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SEMI-ANNUAL PROGRESS REPORT NO. 8

May 1, 1977 - October 31, 1977

APPLICATION OF REMOTE SENSING TO STATE AND REGIONAL PROBLEMS

NASA Grant NGL-25-001-054

Submitted To
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
Office of University Affairs
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Washington, D. C.

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Nov. 7, 1977

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SEMI-ANNUAL PROGRESS REPORT #8

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APPLICATION OF REMOTE SENSING TO STATE AND REGIONAL PROBLEMS

I. INTRODUCTION

A resolution approved by the membership of the National Council of State Legislatures (NCSL) at their annual meeting in August, 1976, strongly indicated concern for "...the continuation of the satellite-based natural resource information." In support of this, it was stated that the Remote Sensing Task Force of NCSL "... found innumerable State activities about which more informed decisions could be made with the systematic availability of remote sensed data." What is not mentioned directly in this document, but which is implied in other documents issued by the Task Force, is a parallel need for a technology-transfer function to provide operational techniques for use in the "innumerable State activities" used for decision-making. This need was very evident at a recent NCSL Legislative Workshop on State Uses of Remote Sensing. Presentations by representatives from Texas, Georgia, and Florida, states which have institutionalized their remote sensing efforts, stimulated a great deal of interest on the part of the "have not" states, primarily Mississippi and Alabama. This interest, particularly expressed by Representative William Wilkerson, of Mississippi, has resulted in

dialog between the Program Coordinator, Representative Wilkerson, and the members of a joint meeting of the Mississippi House-Senate Forestry Committees. Topics discussed were availability of trained personnel, availablity of training for additional personnel, availability of existing equipment and cost of additional equipment, and options for institutionalizing data management in a service mode. Current plans are to constitute a task force composed of heads of State agencies who have used or who have a need for LANDSAT data for planning and decision making. Personnel of the MSU Remote Sensing Application Program are continuing to assist in this planning as well as to assist various units of state and local government in an attempt to bridge the gap between technology and use. The objective of the program is to assist the State of Mississippi in the recognition and solution of problems in enviromental monitoring, resource planning, and decision-making, and in the socio-economic area. Program personnel are interacting with state and federal agencies, and local units of government in the following ways:

1. Identifying and analyzing State and local problems, real needs of major importance, which remote sensing techniques of demonstrated feasibility can help to solve.
2. Assisting potential users to learn how to better use remote

sensing where it is appropriate to the solution of specified problems.

3. Conducting remote sensing applications programs to bring remote sensing technology to bear upon the solution of selected high priority problems.
4. Identifying additional research needs to which remote sensing technology may be applied and establishing priorities for meeting these needs.
5. Stimulating, guiding, and aiding the faculty and students at Mississippi State University, and others in the State of Mississippi, to utilize information from the NASA Earth Resources Satellites and the Aircraft program in research and public service activities. This program is augmented by cooperation from the EROS Users Assistance Center, National Space Technology Laboratories at Bay St. Louis, MS, and the George C. Marshall Space Flight Center at Huntsville, AL.
6. Provide a center of expertise and an operational laboratory for short course training of users, and provide assistance to departments and agencies in utilizing appropriate remote sensing technology in solving their problems, and making certain specialized equipment available to users.

Program participants are recruited from various departments of both the University and the Agricultural and Forestry Experiment Station, and expertise is currently available in the areas of Agronomy, Wildlife and Fisheries, Forestry, Geology and Geography, Landscape Architecture, Mathematics, and Computer Science. In addition, input to the program is being obtained from State and Federal agencies such as the Forestry Commission, the Parks Commission, the Geological Surveys of both Mississippi and Alabama, the Research and Development Center, and the U. S. Forest Service.

W. Frank Miller, Associate Professor of Forestry, is serving as Program Coordinator. Other key personnel in the program include;

Dr. Bradley D. Carter, Associate Professor of Computer Science;

Dr. David E. Pettry, Professor of Soil Science;

Dr. Gary K. Higgs, Assistant Professor of Geology and Geography;

Dr. James L. Solomon, Assistant Professor of Mathematics;

Dale A. Quattrochi, Research Assistant.

II. PROJECT PROGRESS REPORTS

A. The Natchez State Park

This project has been completed with the exception of the transfer of the CALUP package to the Mississippi Parks Commission. A paper presenting an overview of the project has been prepared and submitted to a professional journal (Appendix 1).

B. Bark Beetle Project

The southern pine beetle project has remained inactive awaiting completion of the Land Use (Lowndes County) Project (Project E).

C. Resource Inventory - The Homochitto National Forest

This project has also been inactive.

D. Forest Resource Inventory of Sixteenth-Section Lands

Objective

The objective of this project is to determine the most efficient procedure for updating inventories of sixteenth-section lands, and to provide a basis for more intensive management of the State's forest resources.

Current Status - Inactive

Future Plans

Although the Copiah County Demonstration will be re-activated following completion of the Lowndes County project, the preliminary

techniques developed in Copiah County will be perfected in Lowndes County; the boundaries of all 16th-Sections in the county will be digitized and information concerning present land cover and potential forest productivity will be made available to the Mississippi Forest Commission. This will be a subproject of Project E.

E. Remote Sensing Applications in Land Use Planning

Objective

The objective of this project is to demonstrate the utility of a data management system based largely on remotely sensed data in the land use planning process.

Current Objective

In addition to providing a data base to the Golden Triangle Planning and Development District and the Mississippi R & D Center for planning purposes, data and software will be modified to meet the needs of the county government, the Board of Supervisors, and the Mississippi Forestry Commission.

Accomplishments

Inputs to the data base have continued and currently the variable list includes:

County Line	Waterway
Heavy Duty Roads	Pine Forest
Medium Duty Roads	Hardwood Forest
Light Duty Roads	Cropland
Unimproved Roads	Pasture
1st Order Stream	Gravel Pits
2nd Order Stream	16th Section Boundary
3rd Order Stream	Low Density Residential
Railroads	High Density Residential
Power Lines	Cemetery
Lakes and Ponds	Commercial
Urban	Industrial
Airport	Recreation Sites
Floodprone Areas	Public & Utilities
Aquifer	

The HINDU software package proved to be unsatisfactory, and most of the efforts have been directed to obtaining the LARSYS software package from the NASA/JSC and adapting the software to the university UNIVAC 1106 (See Project I).

The June LANDSAT CCT also proved to be unsatisfactory due to heavy antecedent thunderstorms in the southwest portion of the county. The water signature generally overrides the land cover signature, thus obscuring other land cover type signatures and making accurate discrimination impossible. A search was, and continues to be made to obtain a high quality, cloud-free CCT from a pass during the 1977 growing season.

Current Status

However, in order to assist the Lowndes County Board of Supervisors, a subproject was undertaken to provide for rural land

tax assessment purposes, a data base combining present land cover and soil productivity potential (Appendix III). This project is 80% complete, and final results will be forthcoming when the new CCT is analyzed for land cover classes. The results will be in the form of a county map with a 5 ac. grid; each rural area grid cell will be assigned an integrated value of soil productivity and present land cover. Soil associations were obtained from the Soil Conservation Service to meet the immediate needs of the Board; however, for accurate individual parcel evaluation the results of the detailed County Soil Survey should be substituted when the Survey becomes available.

A ten-class evaluation is being made as follows:

CLASS	COVER	PRODUCTIVITY LAND
1	cropland	High
2		Moderate
3		Low
4	pasture	High
5		Medium
6		Low
7	forest	High
8		Medium
9		Low
10	unclassified	

A preliminary report is presented in Appendix III.

Due to errors in the NCIC digital topographic tapes obtained, a new set is being ordered. The values for several input variables depend upon the decoding of these tapes.

Plans

This project has the highest priority, and the major portion of the program resources will be utilized to complete the several parts of the project.

F. Applications of LANDSAT Data to Strip Mine Inventory and Reclamation Progress

Objective

This project is intended to provide the Geological Survey of Alabama with the software and interpretive techniques for monitoring strip mine occurrence and reclamation activities periodically. The results of this project will be provided to the Mississippi Geological, Economic, and Topographic Survey - the State agency which is responsible for administering the strip mining law in Mississippi.

Accomplishments

During July and August efforts were made to employ the operational Histogram Inspired Neighborhood Discerning Unsupervised System (HINDU) to obtain spectral signatures of strip mining areas (identified thru aerial photographs) in the Warrior Coal Basin in Northwest Alabama.

A. T. Anderson and Jane Schubert, "ERTS-1 Data Applied to Strip Mining", Volume 42, No. 2, February, 1976, pp. 211-219, indicate bands 5 and 7 to be more important than bands 4 and 6 in obtaining spectral signatures for strip mining areas. Runs have been made where from four to sixteen significant clusters have been obtained; thus, far, no good signatures have been obtained using HINDU.

With the acquisition of LARSYS, it is felt that these signatures will be obtainable. Further information in regards to the approximate phase of reclamation of the mines (during the period covered by the tapes which we have) must be obtained from the Geological Survey of Alabama.

Plans

When the spectral signatures are acquired, it is feld that a clustering technique, such as HINDU employs, utilizing only 5 and 7; i.e., a feature extraction or reduction in dimension of the feature space will provide rapid recognition of the major phases in the reclamation of strip mines.

If these classifications prove to have a high probability of correct classification, a CCT of a later date will be analyzed to determine the feasibility of rating reclamation efforts.

G. Remote Sensing Applications for Industrial Siting on the Tennessee-Tombigbee Waterway

Introduction and Objectives

The Mississippi Research and Development Center is engaged in industrial development studies in the Tenn-Tom canal area. The establishment of a sound basis of development is a critical issue because the maximum developmental benefits must be derived at minimum enviromental cost while optimizing the use of natural and cultural resources. This objective requires the establishment of a controlled plan of economic growth. The controlled growth concept has proven essential to the prudent use of land resources in many parts of the country where growth has occurred. The principles underlying this need include the fact that unplanned growth has led to enviromental damage, and placing industry and scarce resources in less than optimal situations. To maximize the benefits of the resources invested the development of the Tennessee-Tombigbee Waterway, proper allocation of land and capital is necessary. This allocation stage requires that land be put to the highest and best use with minimal waste and this in turn requires decisions based on the best available data.

In line with the optimal land use concept, Mississippi Research and Development Center has been charged with selection of suitable industrial sites adjacent to the Tenn-Tom Waterway. The R and D Center, in turn, has requested Mississippi State University's Geology

and Geography Department to handle a portion of the siting research--the subject of this report. Specifically, the Geology and Geography Department of Mississippi State is responsible for the assessment of the physical factors related to industry site selection. In the Tenn-Tom area numerous industrial sites were specified by R and D for this study. The sites were originally identified in separate reports of the Tennessee Valley Authority and Meta Systems (for Tombigbee River Valley Water Management District). This report also evaluated additional sites outside TVA and Meta reports, but with less emphasis on land detail. These "secondary" sites have been identified as a separate phase of this study and have value from a local growth standpoint.

The actual assignments handled by Mississippi State's Geology and Geography Department are covered below.

(Physical Factors)	-Slope of land and length of slope
	-Soil types present; bearing capacity and water-holding capacity
	-Update existing land cover and use
	-Local relative relief
	-Subsurface features and geology
(Enviromental Factors)	-Vulnerability of land to erosion
	-Dangers of atmospheric and water pollution and effects on related or adjacent land uses
	-Destruction of irreplaceable natural resources

Accomplishments and Status

LANDSAT tapes and optical images of the area over a period of time of several years have been acquired. These tapes and images have been analyzed to determine land use conditions and change and areas of standing water as an indicator of flood zones and unsuitable development sites. Data on soil, erosion, potential enviromental damage, and industrial site/ industry type suitability were gathered and analyzed. The inventory of lands within these areas has been completed. Suitable sites have been specified to the R & D Center.

The project is essentially completed, a preliminary copy of the findings and recommendations have been submitted to the Mississippi R & D Center. The remaining activities consist of final edit work, cartographic finish work, and final assembly. The final report will be attached separately as Appendix IV.

