The University of Mississippi

Field Station

Planning Activities:
Development of The University of Mississippi Biological Field Station

Report of the Planning Workshop Held in Oxford, Mississippi, 19-21 February 1997, and Summary of Trips by The University of Mississippi Biological Field Station Staff to Other Field Stations or Marine Laboratories

Edited by M. M. Holland, L. B. White, and K. R. Pigott
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Publication No. 3

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Executive Summary

The enthusiastic and insightful comments of 36 workshop participants, numerous reviewers, and personnel from several other field stations have confirmed that The University of Mississippi Biological Field Station (UMBFS) has the potential to become a nationally and internationally important Station. Unique physical and biological features in an under-represented region of the country provide key elements for achieving national prominence. The urgent need for institutional support to increase the Station's competitiveness is eloquently stated. As summer field courses are developed and advertised, more papers on work at UMBFS are published, and lodging facilities are constructed, it will be easier to attract additional nationally-recognized researchers to work with those already based at the Oxford campus. Regional, national, and international recognition will come as UMBFS maintains its solid science base, disseminates attractive literature about the Station, establishes a track record of informative field courses, and constructs comfortable housing.

The Vision articulated during the workshop has four components as follows:

The **overall vision** for UMBFS is to become a regionally, nationally, and internationally important station for field research, teaching, and service over the next 20 years; as a first step, there will continue to be a tight link between educational and research programs, and investigators from many different departments within The University of Mississippi (UM) will be encouraged to work at the Field Station; in addition, colleagues from other Mississippi Institutions of Higher Learning as well as from neighboring states will be encouraged to utilize the opportunities afforded by the Station for field research.

A **second component of the vision** is for research, service, and teaching activities at the Station, where feasible, to be self-supporting and to generate income to help defray Station expenses.

A **third component of the vision** is for the UM Field Station (FS) to become one node within the larger network currently under development by the Organization of Biological Field Stations (OBFS) collecting long-term data throughout North America; the UM Field Station will foster collaborations with other Field Stations and Marine Labs and become an active participant in other networks.

A **fourth component of the vision** is to continue the focus on current UM research strengths, but over time to incorporate the six research priorities (fundamentals of basic biology and ecology, assessing environmental change, maintaining biodiversity, sustainable ecological systems, predictive management, restoration and rehabilitation) identified for Field Stations and Marine Laboratories nationwide [Lohr, *et al.* 1995] into more projects at the UM Field Station.

Given this vision, the following recommendations were offered by workshop participants:

* change the name from The University of Mississippi Biological Field Station to The University of Mississippi Field Station;

* host an annual gathering where results of research efforts conducted at the Field Station can be presented, discussed, and summarized; and continue to offer periodic tours for the general public where scientists actively engaged in work at the Field Station explain the significance of their research;

* Recognizing the need for The University Administration to increase its financial commitment to the Field Station, the following specific suggestions were offered:

    ** institutionalize a long-term base level monitoring program at the FS by providing support for some graduate student Research Assistantships based at the FS;

    ** institutionalize a long-term educational component at the FS by providing support for both of the following positions: (a) a full-time education coordinator for the Field Station, and (b) a joint faculty appointment between the School of Education and the Field Station, to avail the Field Station of opportunities open to faculty trained in Education;

    ** institutionalize a long-term data management component at the FS by providing support for a full-time position for data management and systems analysis; in the short term this will be one position, but in the long term requires separate positions for each function [the ideal is to find people with experience in science and data management];

    ** increase upper level administrative support for FS to allow development of FS programs and funding options;

    ** over time, hire a separate coordinator for the Center for Water and Wetland Resources complex;

* Recognizing the heightened visibility and national recognition that implementation of the VISION above will bring the FS, the following recommendations for facilities were made:

    ** development of a 20-year site plan for the UM Field Station;

    ** construction of teaching pavilions for field-oriented activities that could be located near ponds and in at least one terrestrial teaching setting;

    ** identification of a permanent location for a library and reference collection within the Phase 2 construction plans.

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I. Background

Particularly over the last decade, scientists from a variety of disciplines throughout the USA have collaborated on projects to better understand the interactive effects of human impacts on different environments. For a number of years, The University of Mississippi Biological Field Station (UMBFS) has been a research site for the study of toxicology and human impacts on aquatic organisms and ecosystems (Cooper 1993; Parsons 1993; Johnston 1994; Suedel and Rodgers 1994a; Suedel and Rodgers 1994b; Deaver and Rodgers, Jr. 1996; Johnston and Haag 1996; Mikell, Smith, and Richardson 1996; Rodgers, *et al.* 1996; Smiley and Parsons, 1997). This Field Station has been a site where scientists from the University and other institutions representing many disciplines, including biology, geology, engineering, toxicology, and pharmacology, can participate in interdisciplinary basic ecology research, as well as applied research that will affect human health, the environment, and agriculture.

