied Remote Sensing Program
University of Kansas
Center for Research Inc.
Lawrence, Ks. 66045

Attn: Ted Talmon

Dear Sir:

The USDA Soil Conservation Service is working with the Jackson and Nemaha County Conservation Districts on the development of the Soldier Creek Conservation and Water Quality Project.

We would like the assistance of the Space Technology Center in developing a family of maps. This would include current land use, identification of critical erosion sites, and other statistical information.

Sincerely,

Thomas W. Badger

Thomas W. Badger
District Conservationist

United States Department of the Interior
BUREAU OF INDIAN AFFAIRS
ANADARKO AREA OFFICE
P. O. BOX 368
ANADARKO, OKLAHOMA 73005

IN REPLY REFER TO
Land Operations

APR - 4 1978

Mr. Ron Shaklee
University of Kansas
Center for Research
2291 Irving Hill Drive
Campus West
Lawrence, Kansas 66045

Dear Mr. Shaklee:

We understand that your space technology office is planning a research project in the Soldier Creek Watershed, Jackson County, Kansas, which includes lands owned by the Potawatomi Tribe of Kansas.

The Horton Agency, Horton, Kansas, has responsibility for the management and protection of lands within the Potawatomi Reservation. This responsibility includes mapping and surveying trust resources and planning for optimum utilization beneficial to Indian owners. These activities are carried out by programs of the Horton Agency Office.

To the extent that your research will benefit Agency resource programs and Indian land owners, we offer our cooperation and support. Our Agency resource people will no doubt be able to make beneficial use of at least a part of the data that you will gather.

Please contact Agency Superintendent Donald Loudner, Horton Agency, or Jim Stivers, Agency Land Operations Officer, Horton, Kansas, if you wish specific information or assistance with Potawatomi trust lands.

Sincerely yours,

Area Director

United States Department of the Interior

GEOLOGICAL SURVEY

Water Resources Division
206 Fulton Terrace
Garden City, Kansas 67846
November 21, 1978

Mr. Ted Tolman
C/O Kansas Applied Remote Sensing Program
Space Technology Center
University of Kansas
Lawrence, Kansas 66045

Dear Ted:

In response to our meeting last week in Dodge City, this letter is to express the need for interpretation of remote sensing imagery as an aid to our study along the Arkansas River. The Garden City U.S.G.S. office is making the study in cooperation with the Kansas State Board of Agriculture, Division of Water Resources. For your orientation a map showing the study area is enclosed, and some background information follows.

Since the early 1970's, there has been a continuing decrease in stream discharge downstream of the Kansas-Colorado State line. A measurable decline of water levels in the subsurface (aquifer) adjacent to the stream has accompanied the streamflow reduction.

In January, 1977, Guy Gibson--Chief Engineer with the Division of Water Resources--placed a moritorium on the approval of applications for ground water and surface water in a 486-square-mile area along the Arkansas River in Hamilton and Kearny counties, Kansas. It was not possible, with information available at the time the moritorium was initiated, to judge the extent to which additional diversions of ground or surface water would impair water use under existing rights. In particular, the Division of Water Resources lacked quanitative information with which to forecast the hydrologic response of the area to additional development of the ground water, different rates of incoming streamflow from Colorado, and different climatological possibilities.

To become better informed, Guy Gibson asked the U.S.G.S. to make a comprehensive evaluation of the geohydrology of the moritorium area. Initiated in 1977, our five-year project will continue through September of 1982. The project's objectives are to:

(1) Define the relationship among ground water, surface water and climatic factors in the Arkansas River Valley,

(2) Evaluate the potential for stream depletion in response to ground-water pumping, and

(3) Construct, calibrate and apply a digital computer model of the stream-aquifer system.

Once the model has been calibrated to simulate the sequence of observed responses to the recent history of hydrologic events, it can be used to predict the effects of different distributions of ground-water pumping. In addition to indicating opportunities for water conservation, the model will demonstrate ways to improve the conjunctive use of ground and surface water in the Arkansas River Valley. At present, project personnel are compiling information for model input--data with which to calibrate the model.

The possibility of using interpretations of the physical system as determined from remote sensing is of considerable interest to us. Such interpretation--if accomplished through your operation and supplied to us in a timely fashion--would prevent our having to delineate essentially the same information using a less-direct, and probably less-efficient, approach.

If interested groups were to receive the required interpretation through your facility, the overall need for field work would reduce. Additionally, 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 similar aspects of the Arkansas River Valley.