THE PRIMARY SITES SPECIFIED BY THE R & D CENTER

Lowndes County

Lowndes County Bluff No. 1 (South) - T19S/R18W
Sections 11, 14, 15

Lowndes County No. 2 (Columbus) - T19N/R18E
Sections 29 and 32

Lowndes County West (TVA) - T19N/R17E
Sections 15-18; 8-10; 3 and 4

Columbus Air Force Base (TVA) - T16S/R18W
Sections 25-27 and 34-36

Clay County

Clay County - T17S/R7E
Section 35

Monroe County

Aberdeen North (TVA) - T14S/R8E
Sections 21 and 22

Aberdeen Southwest - T14S/R19W
Sections 26, 27, 34 and 35; T15S/R8E Sections 5-8 and 18

Aberdeen Southeast (TVA) - T14S/R18W
Sections 31; T15S/R18W Sections 6 and 7; T15S/R19W
Sections 1 and 12

Monroe County Airport - T14S/R19W
Sections 1, 2, 11 and 12

Amory - T13S/R14W
Sections 1-3 and 34-36

Amory Southeast (TVA) - T13S/R19W
Sections 1 and 12; R18W Sections 6 and 7

Amory Northeast (TVA) - T12S/R18W
Sections 17, 18, 20 and 21

Smithville - T11 and 12S/R8E
Sections 1, 2, 6, 10-12, 31 and 36

SECONDARY SITES IDENTIFIED IN THIS STUDY

Site Name	Site Number
1. Columbus, S	24
2. Smithville	13
3. Aberdeen, NW	19
4. Aberdeen, W	20
5. Lackey	17
6. Hamilton	22
7. Nettleton	14
8. Clayburn, W	23
9. Burnsville, N	2
10. Becker, NE	15
11. Becker, SW	16
12. White Springs	12
13. Hamilton, S	21
14. Yellow Creek, SE	1
15. Mantachie, E	10
16. Aberdeen, S	18
17. Holts Spur	4
18. Doskie	3
19. Fulton, W	11
20. Burnsville, W	5
21. Paden, S	6
22. Natchez Trace	7
23. Walker's Bridge	9
24. Moore's Mill	8
25. Forreston	25

Conclusions of Study

A wide variety of industries will be appropriate and interested in locating on the specific sites along the Tennessee-Tombigbee. From the physical aspect most sites as they now exist are suitable for development (exceptions would be Lowndes County No. 2 at Columbus and Paden-Panther Creek.) Light industry--such as garment manufacture, electronics, and household appliances--which is the dominant industrial type in Northeastern Mississippi will continue to grow with little effect on enviroment except for increased load on local sanitation services (which must be improved to cope with growth). From the standpoint of sitings and appropriations of industrial type heavier industry is most likely to effect atmospheric and water standards. Principal heavy industry which would find the Tennessee-Tombigbee Corridor attractive (and at the same time might poise enviromental debate) would include (1) chemical plants (especially commercial fertilizer). The reasons underlying this attractiveness includes the existance of a good power source furnished by TVA and direct bulk shipment of raw materials incluing northern coal and Gulf salt and sulfur and fuels and the convenience of a half-way point located in an agricultural hinterland, (2) pulp and paper industry. The reasons underlying the attractiveness for this class of industry include the fact that the demand for paper and wood products is expected to increase greatly within the next 20-30 years. This coupled with the fact that the South is once again

becoming the dominant wood materials source region within the U. S. and the fact that marginal Mississippi farmland will be reverting to forests is providing added incentives to pulp and paper industries. (3) Cement and asphalt plants--the reasons underlying the attractiveness of these industries include available bulk transport and reasonable power sources. These facts supplemented by the fact that raw materials--where not available from local extractive sources--could be brought in cheaply by barge and the marked relations to planned construction of highways, waterways, and industrial parts are important for construction materials processing, and (4) primary agricultural products processing--principally soybeans and cotton. There are substantial local sources available which would benefit from bulk shipment. All of these industrial types could find suitable locations in Northeast Mississippi (some do already exist) but all could cause serious pollution problems.

Chemical plants for fertilizers could probably be located in any of the Monroe, Clay, or Lowndes County sites with their broad agricultural hinterlands. However, even with regulation chemical plants can be very noxious if the wind blows from the wrong direction or air cleaning devices are not performing properly. In addition, raw material stockpiles which sometimes accompany such operations pose a threat of leakage into the ground or surrounding streams. Sites adjacent to populated areas should probably not be used for this

particular industry type. (Lowndes County No. 2 of Columbus, any of the Amory or Aberdeen sites and possibly Fulton in Itawamba County).

The pulp and paper industry would find suitable locations in Tishomingo, Clay, Itawamba or Lowndes counties. Despite regulation, pulp and paper mills still pollute and their effect can be noted for miles downwind or downstream. Proximity to populated areas should once again be avoided--this suggests Lowndes County No. 1 Lowndes County West, Clay County and the Paden sites (Tishomingo). However, the peculiar nature of the terrain at Paden--sitting in a valley surrounded by high hills--would possibly make it prone to inversions.

The industries engaged in processing of agricultural products do not tend to be as severe a polluter as the pulp and paper, chemical and cement industries, however, there are enviromental changes associated with agricultural processing. These industries would probably prefer to be concentrated in the four southern-most counties of the Tenn-Tom canal. Prevailing winds in autumn tend to be from the northwest, possibly eliminating the sites of Columbus Air Force Base, Aberdeen North as well as Lowndes County at Columbus (proximity) and Amory (proximity).

Plans

During the immediate upcoming period the final edit and graphic will be completed and the final draft submitted.

H. Beach Erosion Control Study--Pass Christian

Introduction

The aeolian beach erosion problem exists in varying degrees not only on the Mississippi coastal area but also throughout the entire Gulf and Atlantic Coast zones. In the Mississippi coastal area, particularly around Pass Christian, Mississippi, it is a complex and difficult problem of long-standing. The origins of the aeolian sand condition in the Pass Christian appear to lie in the nature of the beach itself, its history, and the complex intergovernmental interests involved.

Initially, the shoreline along this portion of the Mississippi coast, according to records and personal accounts, was a narrow, transient, sand-mud-gravel zone. For purposes of tourist attaction, commercial asthetics, and neighborhood improvements, the local business and residential communities, the Chamber of Commerce and related private sector interests in conjunction with local government interest encouraged the development of a broad, stable, clean attractive white sand beach. Today the area around Pass Christian, Mississippi, is one of the most outstanding examples of such a beach. Thus, a portion of this shore area is essentially a manmade beach.

The creation and stabilization of this beach area necessitated the construction of occasional offshore obstructive features which

served to modify the character of along-shore currents. As a result of the interaction of natural and cultural features and activities, the beach appears to be accreting. Due to offshore winds and obstructions, tidal processes, and beach management practices, substantial sand movement onto the coastal highway and residential and commercial areas has occurred. Variation in the above factors create uneven sand erosion and deposition patterns. Sand movement along a beach occurs when the wind energy due to wind speed at the surface (laminar flow) becomes sufficient to overcome the weight and inertia of the individual sand grains. This nature of this process suggests that if the wind speed at the surface can be reduced in the laminar flow area and turbulence created, sand movement can be reduced.

Many methods of slowing surface winds and breaking up laminar flow into turbulent eddys have been developed. However, they have not been applied to this problem because of cost, asthetics, and conflict with recreational beach uses. Additionally, the determination of the origin of blowing sand is extremely difficult from the ground when the entire beach including both origin areas and stable locations in covered with a laminar flow zone of air and moving sand. For this reason, in particular, LANDSAT data on factors related to sand movement such as beach morphology, morphometry and change, and the nature

and location of both offshore and onshore features combined with ground truth and meterological data will provide substantial insight into the location and design of protective structures.

Purpose

The purpose of this proposal is to refine and apply existing NASA-developed remote sensing technology to demonstrate its contribution to the solution of the aeolian beach erosion problem along the Mississippi Gulf Coast. More specifically, LANDSAT digital MSS data will be utilized to define the major zones of blowing sand, the beach morphology, and the offshore and onshore structures and features and configurations associated with erosive areas. This will in turn assist in the delineation and the most vulnerable erosion areas and the development design and siting of asthetically pleasing stabilization or laminar flow obstruction features, such as picnic areas, organized play facilities, and garden (park)-like vegetative communities suitable for beach life and tourist attraction.

LANDSAT data will be used because (1) it can provide easily available repetitive information about beach forms and their changes, and offshore - onshore influences; (2) it is in a suitable format for comparison and interpretation with meterological data; and (3) it can be readily evaluated in light of ground observation of sand condition.

Justification

This sand movement is a source of governmental and private sector concern and substantial expense in the immediate inshore area. The concern and the unique relations of intergovernmental interest in this situation are illustrated by the fact that the local commercial and residential community and the City of Pass Christian are interested in maintaining an attractive (tourist-oriented)beach. Harrison County, the governmental unit responsible for maintenance of the beach is interested in a stable, easily maintained beach. The Southern District of the Highway Department, the governmental unit responsible for the maintenance of and cleaning sand from U. S. Highway 90 is interested in reducing or eliminating the sand movement in order to reduce the current cost of several hundred thousand dollars per year in clean-up expenses. The Mississippi Marine Resource Council (MMRC), the governmental unit responsible for coastal zone management and planning and permit issuing (CZM) is interested in a stable, well-planned shoreline, whose use is consistent with wise planning and land use to minimize erosion and other enviromental stresses. Similar and related interest and problems exist for the private sector activities in the immediate inshore areas.

Thus, the problem of aeolian beach erosion along the Mississippi

Gulf, as in other similarly effected areas, is not only a technical and economic issue, but also a complex problem of intergovernmental interest and conflicting objectives.

Appendix V presents justification documentation from MMRC and the Harrison County Board of Supervisors.

Objectives

The overall project objective is to apply remote sensing technology to the delineation of zones of high erosion along the beach.

Specific objectives are:

(1) to refine and adapt remote sensing techniques to identify and define those beach areas along the Mississippi Gulf Coast at Pass Christian, Mississippi, which are sources of wind-blown sand.

(2) develop automated procedures calibrated with ground truth information and meterological data for estimating sand area movement.

(3) locate and design sand stabilization or laminar flow obstruction features which, when located on the beach, will reduce sand erosion and are aesthetically pleasing and consistent with tourist attraction and use and local commercial activities.

Technical Plan

This project will utilize primarily satellite remotely sensed data in both digital and image form. Although the major emphasis will be on LANDSAT MSS data in digital form, imagery, catographic data, ground observation, and metrological data will also be used as sources of ground truth information to correlate with, and verify conclusions and findings, and to establish erosive zones and related factors.

The MSS data will be processed and analyzed using interactive digital processing systems such as the COMTOL DAS, and both proces-ing systems such as EOD LARSYS Procedure L, ELLTAB, and IBAS at the Mississippi State University Computer Center, or at NASA/JSC. Various MSS data preprocessing functions will be performed using general purpose computers. All the work will be performed in close cooperation with the interested governmental agencies as they will facilitate exchange of information and assist in the technology transfer function.

Approach

A. Select and define a test area on a portion of the beach front in Pass Christian, Mississippi. This area will serve as a demonstration for technology application to the same problem throughout not only Mississippi coastal areas but also other portions of the Gulf area.

1. Obtain all available LANDSAT imagery and CCT's of the test area.
2. Establish and survey ground observation points on the beach surface, specifying both location and elevation relative to the datum.
3. Obtain meterological data for the test area corresponding in the time to the date of available imagery and tapes.
4. Begin literature review and search to determine and catalogue possible techniques for (a) laminar flow obstructions in wind erosion control and (b) sand stabilization.

B. Process the CCT's and imagery optically and digitally using the COMTOL DAS system and color additive viewers at Mississippi State and density scan and slicing devises at EROS/NSTL as well as the EOD LARSYS Procedure 1, ELLTAB, and IBAS software programs to identify zones of presumed high erosion.

1. The techniques and methodologies of application of LANDSAT MSS imagery and data to sand movement which have been demonstrated in numerous studies will be utilized as optical and digital processing to locate (i) areas of origin of aeolian erosion (based on moisture and related factors), (ii) beach morphology and (iii) related offshore and onshore features which have an influence on erosion and may then be used in design and siting of stabilizing or obstructing features.

a. mapping of sand moisture zones and relations to wind erosion with LANDSAT MSS using EOD LARSYS 1 (ER-600, JSC-08057, NASA TM c 58118, July 74, pg. A19- A 22, B-C and 9-29, 9-30) (see Figure 1).

b. mapping of beach morphometry and change and relations to erosion with LANDSAT MSS using EOD-- change detection, and signature extension as well as IBAS sub-pixed texture analysis. (An ERTS-1 study of coastal features on the North Carolina Coast, G. H. Miller, D. W. Berg. Coastal Engineering Research Center, Fort Belvoir, VA).

c. classification and measurement of beach morphometry in relation to wind sand movement using ISOCLAS and related technique (Unsupervised classification and area measurement of land and water coastal features on the Texas coast, L. M. Flores, et. al., Lockheed Electronics Company).

d. identify, locate and map related offshore and onshore features in relation to processes and beach morphometry (Variability of Coastal Processes and Resulting Shoreline Morphology Along the Pennisula of Baja California, L. C. Wright, et. al., L.S.U. Coastal Studies Institute.)