The University of Mississippi is establishing the Center for Water and Wetland Resources (CWWR) to be based at UMBFS. Facilities are being constructed using Federal support from the Buildings and Facilities Program administered by the US Department of Agriculture (USDA) Cooperative State Research, Education, and Extension Service, and matched with State of Mississippi funds. This project is to be at least $6.5 million with initial funds being provided on a 1:1 federal to state match. The CWWR will support development of a research and academic infrastructure to assist American agriculture in achieving long-term viability by addressing the impacts of agricultural practices and chemicals on the environment and human health.

UMBFS is located in northern Mississippi approximately 18 kilometers northeast of the Oxford campus. Acquired by The University of Mississippi in 1985, UMBFS includes an area of approximately 296 hectares, and encompasses pine and mixed hardwood forest, bottomland forest, open fields, springs, ponds, and wetlands, including eight constructed wetlands. Over 200 experimental ponds and mesocosms (Plates 1, 2, 3, and 4) offer unique opportunities for experimental research on aquatic ecosystems (Knight 1996).

Since January 1995, UMBFS' mission has been broadened to provide enhanced opportunities for both research and education in aquatic and environmental sciences. In April of 1996, The University of Mississippi Biological Field Station submitted a proposal to the National Science Foundation (NSF), "Planning Activities: Development of the University of Mississippi Biological Field Station." This request was funded in September of 1996. The majority of the funds received from the 1996 NSF Field Station and Marine Lab (FSML) competition were employed to sponsor a workshop at The University of Mississippi to: (1) review and clarify the mission of UMBFS; (2) discuss the organization, physical design, and equipping of UMBFS; and (3) examine the role of UMBFS within the larger developing network of Field Stations and Marine Laboratories. The remaining funds were used to allow Field Station staff to travel and investigate the operation, organization, and structure of several North American Field Stations noted for their sound balance of research and training activities. Based on the information gathered by Field Station staff during trips to other Field Stations along with advice from participants in the workshop, the mission and strategic objectives of UMBFS are being clarified.

II. Planning Workshop Overview

A. Introduction

The Planning Workshop was held in Oxford, MS on 19-21 February 1997. Scientists with backgrounds and experience in at least one of the following areas attended: research at a FSML, management of a FSML, information management, maintenance of long-term ecological datasets, undergraduate and graduate training at FSMLs, K-12 environmental education programs, or informal educational and public outreach programs (see Appendix A).

During the first morning, participants heard presentations from Susan Lohr on the purpose of the NSF FSML competition, Marjorie Holland on current UMBFS operations, Kevin Pigott on the creation of a Geographic Information System (GIS) for the Field Station (Plate 1) and initiation of a long term monitoring plan for the Field Station (Plate 2), and from Robert Baca on an EPA-funded EPSCoR mesocosm research project (Threlkeld 1997).

Susan Lohr's Presentation

Susan Lohr started the workshop off with a brief overview of the purpose of the Field Stations and Marine Laboratories competition. This National Science Foundation program provides limited financial support to qualifying facilities for institutional planning. These grants focus on the Field Station as a whole facility seeking support for comprehensive plans in developing research and training missions, facility needs appraisals, and research and training programs. Successful grants for this type of program seek workshops, conferences, and visits to involve participation from individuals throughout the scientific and educational community.

Marjorie Holland's Presentation

Marjorie Holland began by reviewing the Mission and Goals adopted for the UMBFS (Appendix F) and continued by describing how the Field Station User Committee has adopted four designated use categories for the Field Station (Plate 1). These are Biological and Geological Use, Educational Use, Toxicological Use, and Intense Use. The Intense Use Area, including Program, Laboratory, and Maintenance Use, has been set aside as an area where heavy pedestrian traffic will occur and is where the future Center for Water and Wetlands Resources and other buildings will be constructed. The Toxicological Use area includes areas where toxicological research specifically has been conducted in the past and can continue to be undertaken in the future. The Educational Use area is an area where various educational activities, tours, etc. can take place with a minimum of UMBFS staff involvement [e.g. away from open water] and where an extensive interpretive nature trail is envisioned. This is an area set aside so that general educational activities can occur without disturbing sensitive investigator-initiated research at the Field Station. The last area, Biological and Geological Use is where the bulk of the research is conducted at the Field Station.