As far as our study is concerned, the required interpretation (that might conceivably result from remote sensing), is summarized below in outline form.

I. Deliniation of Stream Channel Geometry:

- A. Distribution of active stream channel.
- B. Location of flood plain.
- C. Distribution of local drainage system (major tributory channels).
- D. Knowing the change with time of A., above, would be beneficial (e.g., a succession of maps showing areal extent of stream channel for 1950, 1960, 1970, and 1978).

II. Deliniation of Soil Cover:

A. Differentiate among:
   1. Phreatophyte growth
   2. Irrigated pasture or farmland
   3. Raparian grassland, and
   4. Sanddunes
B. Distribution of dead cottonwood trees.
C. Differentiation of crop type by categories of similar evapotranspiration demand (e.g. alfalfa-pasture land, corn-sorghum, and wheat), if possible.

The above information is requested in areal or map form at a scale no smaller than 1:125,000. Ideally, the interpretation should cover the area between the bedrock boundary (see enclosed map) upstream of the Bear Creek Fault; downstream, the information is needed everywhere within the limits of the study area in Kearny county. Interpretation for the upstream area is needed as soon as possible before March-June 1979.

Again, thank you for making us aware of the capabilities of remote sensing and of the possible applications in our work.

Sincerely,

Rene' A. Barker
Hydrologist'

cc; Don Jorgenson, WRD
Lawrence, Kansas

Encl.

RAB;kc

THE STATE OF KANSAS

THE KANSAS STATE PARK AND RESOURCES AUTHORITY
503 KANSAS AVENUE, P. O. BOX 977
Phone (913) 296-2281
TOPEKA, KANSAS 66601

November 22, 1978

Mr. Ted Talman
Kansas Applied Remote Sensing Program
University of Kansas
Space Technology Center
Lawrence, Kansas 66045

Dear Ted:

At the meeting in Dodge City October 15, 1978, several agencies expressed an interest in the use of the Arkansas River Corridor from Great Bend to the Colorado state line for one or more reasons after viewing the color photos furnished by the Fish and Game Commission. Our agency is particularly interested in recreation potential as related to the River.

During F.Y. 1979, the Kansas Park Authority is scheduled to complete the statewide stream study for inclusion to the 1980 State Comprehensive Outdoor Recreation Plan update. As a part of the stream study, major emphasis will be placed on the Arkansas River as a potential recreation corridor for southwest Kansas. The following data is needed for our analysis:

1. Identification of existing vegetative patterns.
2. Areas capable of handling minimal development
3. Types of activities best suited to the corridor
4. Hazardous areas or areas of pollution along the stream
5. Areas of debris that need clearing
6. Actual patterns of stream flow and sand bars

Any of the above data that your agency can furnish us will assist in the location of potential recreation sites along the river. In prior studies this has been slow and time-consuming thus our stream studies have been very limited in scope.

Our efforts will be coordinated with the Southwest Regional Planning Commission in the final decision-making process toward recommendations for a recreation corridor along the Arkansas River.

Sincerely,

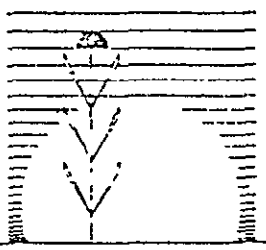
Lynn Burris, Jr.
Director

Wayne Herndon

By Wayne Herndon
Planning Coordinator

WH:bam

Greater Southwest
REGIONAL PLANNING COMMISSION



Phone 316-275-9176 P.O. Box 893 1118 North Taylor Garden City, Kansas 67846
RESEARCH AND DEVELOPMENT

November 28, 1978

Ted Tolman
Kansas Applied Remote Sensing
Space Technology Center
University of Kansas
Lawrence, Kansas 66045

Dear Ted,

As you probably know the concept of a linear park system on the Arkansas River has been discussed for several years. Combined with the fact there is a critical shortage of this type of recreation as identified by the Kansas State Comprehensive Outdoor Recreation Plan then we begin to see that recreation development of some type is inevitable.

The Kansas State Park and Resources Authority has included for study purposes the Arkansas River beginning at Great Bend and extending west up river to the Colorado state line in Hamilton County. Although we talk about a Linear Park System, it is in concept only. Any development would consist of selecting appropriate sites along the river for locating support facilities for camping and hiking. At this point we are tentatively planning 6-10 sites within the study area and possibly 5 of those in our region. Unfortunately, we have not been able to progress any farther than this general project outline. It appears that until the state is willing to become actively involved it will probably be 4 or 5 years before any activity will occur.