2. The sand moisture zones, beach forms, and related offshore and onshore features, which have in other studies been

shown to be related to erosion and sand movement, will be collectively mapped and together yield regions of presumed sand erosion origin.

a. These regions will be monitered using LANDSAT MSS data over the period specified by the length of the study and the period of available data for stability.

b. Extensive ground truth observations will be conducted during the period of the study to attempt to verify these regions as sand erosion origins.

c. Ground observations, imagery, and ADP products will be evaluated in light of the corresponding materological data (day-to-day) to determine wind patterns and directions of laminar flow.

d. maps of wind patterns and erosive zones will be prepared and evaluated for potential siting of obstruction or stabilizing features.

e. the obstructive or stabilizing features of installations identified in the literature review phase of this project will be evaluated for each of the sand erosion origin regions located.

f. one or more types of obstruction or stabilizing features will be recommended for each site.

g. a site design plan will be prepared for each erosion zone, and for each feature recommended. Factors to be considered

will be temporal aspects, moisture, and region-size-form setting and location.

C. Recommendations will be made to MMRC to install the erosion control features.

Expected Results

MMRC has agreed to install on the beach in selected sites to be agreed upon the specified facilities to demonstrate and test the effectives. The facilities may include a landscaped, vegetative community, a playground with landscape vegetation and some equipment on park-like grassy area.

Transferability

This application will be fully documented and transferred to the appropriate government agency responsible for the remainder of the Gulf Coast. Information will also be supplied to appropriate agencies in other states along the Gulf Coast.

Tentative Project Procedure

1. proposal
2. grant
3. establish project management
4. design project procedures
5. define and map test area
6. obtain LANDSAT imagery and CCT's
7. obtain meterological data
8. establish ground survey observation points
9. begin literature review on beach wind obstruction and sand stabilization.
10. process CCT's and imagery
11. map sand moisture
12. map beach morphometry
13. classify and measure beach forms
14. locate, identify and map offshore and onshore features related to erosion andmorphometry.
15. compile and interpret above data and map erosion zones
16. ground truth test
17. map metrological data
18. evaluate ground truty erosive zone map and meterological data to determine prime high erosion sites.
19. using literature findings, site and design obstruction on stabilization facilities.
20. prepare final report
21. transfer findings to MMRC for implementation and installation of recommended features.

I. Remote Sensing Data Analysis Support Systems

Objective

It is the objective of this effort to provide the data collection and processing capabilities necessary to support the various demonstration projects and to provide a low-cost operational center so that such projects can have continuing input into the overall objective of the Applications Program, for both present and future use.

Accomplishments

During the last six months, data processing efforts have been primarily directed toward the follwoing areas:

(1) Land cover classifications from LANDSAT data for the Lowndes County Land Use Planning Project and the Strip Mining Inventory and Reclamation Inventory Project.

(2) Data base development for the Lowndes County Land Use Planning Project.

(3) Adaptation and implementation of a version of the LARSYS classification system at the MSU Computing Center.

(4) Enhanced graphic display techniques utilizing the Gerber flat bed plotter obtained from Marshall Space Flight Center (NASA-Huntsville.)

(5) Acquisition of a minicomputer system and appropriate graphics/image processing equipment to significantly enhance capabilities of the Remote Sensing Data Analysis Support Systems.

Significant progress has been made in each of the above areas.

Current Status

Concerning items (1) and (2) above, the current status of each is described in the progress reports of the appropriate projects. Both HINDU and LARSYS classifications have been made for each project and these are currently being analyzed and refined. Routines to manage the Lowndes County data base have been written and are operative. The data base is now approximately 60% complete.

Converting the LARSYS classification package has been a substantial undertaking, but is now approximately 80% complete. All basic classification and display routines are operative with only some ancillary routines yet to be implemented.

Interfacing existing routines to the Gerber plotter is virtually complete and will provide significantly enhanced capabilities in data verification, especially in the data digitization and training sample selection phases of the process. This system should be totally operational within one month.

Acquisition of appropriate computer hardware systems has been a difficult task. Although project personnel developed specifications for the hardware approximately ten months ago, the approval process has been slow. Currently, bids have been received on part of the system and hardware has been selected by project personnel. A request for the purchase of the equipment is now awaiting action of the Central Data Pro-

cessing Authority of the State of Mississippi. Figure I illustrates the complete funds of each of the system components. Installation of the equipment is now expected for February, 1978.

Future Plans

In addition to continued support of projects at existing levels, future plans include (1) the complete implementation of the LARSYS classification package and (2) the development of appropriate software systems to effectively utilize the new hardware. This includes the development of generalized image processing software for the minicomputer as well as the conversion of some existing classification subsystems (such as training sample selection) to an interactive mode for more effective people/computer utilization. Such systems will be developed for use with existing demonstration projects and similar projects that will certainly evolve. Extensive software documentation will be developed.

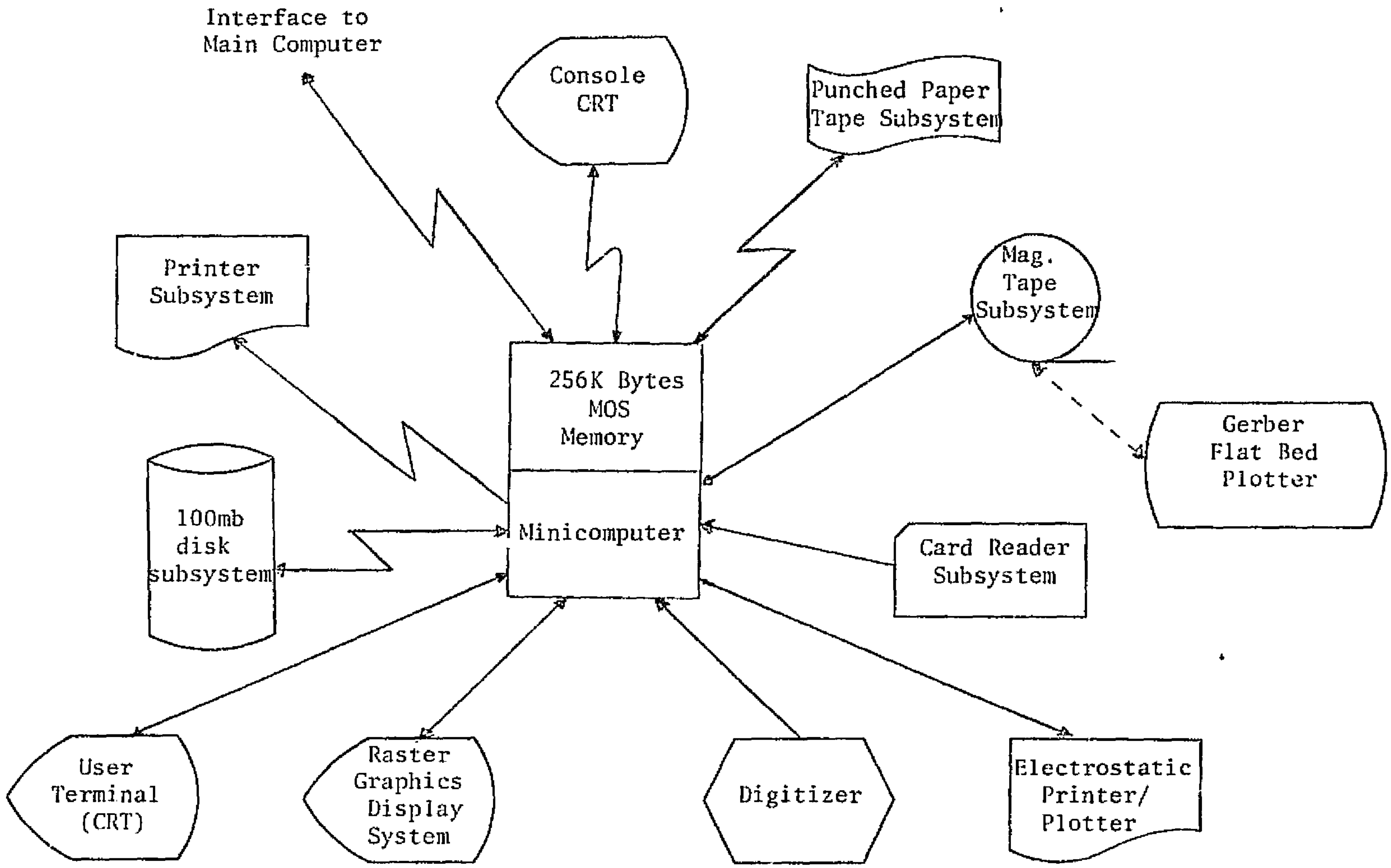

Figure 1. Graphics/Image Processing Minicomputer System Configuration

Table 1
Graphics/Image Processing Minicomputer System
Status Report

Item	Bids Received	Cost	Source of Funds	Estimated Date of Order	Estimated Date of Installation
Minicomputer	Yes	$45,875	MSU (Dept. of Elec. Engr.)	Nov. 7, 1977	Feb. 7, 1978
Disc Subsystem	Yes	23,220	MSU (Div. of Numerical Serv.)	Nov. 7, 1977	Feb. 7, 1978
Tape Subsystem	Yes	8,910	NASA #NAS8-31785 (Huntsville)	Nov. 7, 1977	Feb. 7, 1978
Card Reader Subsystem	Yes	4,845	MSU (Dept. of Elec. Engr.)	Nov. 7, 1977	Feb. 7, 1978
Paper Tape Subsystem	Yes	5,010	MSU (Dept. of Elec. Engr.)	Nov. 7, 1977	Feb. 7, 1977
Extra CRT Terminal	Yes	2,376	MSU (Dept. of Elec. Engr.)	Nov. 7, 1977	Feb. 7, 1977
UNIVAC Interface	No	1,500*	MSU (Dept. of Elec. Engr.)	Nov. 30, 1977	Feb. 7, 1977
Raster Graphics Display System	No	25,000*	NASA #NGL-25-001-054	Nov. 30, 1977	Feb. 30, 1977
Electrostatic Printer/Plotter	No	21,000*	NASA #NGL-25-001-054	Nov. 30, 1977	Feb. 30, 1977
Digitizer			Existing Equipment		
Printer Subsystem			Existing Equipment		
Gerber Flat Bed Plotter			Existing Equipment		

*Estimated cost

III. LIST OF SPECIAL ASSISTANCE OFFERED

The facilities and data library of Remote Sensing Laboratory have received increased usage over the past six months. Although students from the various discipline areas are still utilizing the Lab facility, increased use from Geography and Forestry have been noted.

In addition to student use, the following individuals and agencies have utilized the facilities:

John Griffin, District Conservationist, Soil Conservation Service

Joe Sigrest, Soil Conservation Service, New Orleans, LA

Ray Gildea, Civil Defense Director, Columbus, MS

Bruce Johnson, Ecological Service, Fish and Wildlife Service, Decatur, AL

Bruce Bell, Project Impart Evaluation, Atlanta, GA

Information and/or data were supplied to the following persons:

William Wilkerson, State Representative

Mack McInnis, State Representative

John M. Nipper, State Representative, Grenada, MS

Harry Dunn, Timber Management Planning, Gulf State Paper Company, Coker, AL

Steve Reed, Forester, U. S. Corps of Engineers, Vicksburg, MS

Everard Baker, Instructor, Columbua Training School, Columbia, MS

Canadian Center for Remote Sensing, Ottawa, Canada

Robert Hoke, Research Forester, Weyerhauser Co., New Bern, NC

J. R. Steverson, Soil Conservation Service, Amory, MS

Dr. John Mundey, Virginia Institute of Marine Sciences, Gloucester Pt, VA

Van Easterling, George County Farm Center, Lucedale, MS

Other project related activities include presentation by the Program Coordinator at:

Civil Air Patrol - Lowndes County

Sheriff's Office - Lowndes County

County Engineer - Lowndes County

Fire Department - Lowndes County

City Engineer - Columbus, MS

City of Columbus, Building Director

Mayor and City Council, Columbus

Mississippi Joint House and Senate Forest Committee

IV. SHORT COURSES AND WORKSHOPS

Although no formal workshops were held during the past six months, displays illustrating the various Program activities were placed at the following meetings:

Displays

Sixth Annual Land Use Seminar, MSU, August, 1977

Annual Meeting, Mid-South Region, American Society of Photogrammetry

Opening of Civil Defense Headquarter, Lowndes County, MS

Visit by Mississippi State Committee on Forestry

In addition, the program coordinator participated in the following workshops:

NCSL Legislative Workshop on Satellite Remote Sensing, Bay St. Louis, Mississippi

EROS Forest Industry Advanced Remote Sensing Workshop, Bay St. Louis, Mississippi

Association of American Geographers, 73rd Annual Meeting, Remote Sensing Workshop, Salt Lake City, Utah

APPENDIX I

RATIONAL LAND USE DECISION-MAKING: THE NATCHEZ STATE PARK

W. Frank Miller, Program Coordinator

Bradley D. Carter, Assoc. Prof. Computer Science

Remote Sensing Applications Program
Mississippi State University
P. O. Drawer FD
Mississippi State, MS 39762

ABSTRACT

Mississippi State University undertook a remote sensing application project to assist the Mississippi Park Commission in selecting a suitable site for a proposed state park in Adams County, Mississippi. Due to political and geographic constraints, a study area of approximately 130,000 acres was selected. High altitude color infrared imagery of scale 1:120,000 was available, and these data together with various base maps such as topography, yielded the basic data for the construction of a computerized data management system. The cell size for data input was 4 ha. Ten possible areas were selected by modeling and visual evaluation, and when the Commission personnel had selected one site, a low altitude flight was made to obtain 1:24,000 color infrared imagery. These data in conjunction with map information were used to develop a data management system for more intensive analysis and modeling on a 1 ha grid. The modeling effort indicated those cells which had the highest suitability for individual recreational activities. Master planning efforts for the park incorporate these data.