Holland then went on to describe the current staffing and volunteer Committee structure for the Field Station (Figure 1), and concluded her talk by informing workshop participants that the UMBFS

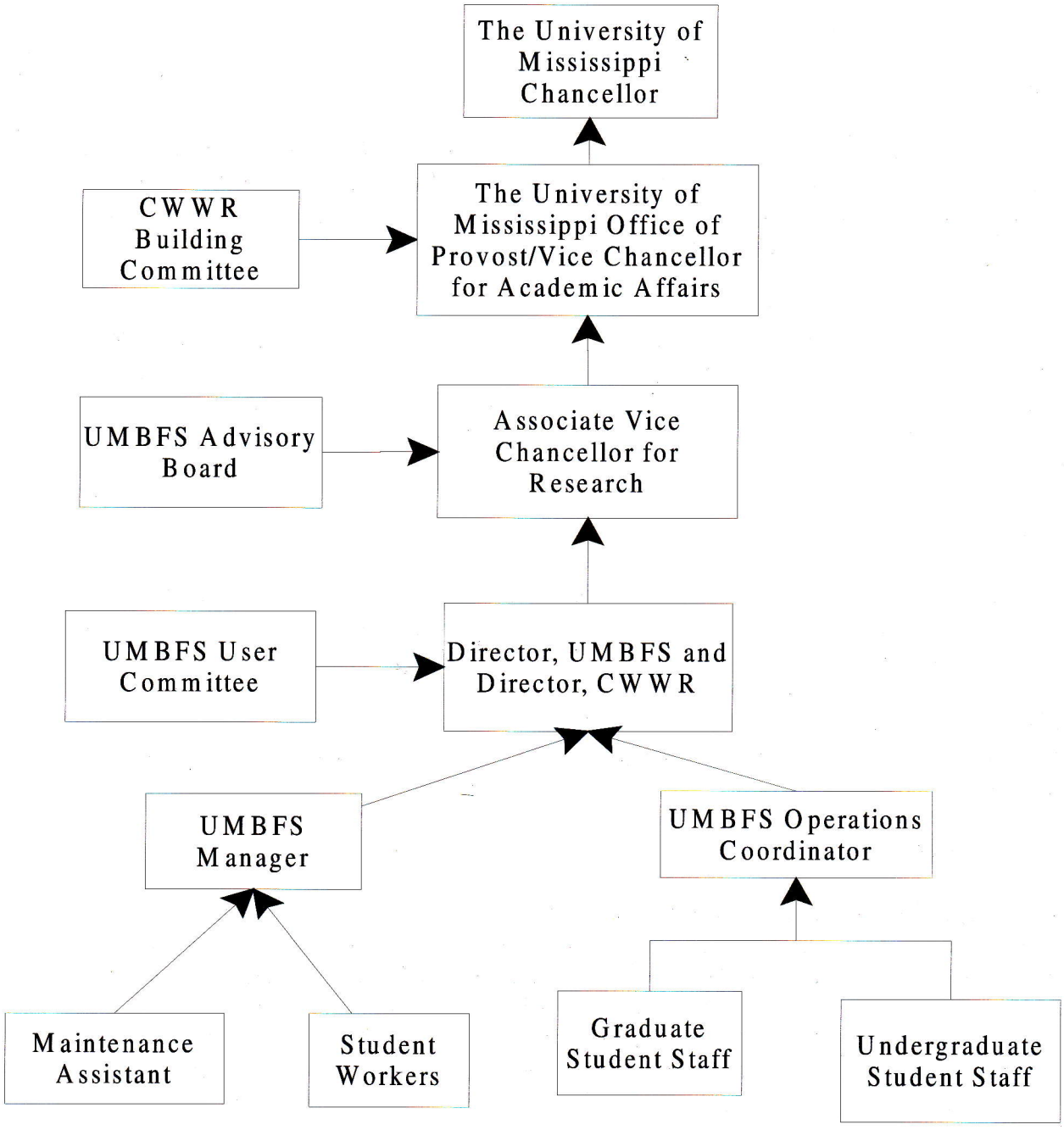

Figure 1. Current Organizational Flowchart - UMBFS (February 1997)

Advisory Board (see Appendix E) would be meeting that Friday and Saturday, with the Friday portion of their meeting spent listening to the recommendations presented by the workshop participants.