It is my belief that if we could present a feasibility study for the 6-10 proposed sites on the Arkansas River along with documentation of local support, then the state might be willing to act sooner then the tentative 4 or 5 year date. In preparing this feasibility study, the major emphasis will be directed towards the physical characteristics in determining what areas or sites are best suited to support recreation development.

It is my understanding that the Kansas Fish and Game Commission has already obtained color infrared photography of the Arkansas River

Basin and are willing to work with other agencies in planning developments. If you (K.A.R.S.), could use your facilities to obtain the physical data necessary for the feasibility study, then it would allow our office to work with the Kansas Fish and Game Commission and the Kansas Park and Resources Authority to determine the most suitable sites for development.

From previous conversations I'm assuming that K.A.R.S. will be able to provide the following list of information:

1. Land use along the river
   (a) Agriculture
   (b) Rangeland

2. Locate all tributaries feeding the Arkansas River

3. Locate sandpits

4. Identify sandhills areas
   (a) Stable
   (b) Exposed

5. Locate major vegetation types
   (a) Trees (deciduous)
       Distinguish between live tree massings and dead or dying tree massings
   (b) Riparian vegetation

6. Distinguish between standard project flood stage and intermediate flood stage.

7. Locate and identify: Highways, county roads (paved and unpaved) farm roads and trails along the river.

8. Locate the road bed for old U.S. Highway 50.

If K.A.R.S. could provide this information then we would have the technical documentation necessary to make the following decisions; site selection, trail locations for hiking, camping areas, locate open spaces for field sports, identify natural habitat areas for study and sensitive areas not suited for any development.

I am convinced that your input will directly affect the scale of development for this project, as well as the implementation date.

Please contact me if you should require additional information.

Respectfully,

John J. Gilmore
Landscape Architect

JJG:rd

cc: Wayne Herndon
Rene' Barker
Bill Hanzlick
Dennis Foltz

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

December 5, 1978

Mr. Ted Talmon
Research Scientist
Raymond Nichols Hall
2291 Irving Hill Drive - Campus West
Lawrence, KS 66045

Dear Ted:

Could you please send your latest information on the antelope release site in Clark County and surrounding areas. Our St. Jacob's Well-Big Basin project lies in this area, and I need updated information to be presented at a meeting with the National Park Service, Heritage Division, later on this month. This information will be used to determine whether the St. Jacob's Well project will be designated as a natural landmark and placed on the appropriate federal register. I have been requested to attend this meeting.

Anything you could send me in this regard would be appreciated.

Sincerely,

Bill Hanzlick (BH)

Bill Hanzlick
Regional Management Supervisor

BH:ck

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 DEPARTMENT OF AGRICULTURE
KANSAS DEPARTMENT OF ECONOMIC DEVELOPMENT
KANSAS DEPARTMENT OF HEALTH AND ENVIRONMENT
KANSAS DEPARTMENT OF REVENUE
KANSAS DEPARTMENT OF STATE PLANNING AND RESEARCH
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 CONSERVATION SERVICE (ASCS) U.S.G.S. 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.