RATIONAL LAND USE DECISION-MAKING: THE NATCHEZ STATE PARK

W. FRANK MILLER, Program Coordinator and
Associate Professor of Forestry
AND
BRADLEY D. CARTER, Associate Professor,
Computer Science

Remote Sensing Applications Program
Mississippi State University
P. O. Drawer FD
Mississippi State, MS 39762

INTRODUCTION

Land, a finite resource, a resource required to serve the needs of conflicting consumer groups, is an essential element in the structure of society. However, as Rennie (1963) noted, " ... over the earth's surface today there remains little useful terrain which has not already been exploited, utilized, or developed for agricultural, forestry, or urban uses." Of even more importance is the fact that many of the uses, particularly consumptive uses, are competitive and often conflicting. The problem is not of recent origin (Moncrief, 1970; Hardin, 1968), but it has become more visible in recent years. More and more frequently, segments of our society are coming to accept Wagar's (1970 concept of the "good life," or quality of life (QL) which he expresses in equation form as:

$$QL = \frac{\text{Produced Material Goods - Losses}}{\text{Population}} + \frac{\text{Services/Time}}{\text{Population}} + \frac{\text{Experiences/Time}}{\text{Population}}$$

Based on a short-run economic philosophy, "experiences" such as aesthetic viewing, clean camp sites, and open space are relatively abstract values. Nevertheless, with the increasingly intensive competition for land among consumer groups, the short-term economic structure

which favors goods and services and reduces the quantity and quality of experiences must be carefully weighed.

In order to maintain even a semblance of balance between the three components of the equation, perhaps it will become necessary, as Odum (1968) suggests, to employ tax relief, restrictions on use, scenic easements, and public ownership if significant land and water areas are to be held in protective categories. Or is it possible that rational land use apportionment might be accomplished by bringing the relative benefits and costs (both economic and environmental) to the attention of legislators and other decision-makers?

The study described in this paper presents a technique which allows a large quantity of cultural, physical, and biological data to be gathered, input into a computer, and queried to locate areas having high suitability for a wide variety of land uses. It is, therefore, a means of apportioning a land area among conflicting land use activities. Although this study deals with only one major type of land use activity, recreation, the technique is applicable to any type of land use for which "suitability" parameters can be defined. The data management system developed in this work is similar in concept to existing systems (Buckner, 1977; Seitz, et al., 1977).

THE STUDY

In 1973, Mississippi State University initiated a remote sensing program* that would, in part, identify State and local problems where the application of existing remote sensing technology might facilitate problem solution. One of the problem areas was suggested by the

*Supported by NASA Contract #NGL 25-001-154, Office of University Affairs

Mississippi Park Commission. The Commission was faced with the task of selecting the most appropriate site for a new park in Adams County, Mississippi. In 1972, a 25 million dollar bond issue was passed for acquisition and development of the State's recreational resources; however, the Park Commission has been hampered in many of their planning and development efforts due to lack of readily available site planning information. Not only is information needed concerning the immediate area of development, but also information concerning the impacts of the development on adjacent areas. Conventional methods of survey, although quite accurate, are time-consuming and expensive, and do not normally investigate areas adjacent to the proposed development site.

It was proposed to the Park Commission that the integration of remote sensing technology and a computerized geo-information system would allow the Commission not only to select proposed sites, but also to obtain planning data more rapidly, and to collect a larger number of cultural, biological, and physical parameters. The project was initiated by personnel of the Remote Sensing Applications Program in May, 1974; the objectives of the project were to demonstrate the capabilities of high and low altitude aircraft imagery as the major source of discrete site information, and to analyze sites by use of a computerized geo-information system. The planning constraints were that the park should be in the general vicinity of the Natchez Trace Parkway, that it should be approximately 3000 ac in extent, and should have the physical ability to support a lake of approximately 600 ac.

PROCEDURE

The initial phase of the study was to develop methodology which

would permit a broad-scale evaluation of approximately 130,000 ac for suitable park locations. Following the selection of a site by Mississippi Park Commission personnel, the second phase of the study would involve acquisition of data to assist in the master planning of park activities.

Phase I

After evaluation of several alternative approaches to data collection and management, Program personnel from the Departments of Forestry, Computer Science, and Landscape Architecture adopted a grid-based analysis system similar to that developed at Harvard University for the Honey Hill Study (Murray, et al., 1971). The system provides an efficient method of data storage and retrieval based on a coordinate reference grid.

In order to cover the extensive area indicated in the initial site location phase, a 4 ha (9.88 ac) grid was selected. Another major reason for the selection of this cell size was the availability of 1:120,000 color infrared imagery obtained during the winter of 1972-73 by the National Aeronautics and Space Administration (NASA/JSC, Mission 054/255). The degree of detail mappable from the imagery conformed to data requirements for a 4 ha cell. Other data sources were U.S.G.S. 15 min. quadrangle maps, and geologic maps.

Selection of the variables to form the data management system was considered to be highly important, and personnel from all cooperating departments and the Parks Commission were involved in the selection. The major criterion used for selection was that the variable under consideration must have significant influence on either the vulnerability of a site to a particular use, or the attractiveness of a site

for a use. Vulnerability is defined as the degree of the environmental degradation which would occur on the site if a particular activity occurred. Preliminary selection was based on the anticipated data needs to develop models which would indicate suitability (vulnerability and attractiveness) for recreational activities such as single-family cabin sites, tent camping sites, group camp sites, and marina sites. A further constraint was that the variables were subject to accurate, manual interpretation from winter season, color infrared imagery at a scale of 1:120,000 (NASA/JSC Mx 054/225). The final listing of variables included topographic information such as slope percent, aspect, and elevation; soil characteristics such as textural class, wetness class, and erosion; ecological information such as forest stand composition, size and density; and existing land use, and transportation network location (Table 1). In addition, the program generated "search" or proximity variables. This group of variables facilitates the selection of cells with a certain set of parameters within a specified distance of, for example, the proposed lake, a highway, or cultural activity. The marina location, for example, must lie within one cell of the lake; therefore, only those cells touching, or within one cell of the lake boundary will be evaluated on the basis of the other variables serving as a means of evaluation (Table 1).

A base map was constructed from four U.S.G.S. 15 min quadrangle sheets, and a 4 ha grid was drafted on the mosaic. The study area contained 12,862, 4 ha cells.

Using a Bausch & Lomb Zoom 240 Binocular Stereoscope mounted on a Richards Light Table, variables were mapped on mylar from positive transparencies of the imagery. Each variable was transferred to

Table 1. Partial List of Variables and Subvariables in the Natchez Park Geo-Information System.

Variable No.	Data Card Column	Variable Name	Code
#6	14	Soil Water Regime	
		Moist, moderately to WD	1
		Droughty, somewhat excessive	3
		Wet, poorly to SPD	5
		Ponded, very poorly drained	9
#7	15	Surface Water	
		3rd order stream	1
		2nd order stream	2
		1st order stream	4
		River 150'	6
		Lake (more than 10 ac.)	7
		Pond	9
#8	16	Forest Stand Composition	
		Pine - hardwood	1
		Hardwood	3
		Pine	5
		Open (less than 17% cover)	7
#9	17	Forest Stand Density Class	
		Over 75% closure	1
		50 - 75% closure	3
		25 - 50% closure	5
		17 - 25% crown closure	7
		Open (less than 17% cover)	9
#10	18	Forest Stand Condition Class	
		Unevenaged sawtimber	1
		Evenaged sawtimber	2
		Unevenaged poles	4
		Evenaged poles	5
		Unevenaged reproduction	7
		Evenaged reproduction	9
S-1	19	Proximity to Proposed Lake	
		In cell	1
		Within 1 cell	2
		Within 2 cells	3
		Within 3 cells	4
		Within 4 cells	5
		Within 5 cells	6
		Within 6 cells	7

copies of the base map by means of a B & L Zoom Transfer Scope. Topographic variables were taken directly from the base map. All variables were manually coded on computer input forms. Concurrently, personnel of the Computer Science Department were developing the necessary software to conform to the analysis requirements of the project. The program which evolved is known as CALUP, Computer-Assisted Land Use Planning, a geo-information and data management system (Carter, et al., 1976; Carter, 1977).

One of the most difficult processes in the project was the development of "suitability" models. A suitability model combines attributes of both vulnerability of a given set of conditions to environmental impacts from a given land use, and the attractiveness, both aesthetic and economic, of the site for the use. These models were developed in a joint effort of the user agency and the Program personnel; specialty areas represented were landscape architecture, wildlife management, agronomy, forestry, and computer science. The process involved three major steps: 1) selection of those physical, biological, and cultural variables which were considered to be most indicative of suitability for the stated recreation use, 2) determination of the relative contribution (weight) of each variable to the overall suitability, and 3) assignment of weights to the subvariables within each major variable group (Table 2). A detailed procedure is given in Appendix I.

Areas suitable for a 600 ac lake were identified from both the imagery and the topographic maps, and lands surrounding the designated areas were evaluated to determine the number of highly suitable cells (sites) for each proposed park activity; marina, lodge, day use,

Table 2. Example of Suitability Models - Lodge.

Suitability Index Name LODGE Study Natchez

Date 6-11-75

Variable No.	Subvariable No.										Weight	Weight Per Cent
	0	1	2	3	4	5	6	7	8	9		
	Rank											
2	0	0	1	2	4	5	9	8	5	4	6	8.7
3	0	7	0	9	0	6	0	1	0	0	6	8.7
5	0	7	5	0	0	0	0	9	4	0	8	11.6
4	0	7	9	0	5	1	0	0	0	0	8	11.6
S-7	0	0	0	0	1	3	5	7	9	9	8	11.6
10	1	9	8	0	6	3	0	0	0	0	7	10.1
S-1	0	3	7	9	8	5	1	0	0	0	10	14.5
8	0	7	0	9	0	5	0	1	0	0	7	10.1
S-10	0	0	0	1	2	3	4	5	7	9	6	8.7
S-9	1	3	5	9	9	9	7	5	3	1	3	4.4

Rate each value for each variable from 1 (low) to 9 (high).
To reject a cell on a particular condition, code a 0 under those particular variable values.
Weight - relative contribution of each variable to attractiveness or vulnerability.

single-family cabins, trailer camping, field game areas, group camping, and extensive recreation area.

Phase II

The Marshall Space Flight Center agreed to support the project by obtaining 1:24,000, color infrared imagery of the area selected in Phase I. A one hectare grid system was established and photographically superimposed on the base map. The imagery was interpreted and mapped, and the variables were again manually coded for use in the CALUP package. The same suitability models were used in both study phases; in Phase II, however, the intensity of interpretation was greater and the resulting variable delineations were much finer. Concurrently with data acquisition, the CALUP program was modified in order to accomodate not only the Park project, but also more generalized situations and problems.

RESULTS

Phase I

Ten sites were identified, evaluated, and ranked on the basis of the numbers of suitable alternative sites for various park activities, the configuration of the lake shoreline, and proximity to the Natchez Trace Parkway (Figure 1). Planners from the Park Commission spent one day in the field visiting those areas which received the highest rating, and one of the sites was selected for more intensive study (Figure 2).

On the strength of the Commission's commitment and acceptance of the techniques developed in this phase of the study, the State

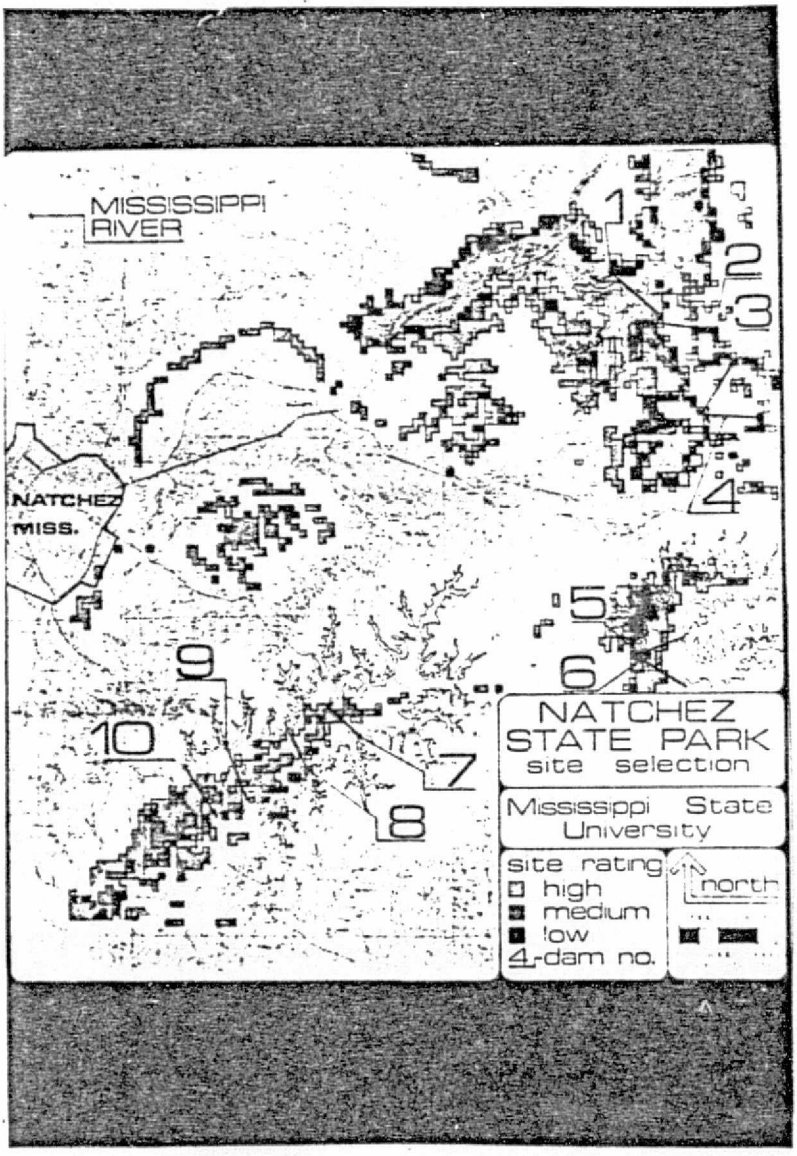

Figure 1. Location and rating of potential park sites, Adams Co., Miss.

Figure 2. Site selected by the Mississippi Park Commission for more intensive study.

initiated an active land acquisition program for the park site. Mr. Bill Barnett, Executive Director of the Park Commission was quoted in the Natchez Democrat (April 12, 1975) as stating that more effort was put into the site selection of the park than any other with which he was familiar, and that he felt that it was the only logical location in the entire study area.

Phase II

After the necessary data were collected and digitized, the CALUP analysis package was used to generate grey-scale printer maps for each of the suitability models (Figures 3 and 4). Based on the suitability models, a visual statement was generated to illustrate the characteristics of cells having either a high or low suitability for a given use. The situation indicated in Figure 5 reflects the high ratings for location of a lodge building given to an upland ridge flat with coarse-textured soils on a south or southwest-facing, three to seven percent slope supporting a sawtimber-sized hardwood stand; the location of the cell must be within three cells of the lake and more than nine cells away from cultural activity. Other recreational activities were treated in a similar manner. The printer maps and the supporting information were supplied to the Director of Planning and Engineering for the Park Commission. The information generated in the final phase is actively being utilized in the master planning of the park. Mr. Thomas Wetzell, Director of Planning and Engineering, estimated that the application of the technique in both phases saved the State approximately $62,500 and two years of effort.

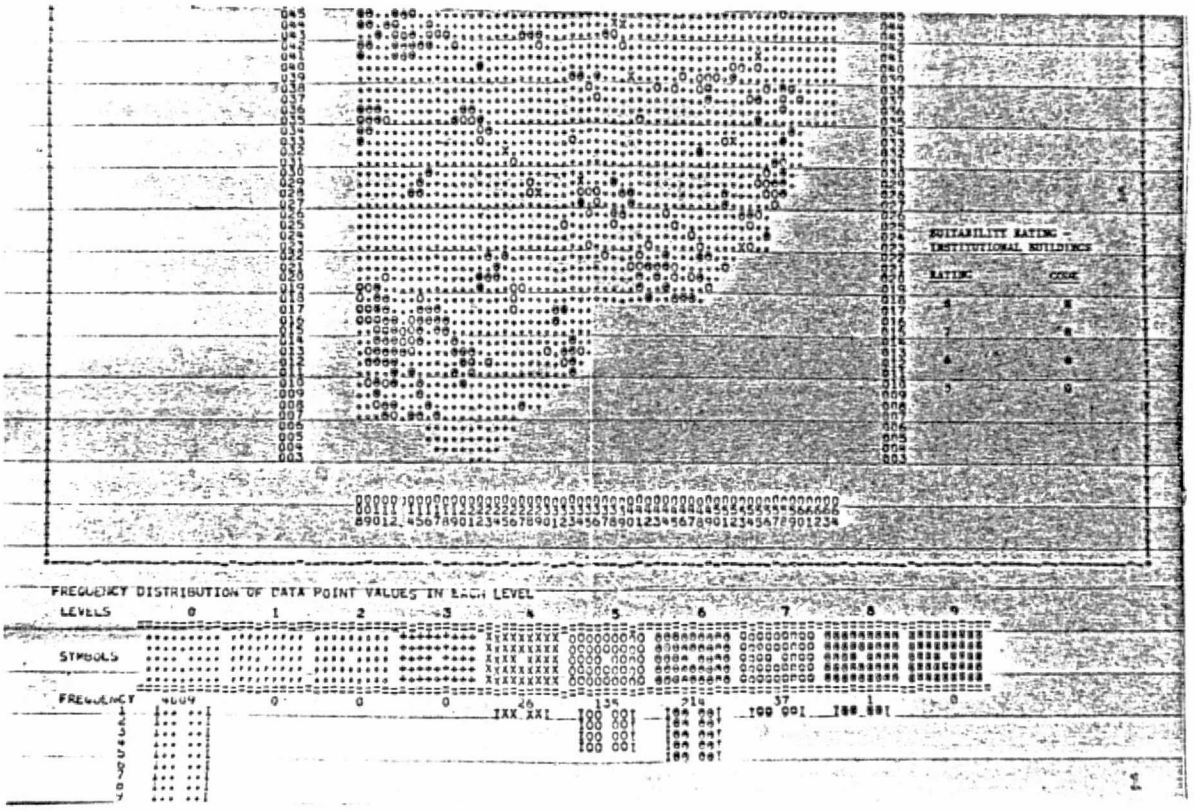

Figure 3. A suitability rating of the southern portion of the park area for institutional building sites.

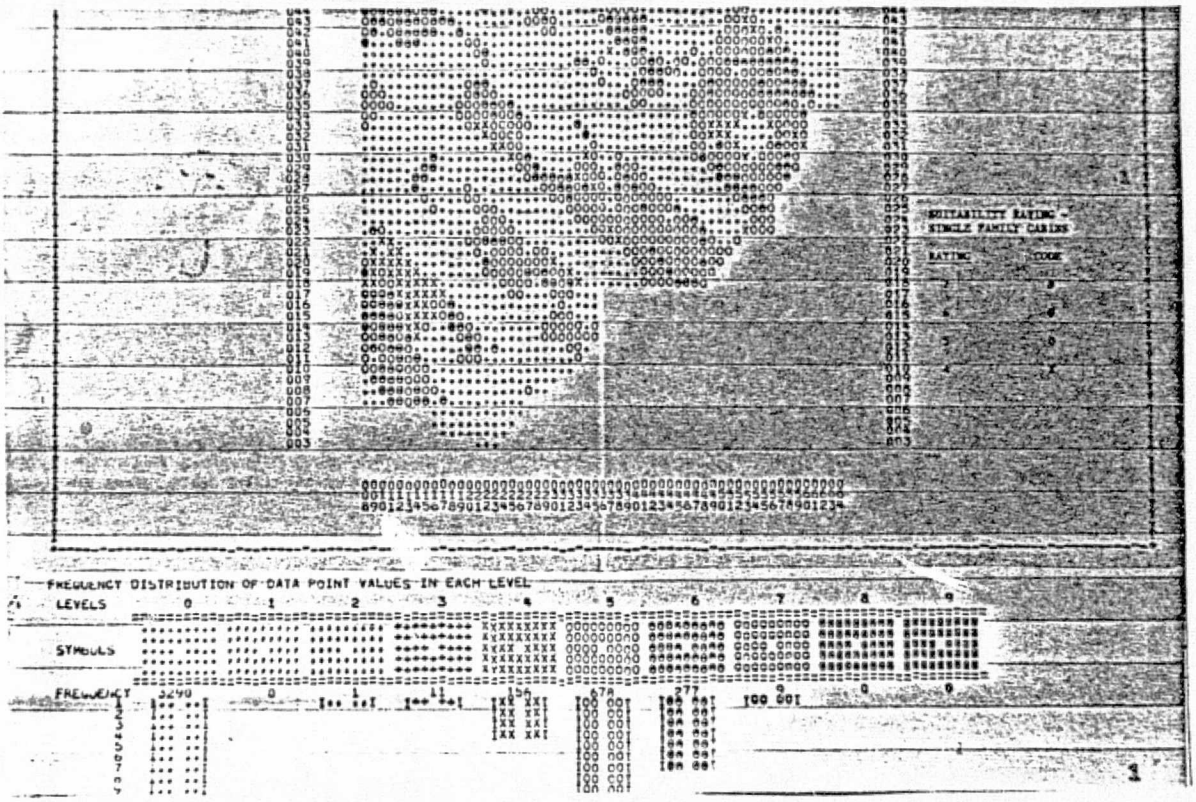

Figure 4. A suitability rating of the southern portion of the park area for single family cabins.

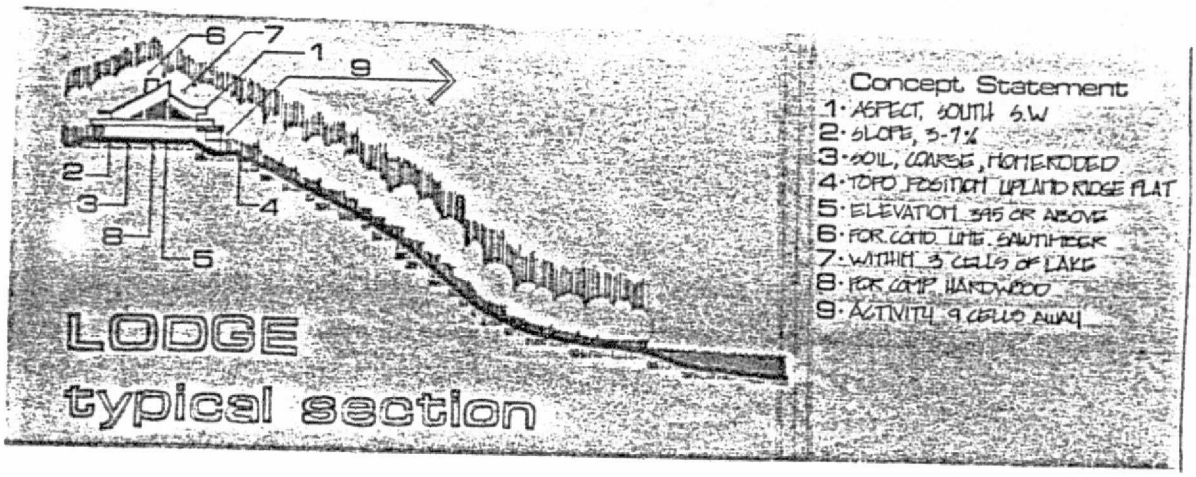

Figure 5. A visual presentation of cell characteristics which have a high suitability for location of a lodge building.