APPENDIX IV

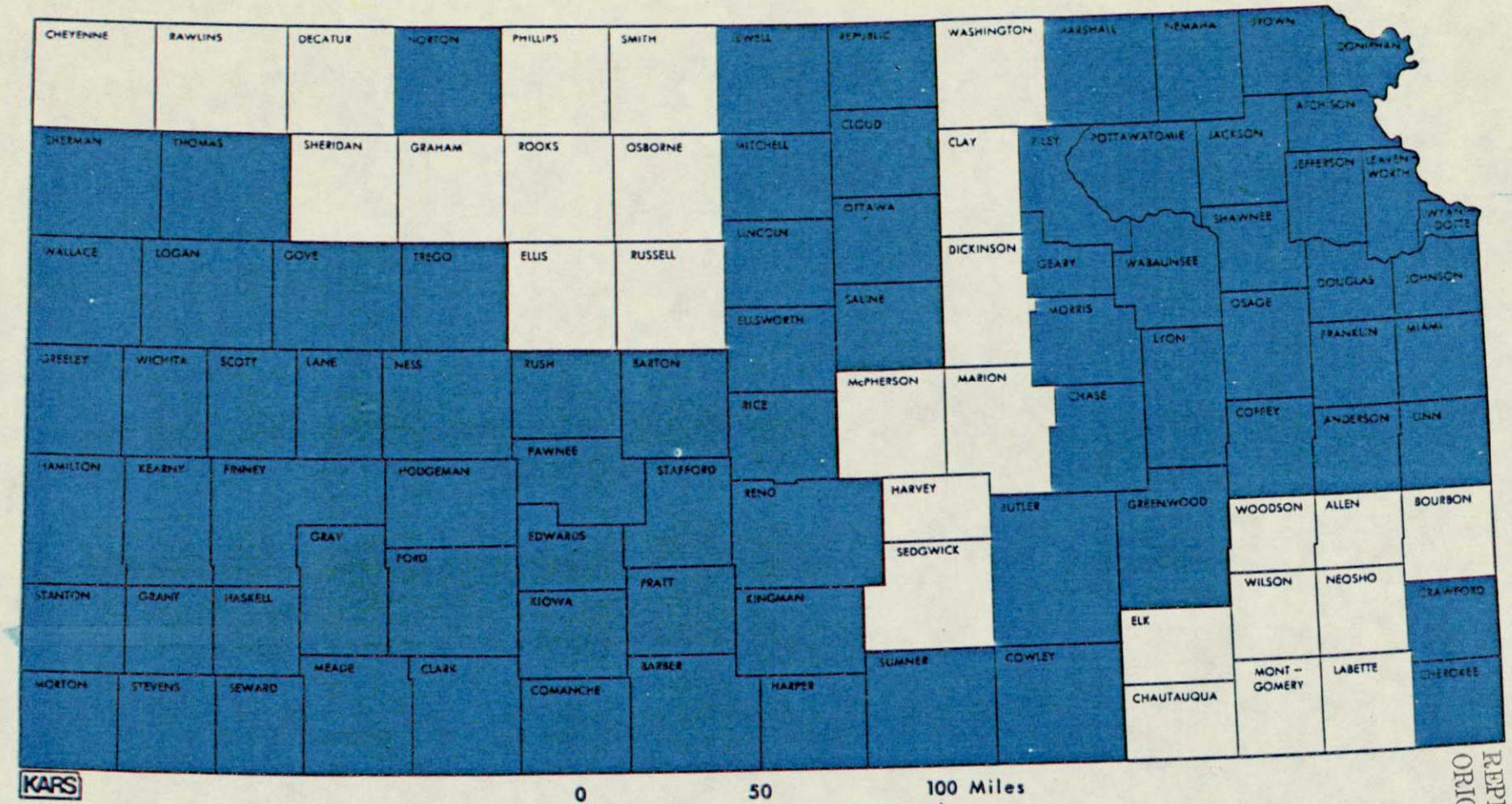
DESCRIPTIONS & LOCATION OF PROJECTS

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 Reservoir	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		
		Total	7	24	8	8	7	2	13	4	11	0	23

Kansas Applied Remote Sensing



Project Areas 1972-1978

INQUIRIES AND VISITATIONS TO THE

KANSAS APPLIED REMOTE SENSING PROGRAM

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

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

NEWSLETTER DISTRIBUTION **

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

** Newsletters are sent only to those individuals 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.

KARS PROGRAM STAFF

	1972	1973	1974	1975	1976	1977	1978
Faculty	3	3	3	3	2	2	3
Graduate Research Assistant	2	4	4	4	9	5	3
Staff	2	2	2	2	2	2	4
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.

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	13,000
			Total	$28,500

EXTERNAL FUNDING FROM AGENCIES BY YEAR

	Project	Agency	1972	1973	1974	1975	1976	1977	1978	1979
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.	Evaluation 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 Agriculture 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 Southeast 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
		Total		$5,000	$6,550	$18,800	$14,170	$70,500	$76,000	$75,630

REMOTE SENSING COURSES OFFERED BY THE UNIVERSITY OF KANSAS

		Course Title	Enrollment
1.	*Geol 756 and *EE 681	Remote Sensing	20
3.	*Geol 410	Introduction to Field Geology	35
4.	CE 785	Terrain Analysis	20
5.	EE 785	Pattern Recognition	20
6.	EE 766	Radar Remote Sensing	9
7.	EE 870	Radiometric Remote Sensing	10
8.	*Geog 426	Map and Air Photo Interpretation for Environmental Analysis	40
9.	*Geog 626	Image Interpretation	15
10.	Geog 899	Advance Post Graduate Seminar in Remote Sensing	5
11.	*Geog 998	Research in Geography (Remote Sensing)	5
12.	*Geog 913	Practicum in Cartography/Remote Sensing	1

* Courses offered every school year.

CRINC