CONCLUSION

An integration of remote sensing data products, standard map products, and other resource materials into a computerized data management system permits planning objectives for both natural and human resource management to be accomplished with minimum environmental degradation and maximum environmental enhancement. For any given land use activity, the interaction of a large number of biological, physical and socio-economic variables can be evaluated to determine the suitability of a site for the activity. In a similar manner, the concept of use suitability allows a weighing of the effects of alternative land use activities.

This project was funded by a grant from NASA, Office of University Affairs.*

* NGL-25-001-054

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APPENDIX I

PROCEDURE FOR DEVELOPMENT OF SUITABILITY MODELS

Step 1. For any given land use, carefully examine the listing of variables accommodated in the geo-information system, and select variables indicating either vulnerability of a site to the use, or the attractiveness of a site for use. Examples of variables indicating vulnerability would be slope and soil textural class as they would influence site erosion under the impact of the stated use. Similarly, factors such as proximity to transportation, or availability of surface or ground water supplies, would indicate the degree of "attractiveness" for some potential land use. (Note: an interdisciplinary team should be convened to make evaluations - the MSU procedure involves the interplay between representatives of the user agency, and personnel from the MSU Departments of Forestry, Wildlife & Fisheries, Agronomy Soils, Landscape Architecture, and Computer Science.)

Step 2. List the variables on the Suitability Index Evaluation Form, and assign relative weights to each depending upon the opinion of the evaluation team. The relative weighting is done in the following manner: determine the most impacting variable dealing with vulnerability and assign it a weight of 1; also assign a weight of 1 to the most important attractiveness variable; all other variables are weighed in comparison. These fractions are usually converted to whole numbers for ease of computation. The percent weight is calculated.

Step 3. The subdivisions (subvariables) of each variable are then considered as to relative importance of a 1 (low impact) to 9 (high importance) basis. In the event a subvariable is not to be considered, it is given a zero weight.

Step. 4. In order to test the validity of the importance assigned to each subvariable, a system of penalty points is utilized in the following fashion:

For the location of the lodge building, it was felt that the slope percent should have a weight of 6 in a total of 69 points or a weight percent of 8.7. Within the slope percent variable, a subclass of 12 - 20% was rated at a 1 on a 1 (low suitability) to 9 (high suitability) basis: therefore, a rating of 1 indicates a "penalty" of 7.7% (Table 2). Based on the same procedure, it can be noted that the most severe penalty assigned was a cell which was located six or more cells away from the proposed lake. In a similar manner, the same penalty was assessed a cell containing a medium-textured, eroded soil and a cell falling on the upper slopes of an upland topographic position. Examination of the penalty points assessed each situation allows the interdisciplinary team to make adjustments in the ratings if it is felt that too severe or too light a penalty was assigned to a given set of situations.

APPENDIX II

BOARD OF SUPERVISORS

LOWNDES COUNTY

COLUMBUS, MISSISSIPPI 39701

June Fifteenth,
Nineteen Seventy-Seven

Mr. W. Frank Miller, Program Coordinator
Remote Sensing Applications
Drawer FD
Mississippi State, Ms 39762

Dear Frank:

Lowndes County has contracted with Western Appraisals to re-evaluate the real and personal property in our county. I've been made aware that your Remote Sensing Application Programs will be of valuable assistance to us in classing our rural lands. I hereby make a formal request for your assistance.

I'm appointing Mr. William S. Della Valle, Data Processing Manager for Lowndes County, to be our representative and to become as involved as you feel necessary in reaching our objectives.

The result of this endeavor will be used not only in our re-evaluation but also in our master plan for land use in Lowndes County and as a model for other counties in Mississippi.

I wish to thank you for whatever assistance you can give us in setting this plan in motion.

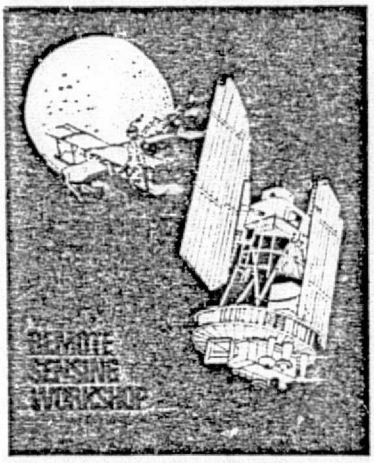
Sincerely,

S. A. Smith

S. A. Smith
President, Board of Supervisors

APPENDIX III

The Remote Sensing Application Program
Mississippi State University



A DATA MANAGEMENT SYSTEM FOR LOWNDES COUNTY, MISSISSIPPI

PART I. RURAL LAND ASSESSMENT

W. Frank Miller, Program Coordinator
David E. Pettry, Professor of Agronomy
Bradley D. Carter, Assoc. Professor of Computer Science

And

The Lowndes County Board of Supervisors
S. A. Smith, Jr., President
William Della Valle, Data Processing Manager

In Cooperation With

THE OFFICE OF UNIVERSITY AFFAIRS
NATIONAL AERONAUTICS & SPACE ADMINISTRATION

September 1977

Illustration: an example of NASA high altitude color infrared imagery used in the Lowndes County project; 1" = 10,000'

STATEMENT OF THE PROBLEM

The Lowndes County Board of Supervisors requested assistance from the Remote Sensing Applications Program with the evaluation of rural real and personal property in Lowndes County, (see letter attached.) The Remote Sensing Applications Program agreed to provide the best data available concerning the productivity and present use of rural lands.

The general approach selected was to divide the county into 5 acre cells based on a rectangular coordinate system. Soil association information was obtained from the Soil Conservation Service and a land cover classification was obtained from the LANDSAT satellite and placed in a computer file. The computer was then programmed to intergrate the soil and land cover information into a 10 level assessment rating system; tha is, high, medium and low levels of productivity for row-cropping, pastures, and forest, plus a non-utilizable category which included gravel pits and water.

It must be recognized that there are inherent errors in the classification due to two sources:

1. The use of broad soil associations rather than the more intensive mapping units found in a county soil survey.
   A soil association is an assembly of soil series which commonly occur in a landscape. For example, in the Smithdale-Savannah association, the Savannah soil occurs in the broad ridges with Smithdale occuring in the sides of the ridges. Although the Savannah soils are generally more productive than the Sweatman soils, they occupy a lesser area in the association, and thus the overall rating for the association is "poor" for row crops.

2. The computer pattern recognition/classification procedure plus the 5 acres average condition assigned to each cell.
   The electronic signals recorded by the satellite sensing system are also average reflectance value (signal strength) for an area approximately 1.1 acres in size. After the land cover types are correlated with signal ranges, they are then grouped into 5 acre blocks. Thus, an accuracy of identification of approximately 85% is achieved.

BOARD OF SUPERVISORS

LOWNDES COUNTY

COLUMBUS, MISSISSIPPI 39701

June Fifteenth,
Nineteen Seventy-Seven

Mr. W. Frank Miller, Program Coordinator
Remote Sensing Applications
Tower 20
Mississippi State, Ms 39762

Dear Frank:

Lowndes County has contracted with Western Appraisals to re-evaluate the real and personal property in our county. I've been made aware that your Remote Sensing Application Programs will be of valuable assistance to us in classing our rural lands. I hereby make a formal request for your assistance.

I'm appointing Mr. William S. Della Valle, Data Processing Manager for Lowndes County, to be our representative and to become as involved as you feel necessary in reaching our objectives.

The result of this endeavor will be used not only in our re-evaluation but also in our master plan for land use in Lowndes County and as a model for other counties in Mississippi.

I wish to thank you for whatever assistance you can give us in setting this plan in motion.

Sincerely,

S. A. Smith
President, Board of Supervisors

INTRODUCTION

As a part of the continuing technology transfer function of the Applications Program, a project was initiated in cooperation with the Mississippi Research and Development Center to develop a computerized information system which would serve as a basis for rational decision-making in resource management in Lowndes County, Mississippi. In an earlier study in cooperation with the Mississippi Park Commission, Dr. Brad Carter of the MSU Computer Science Department developed a data management system to handle data inputs from a wide variety of source materials. High and low altitude aerial imagery, topographic maps, geological and soil maps and census maps were all utilized in the data base. Data is coded on the basis of cells of a stated size. Since in the developmental work the purpose of the study was to assist in the location and planning of a new state park, models were developed which would incorporate the attractiveness of a site for a recreational activity, and the vulnerability of that site to the stated use; thus a model of site suitability was developed. The computer program would then search the area for cells having the specified characteristics. In a similar manner, the Lowndes County data base has been established; a listing of data sources is given in Appendix I. In the process of collecting data from various sources, it became apparent that certain parts of the information system could be of appreciable value to the county government units. This report deals with one aspect

of the information system; the assessment of rural lands on the basis of broad soil productivity classes and the present land cover types.

SOILS OF LOWNDES COUNTY

The soils of Lowndes County formed in marine sediments, alluvium, and calcareous chalk. The Tombigbee River separates the soils developed in chalk from the more siliceous, acid soils formed in unconsolidated, stratified marine sediments. Alluvial soils occur on the flood plains and higher terraces along the Tombigbee and Buttahatchee River, Luxapalila Creek, and smaller streams.

The soils west of the Tombigbee River are located in the Black Prairie physiographic region, while those east of the river are in the Upper Coastal Plain. Generally, soils located in the Prairie section are less acid and contain more calcium and higher contents of shrink-swell clays (montmorillonite) than soils in the eastern part of the county. The soils developed in chalk are also thinner, ranging from a few inches to about six or eight feet thick. Some areas of bare chalk are exposed in the Prairie section where erosion has removed the soil.

A series of terraces occur east of the Tombigbee River that generally range about 200-220 feet above mean sea level just east of the river to about 300-400 feet (MSL) in the Caledonia area. Large areas of highly productive soils comprise these terraces and many are characterized by high silt contents. The terraces are generally broad and nearly level with sloping areas between the different terraces.

The level soils of the flood plains along the rivers and tributaries reflect their alluvial parent materials. The soils adjacent to the Luxapalila are acid and siliceous, similar to the upland soils of the drainage basin. Soils along the Catalpa, Gilmer and Magowah Creeks in the southwestern part of the county are associated with the calcareous, clayey alluvium of the Blackland Prairie section.

SOIL DATA

The soil data presented in this report are based on the general soil map and soil associations prepared by the Soil Conservation Service during the soil survey of Lowndes County. The Soil Conservation Service completed the cooperative soil survey of the County in 1977, and the complete report is in the publication process. Detailed soil survey information and interpretations are available in the local Soil Conservation Service office in Columbus.

The general soil map used in this report is comprised of eleven soil associations. A soil association represents a landscape that has a distinctive pattern of soils. It consists of several soils with one or more major soils and at least one minor component. This soil information is much more general than detailed soil survey data and it is presented on a much broader map scale. Such data are useful as a general guide, but it is not suitable for more exact usage and location of specific sites.

The eleven soil associations in the county may be grouped generally in the following manner based on position, slope, thickness and nature of the inherent parent materials:

NEARLY LEVEL SOILS ON FLOOD PLAINS

These soils are located on flood plains and stream terraces of larger streams and they are subject to flooding.

(1) Leeper - Catalpa Unit - These are somewhat poorly and moderately well drained, non-acid, clayey soils on flood plains. This unit occurs on wide plains in the western part of the county and comprises about 6% of the county. About 60% of the unit is Leeper soils, 25% Catalpa soils and the remainder soils of minor extent. Large areas are in cultivation.

(2) Jena - Mantachie Unit - These soils are well drained and somewhat poorly drained acid and loamy. They occur on flood plains along the Tombigbee and Buttahatchie Rivers and Luxapalila and Yellow Creeks. This unit comprises about 7% of the county. It is comprised of about 35% Jena soils, 25% Mantachie soils and the remainder soils of minor extent. This unit is mostly in woodland.

(3) Cahaba - Prentiss - Vimville Unit - These are well drained loamy soils and moderately well drained loamy soils with a fragipan and poorly drained soils. They occur on stream terraces which occasionally flood. This unit comprises about 12% of the county. It has about 34% Cahaba soils, 24% Prentiss soils, and 18% Vimville soils with the remainder soils of minor extent. About 60% of this unit is in woodland and the remainder in cultivation or pasture.

NEARLY LEVEL TO SLOPING SOILS ON UPLANDS

(4) Prentiss - Rosella - Steens Unit - These are moderately well drained loamy soils with a fragipan, poorly drained soils high in sodium and somewhat poorly drained loamy soils. These soils occur on terraces east of the Tombigbee River. The unit makes up about 17% of the county. It consists of about 30% Prentiss soils, 15% Rosella soils, and 15% Steens soils, and the rest soils of minor extent. About one-half of this unit is in cultivated crops with much of the remaining part in woodland. Portions of the Columbus Air Force Base and residential and commercial areas of Columbus are on this soil unit.

(5) Savannah - Caledonia - Guyton Unit - These are moderately well drained loamy soils with a fragipan, well drained loamy soils and poorly drained silty soils in depressions. These soils occur primarily on the east side of the Tombigbee River. This unit comprises about 13% of the county. It consists of about 40% Savannah soils, 16% Caledonia, 7% Guyton soils, and the remainder soils of minor extent. Much of this unit is in cultivated crops with some tracts in woodland.

DEEP SOILS ON UPLANDS

(6) Smithdale - Savannah Unit - These are well drained loamy

soils and moderately well drained loamy soils with a fragipan. These are hilly soils located in the eastern part of the county. The unit is about 32% Smithdale soils, card 32% Savannah soils, with the rest soils of minor extent. Most of this unit is used for woodland with some ridge tops and level areas in cultivated crops. Steep slopes limit cultivation.

(7) Smithdale - Sweatman Unit - These are well drained loamy soils and well drained soils with clayey subsoils. These are hilly soils partially in and north of Columbus. This unit comprises about 2% of the county. It is made up of about 35% Smithdale soils, 24% Sweatman soils, and the remainder soils of minor extent. This unit is mostly in woodland and much is being urbanized. Steep slopes and clayey subsoils limit usage.

UNSTABLE SOILS OVER CHALK ON UPLANDS

(8) Vaiden - Okolona - Brooksville - These are somewhat poorly drained acid and alkaline, clayey soils over chalk. This unit occurs in the prairie section west of the Tombigbee River. It occupies about 22% of the county. It is comprised of about 53% Vaiden soils, 16% Okolona soils, 6% Brooksville soils, and the rest soils of minor extent. This unit is mostly in cultivated crops. It has good potential for cultivated crops, but poor potential for woodland. The wetness and high shrink-swell clays limit urban uses.

(9) Okolona - Brooksville - Sumter Unit - These are well drained and somewhat poorly drained, alkaline clayey soils over chalk. This unit occurs in the prairie section west of the Tombigbee River. It comprises about 5% of the county. The unit has about 40% Okolona soils, 25% Brooksville soils, 20% Sumter soils, and the rest soils of minor extent. Most of the unit is in cultivated crops. The wetness and shrink-swell soils limit other uses.

(10) Sumter - Kipling Unit - These are well drained and somewhat poorly drained clayey soils over chalk. These are nearly level to steep soil areas in the prairie section. This unit comprises about 8% of the county. It consists of about 45% Sumter soils, 22% Kipling soils, and the rest soils of minor extent. This unit is used mostly for pasture and it contains chalk outcrop.

(11) Kipling - Savannah Unit - These are somewhat poorly drained clayey soils over chalk, and moderately well drained loamy soils with a fragipan. These are nearly level to sloping soils in the northwest section of the county. The unit comprises about 2% of the county. It consists of about 34% Kipling soils and 32% Savannah soils. This unit is used primarily for pasture and cultivated crops, with the rest in woodland.

SOIL INTERPRETATIONS

The major soil associations and interpretations are presented in Table 1. About one-half of the county land area is utilized for cultivated crops, with the greatest acreage in the western portion of the county.

MAJOR SOIL ASSOCIATIONS OF LOWNDES COUNTY AND INTERPRETATION BASED ON GENERAL SOIL MAP

Soil Units	Percent of County	Cropland	Woodland	Urban Uses	Pasture	Intensive Recreation Areas	Extensive Recreation Areas
1)Leeper-Catalpa	6.0	Good (A-1)	Good	Poor: Floods	Good	Poor: Floods	Poor: Floods
2)Jena-Mantachie	7.0	Poor: (A-3) Floods	Good	Poor: Floods	Good	Poor: Floods	Poor: Floods
3)Cahaba-Prentiss-Vimville	12.0	Good (A-1)	Good	Poor: Floods	Good	Poor: Floods	Fair: Floods
4)Prentiss-Rosella-Steens	17.0	Fair: (A-2)	Good	Poor: Wetness	Good	Poor: Wetness	Poor: Wetness
5)Savanna-Caledonia-Guyton	13.0	Good (A-1)	Fair	Fair: Wetness	Good	Good	Good
6)Smithdale-Savannah	6.0	Poor: (A-3) Slope	Fair	Poor: Slope	Fair	Poor: Slope	Fair: Slope
7)Smithdale-Sweatman	2.0	Poor: (A-3)	Fair	Poor: Slope	Good	Poor: Slope	Poor: Slope
8)Vaiden-Okolona Brooksville	22.0	Good (A-1)	Poor	Poor: Wet,Shrink-Swell	Good	Poor: Wet,Shrink-Swell	Poor: Wet,Shrink-Swell
9)Okolona-Brooksville-Sumter	5.0	Good (A-1)	Poor	Poor: Wet,Shrink-Swell	Good	Poor: Wet,Shrink-Swell	Poor: Wet,Shrink-Swell
10)Sumter-Kipling	8.0	Poor: (A-3) Slope,erosion	Poor	Poor: Wet,Shrink-Swell	Fair-Poor	Poor: Wet,Shrink-erosion	Poor: Wet,Shrink erosion
11)Kipling-Savannah	2.0	Fair: (A-2) Slope	Fair	Poor: Shrink-Swell Wet	Good	Poor: Shrink-Swell Wet	Fair: Shrink-Swell Wet

LAND COVER DISCRIMINATION FROM LANDSAT DATA

Numerous computer procedures have been developed to process the electronic data received from the LANDSAT satellite system. Basically, all of the procedures consist of converting the digital signals representing energy levels reflected from the earth's surface into recognizable patterns of land cover. For the purposes of this work, the major classes of land cover discriminated were forest, pasture, cropland, and other. It must be realized that the smallest unit of measure for the data, a "pixel," indicates only the average cover condition on a 1.1 acre area. And considering the other accuracy constraints, a five acre area is necessary to provide an adequate discrimination. Generally, the land cover type with the "strongest response" will dominate and thus the cell will be classified on that basis even though several other cover types may exist within the five acre area. The overall accuracy of discrimination is approximately 85%.

The satellite data utilized in the study were recorded on June 6, 1976; therefore, any changes in land use since that date will not be recorded.

Rural Land Assessment Ratings

Both the soil association and land cover information was registered on the five acre grid system which covers the County. Based on the soil information, yield potentials were rated as high (1), medium (2), and low (3) for each major use - forests, pastures, or croplands. The integration of the current cover type and the potential for that type yields the final assessment rating as follows:

Cropland 1	Pasture 1	Forest 1
Cropland 2	Pasture 2	Forest 2
Cropland 3	Pasture 3	Forest 3

and "other," which is nonproductive (agriculturally) land.

Although computer printout maps accompany the original report, illustrations of these printouts are presented here in Figures 1, 2 and 3

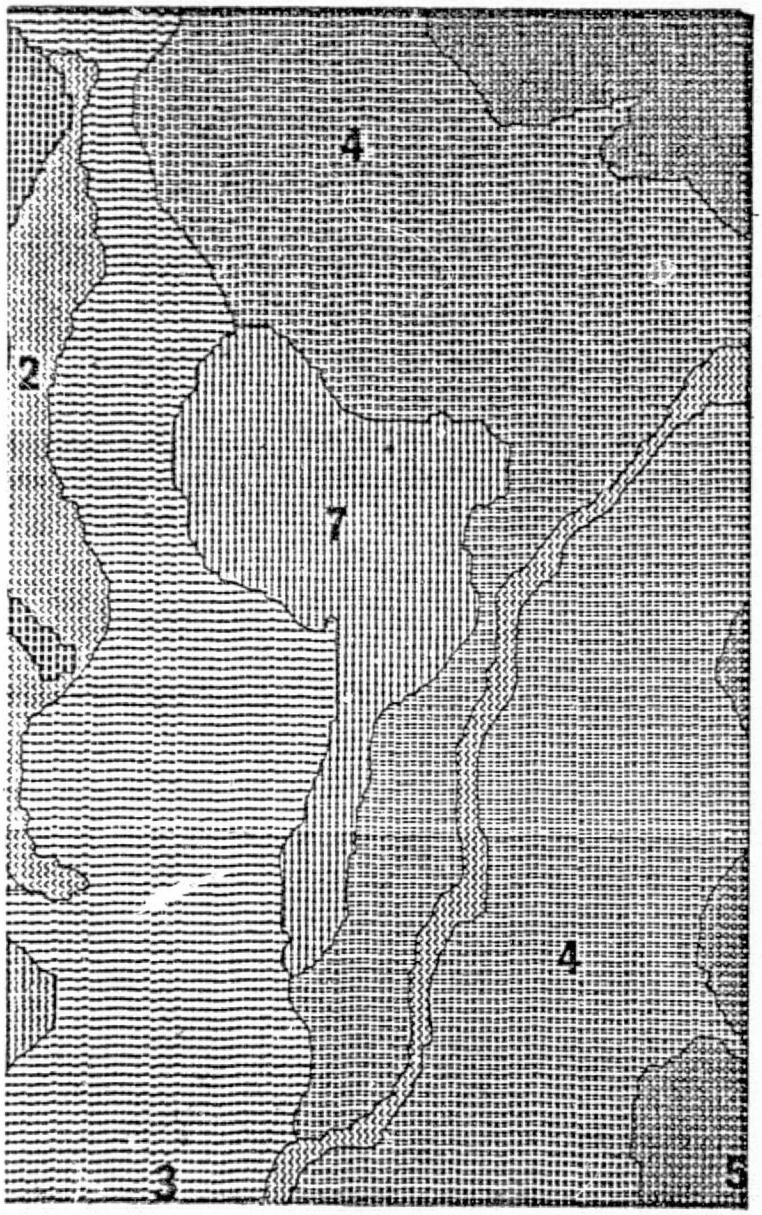


Figure 1. Soil associations of a selected portion of Association 2 is Jena-Mantachie; Association 3 is Cahaba-Prentiss-Vimville; Association 4 is Prentiss-Rosella-Steens; Association 5 is Savanna-Caledonia-Guyton; Association 7 is Smithdale-Sweatman.

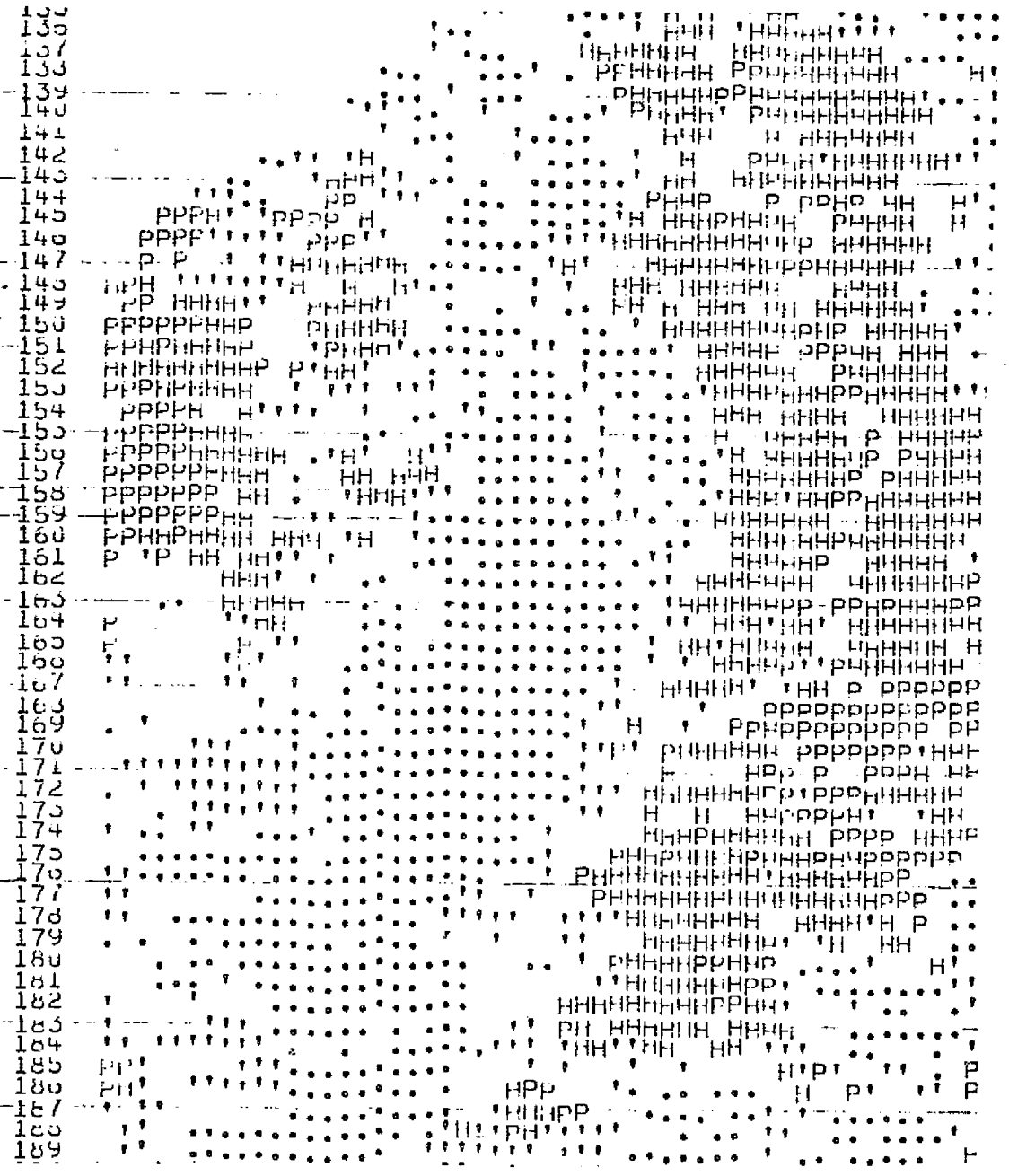


Figure 2. Land cover types of Lowndes County identified from LANDSAT digital data. Cropland is . , pasture land is ' , and forest land is P,H. Unclassified areas are blank; each symbol represents a 5 ac block. Accuracy is approximately 85%

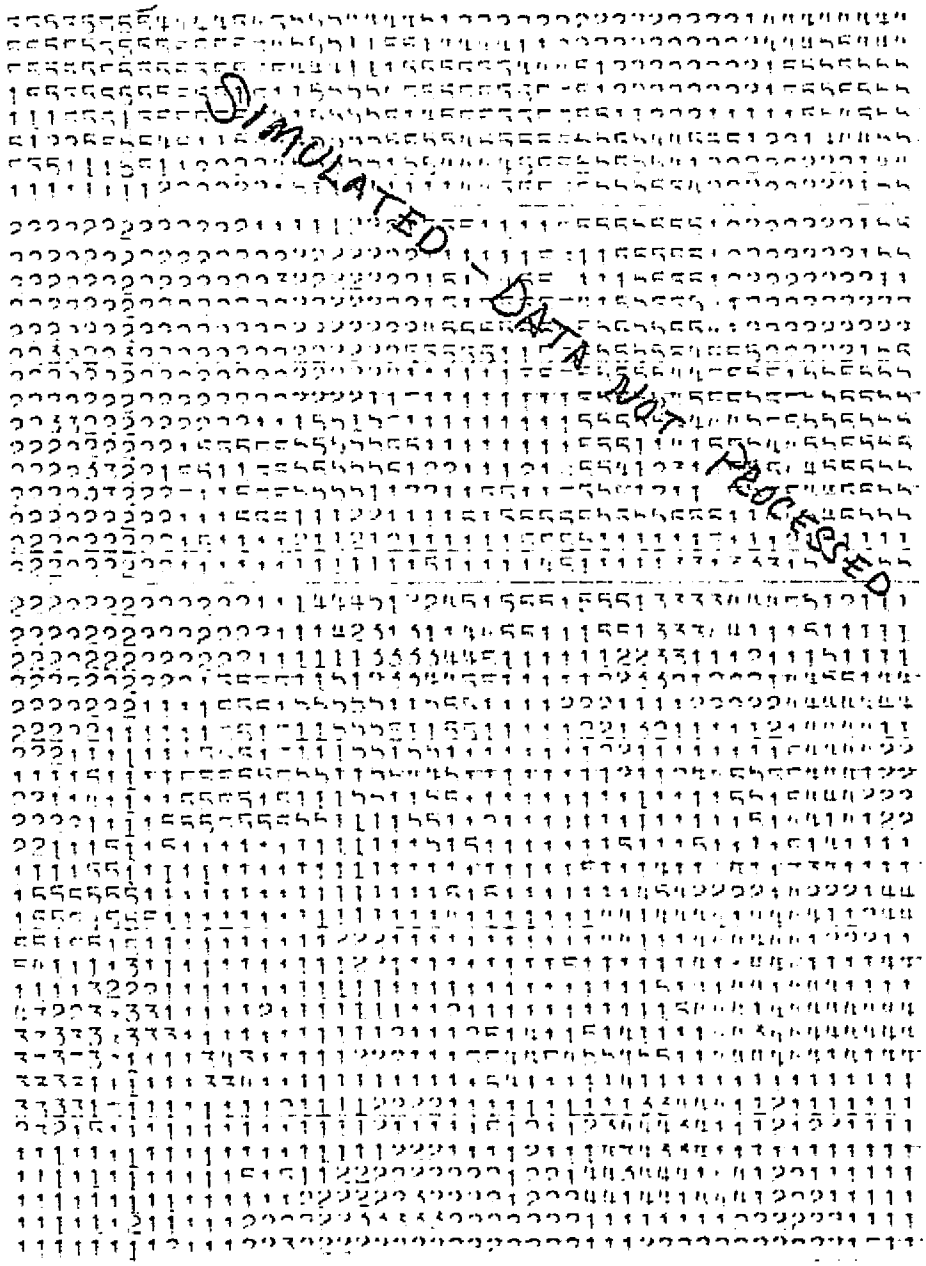


Figure 3. Rural land assessment ratings; integration of land cover and productivity ratings of soil associations:

1 = high productivity cropland
2 = moderate productivity cropland
3 = low productivity cropland
4 = high productivity pasture
5 = moderate productivity pasture

APPENDIX I.

List of Data Sources and Organizations

City of Caledonia

City of Crawford

City of Artesia

Four County Electric Power Company

East Lowndes Water Association

Corps of Engineers, Mobile District

U. S. Geological Survey, 15 min. topographic quadrangle maps, Caledonia, West Point, Artesia, Columbus.

NASA Mission 225, color infrared, 1:120,000 and Mission 215/293, color infrared, 1:12,000

Lowndes County Soil Survey, unpublished, soil associations

LANDSAT computer compatible tape, June 6, 1976

APPENDIX IV

Final Report of Tennessee-Tombigbee Industrial Siting attached separately

See E78-10035

APPENDIX V

iff Finch
Governor

J.E. Thomas, P.E.
Executive Director

Mississippi Marine Resources Council

Post Office Drawer 959 ▫ Long Beach, Mississippi 39560 ▫ 601-864-4602

September 9, 1977

Dr. Gary Higgs
Department of Geology and Geography
P. O. Drawer GG
Mississippi State University, MS 39762

Dear Dr. Higgs:

This is in response to your letter to me dated July 28, 1977 and concerning the proposal entitled "Beach Erosion Control Study -- Pass Christian".

The research work as proposed is needed to help solve the costly, wind-driven sand erosion problem associated with the Mississippi Gulf Coast Beaches. The Mississippi State University Geology and Geography Department's and NASA's interests in the erosion problem are appreciated. We encourage support for this very much needed research. In fact, implementation of your proposed research would complement an on-going project which addresses near shore, wave-current energy and associated sediment movement.

It is recommended that the sand erosion research work be clearly divided into two distinct parts. Part I would be the identification of the sand erosion areas and degree of erosion in the Pass Christian area and identification of factors which readily allow the sand erosion to occur, e.g. low moisture content, lack of laminar flow obstruction, etc. Additionally, Part I would include identification and recommendation of effective and acceptable methods and means for solving the sand erosion problem associated with the beach of Pass Christian.

It is our understanding that the present proposal by you corresponds to Part I. It is also our understanding that NASA has set aside and pledged funds for Part I of the project provided all parties involved agree that Pass Christian has a significant sand erosion problem associated with their beach and that this problem merits research funds which can contribute toward solving the problem. The Mississippi Marine Resources Council agrees that there is a significant sand erosion problem associated with the Pass Christian Beach and encourages NASA to provide research funds for the proposed project.

Part II would be the actual implementation of the methods and means which would alleviate or completely correct the beach sand erosion problem. This may be accomplished by the appropriate siting of aesthetically acceptable laminar flow obstruction objects, vegetation, etc.

Upon completion of Part I, the Mississippi Marine Resources Council will be interested in providing needed assistance in the formulation of Part II. Furthermore, upon completion of Part I, the Council shall determine the degree to which we can participate in the actual implementation of Part II.

We look forward to working with you and NASA in solving the sand erosion problem. If we can provide further assistance or information to you, please advise at your earliest convenience.

Very truly yours,

J. E. Thomas, P. E.
Executive Director

CML:kg

cc: Dr. Cornell Ladner

BOARD OF SUPERVISORS

HARRISON COUNTY, MISSISSIPPI

ERNEST C. MELVIN, PRESIDENT

HARRISON COUNTY COURT HOUSE
GULFPORT, MISSISSIPPI 39501

October 7, 1977

Mr. Gary Higgs
Department of Geography & Geology
Mississippi State University
Mississippi State, Mississippi 39762

Dear Mr. Higgs:

Enclosed herewith, please find one Certified Copy of a Resolution Endorsing Research on the Aeolean Beach Erosion Problem Along the Mississippi Gulf Coast by Mississippi State University, which was adopted by the Board of Supervisors on the 30th day of September, 1977.

If you have any questions concerning this matter, please do not hestitate to call this office.

Sincerely,

Mary Lou Fore

for G. N. CREEL,
Clerk, Board of Supervisors,
Harrison County, Mississippi

GNC:mlf

Enclosure

Supervisor LEROU URIE moved the adoption of the following Resolution:

RESOLUTION ENDORSING RESEARCH ON
THE AEOLEAN BEACH EROSION PROBLEM
ALONG THE MISSISSIPPI GULF COAST
BY MISSISSIPPI STATE UNIVERSITY

WHEREAS, The Board of Supervisors of Harrison County (strongly) endorses and supports the objective and meteorology of the proposed research on the aeolean beach erosion problem in the Pass Christian area of the Mississippi Coast. The Objectives of the research will be to attempt to locate areas of erosion and adapt control systems (to be installed by the Mississippi Marine Resources Council) to reduce erosion while preserving or increasing the aesthetic and recreation value of the beach; and,

WHEREAS, The Board of Supervisors belives that a contribution to the solution of this problem while maintaining the recreational quality of the beach is extremely important to the economy and quality of life of the area. The Board in addition to its endorsement and support offers to contribute to the proposed research through the provision of advise, direction and council and data on the history, maintenance, and evolution of the beach as well as information about specific observations of erosion patterns. The Board further believes it appropriate to maintain the beach and the erosion control facilities (parkshrub, grass lawn, playground, picnic areas) installed by Mississippi Marine Resource Council on the recommendation of this study and in the event of sucessful beach control to participate in the support of on-going beach monitoring program to the extent of $100-200 per year; and,

IT IS THEREFORE RESOLVED by the Board of Supervisors of Harrison County, Mississippi, that there is a definite need for the aforementioned study; and,

BE IT FURTHER RESOLVED that the Board of Supervisors of Harrison County, Mississippi pledges to support the on-going beach

monitoring program to the extent of $200.00 per year.

Supervisor WILLIAM J. "Billy" McDONALD seconded the motion, whereupon the President put the question to a vote with the result that all present voted in the affirmative. The President then declared the motion carried and the resolution adopted this the 30th day of September, 1977.

* * *

STATE OF MISSISSIPPI

COUNTY OF HARRISON

I, G. N. CREEL, Clerk of the Chancery Court and Ex-Officio Clerk of the Board of Supervisors, in and for Harrison County, State of Mississippi, do hereby certify that the above and foregoing transcript is a true and correct copy of an Order passed by the Board of Supervisors at their September Term, A. D., 1977, on the 30th day of September, 1977, as fully and completely as the same appears of record and remains on file in my office and of which I am the Official Custodian.

GIVEN under my hand and official seal of said Board of Supervisors, at my office in Gulfport, Mississippi, this the 6th day of October, A. D., 1977.

G. N. Creel
Clerk of the Chancery Court and
Ex-Officio Clerk of the Board of
Supervisors of Harrison County,
Mississippi

(SEAL)

BY: Mary Lou Fore D.C.