Kevin Pigott's Presentation

During Spring 1996, Kevin Pigott, in conjunction with The University of Mississippi faculty members Dr. Greg Easson and Dr. Marjorie Holland, created a Geographic Information System (GIS) for The University of Mississippi Biological Field Station and created an accurate map for the Field Station. Aerial imagery from 1957, 1977, 1989, and 1996 (Plates 7, 8, 9, and 10) was used to create various data layers within the GIS allowing for the display of the various streams, ponds, roads, existing and proposed facilities, land use, and designated use areas within the Field Station (Pigott 1996). This GIS can be updated with new data as they are collected, as demonstrated by the following Plant Ecology class project.

During Fall 1997, a graduate level course in Plant Ecology, taught by Dr. Holland, instituted a long term vegetation monitoring plan for the Field Station. A 100m x 100m coordinate system was devised to identify any location on the Field Station property. The class established and sampled 20 randomly chosen long term monitoring points (LTMP) within the Field Station property (Pigott and Holland 1996). Quadrats (1m x 1m) were used to sample the understory vegetation (1.52 m in height or less). It was determined that the introduced species *Lonicera japonica* (Japanese Honeysuckle) dominates the understory. Seedlings of *Quercus alba* (White Oak), *Acer rubrum* (Red Maple), and *Quercus falcata* (Southern Red Oak), along with *Smilax tamnifolia* (Bristly Green Briar), and *Uniola sessiflora* (Spikegrass) follow in frequency of occurrence (Davis and Holland 1996; Mastin and Holland 1996). The next time the Plant Ecology course is taught (Fall 1998), it is envisioned the 20 LTMP established will be sampled again, but that more points will be added in the future to better provide coverage of the Field Station. As this future information is collected, these data will be added to the GIS as a more detailed layer. Two important aspects of these two projects are: (1) a database has been started to track biodiversity at the Field Station, and (2) the Field Station staff now have the ability to pinpoint research activities throughout the Field Station, whether they occur in ponds, springs, or terrestrial locations.

Robert Baca's Presentation

The EPA-funded EPSCOR project is a collaborative effort between The University of Mississippi, The University of Southern Mississippi Gulf Coast Research Laboratory, Jackson State University, and Mississippi State University. This project examines the fate and effects of three commonly used agrichemicals [atrazine, chlorpyrifos and MSMA (monosodium acid methane arsonate)] and methyl mercury in wetlands likely to receive runoff from agricultural fields.

Conducted in 66 mesocosm-scaled aquatic environments, the investigators examined wetland responses from mutagenicity, organism defensive responses, organism growth, and development and survivorship to ecosystem production and respiration. The EPSCoR project has provided training opportunities for several undergraduate and graduate students enrolled in the project through the participating institutions. It is anticipated that the current project will be expanded eventually into larger scale investigations (Threlkeld 1997).

Charge to subgroups

Following the presentations, participants toured UMBFS to view the 200 + ponds and mesocosms along with the construction site for the CWWR complex (Plates 1, 2, 3, and 4). Later, participants were split into four working groups, and were asked to address the following pieces of a Long-term Plan:

> i) an integrated framework for research and training that relates to the six research priorities [fundamentals of basic biology and ecology, assessing environmental change, maintaining biodiversity, sustainable ecological systems, predictive management, restoration and rehabilitation] identified for FSMLs (Lohr, *et al.* 1995);
> ii) a review of data management and communication needs;
> iii) an identification of research and monitoring equipment needs;
> iv) an examination of roles for visiting scientists and students;
> v) a review of existing UMBFS "rules," fees, and procedures for facility use, including responsibilities of users;
> vi) an identification of educational goals that not only meet the needs of local and regional school districts, the University, and the local community, but also effectively translate the findings from work on the six priorities identified in (i) above.

Participants worked in one of the following groups: Research/Monitoring; Data Management/Communications; Education; or Funding/ Facilities where they discussed issues related to the development of a twenty-year plan for UMBFS. In thinking about long term needs, each group was asked to consider issues relating to three time frames (one-two years, three-five years, and five-twenty years). This report summarizes the many thoughtful suggestions offered during those group discussions.

B. Report from the Research and Monitoring Subgroup

Participants = T. Benning, Facilitator; E. Blood; G. Gaston; C. Lutken; J. Weis; R. Woolsey

The following Basic Principles were adopted for UMBFS Research and Monitoring:

* Recommend development of an institutional program with permanent staff to support long-term monitoring efforts.

* Recommend maintaining the UMBFS as the overall umbrella entity under which the CWWR (and possibly other centers) develop.

* In formulating the research master plan, considerations should be given to the allocation of research opportunities to various research groups (students, faculty, affiliates, visiting investigators from research and teaching institutions) with specific attention to having an 'open door' policy versus an active recruiting approach. These decisions have implications to the rate at which the institution will reach national prominence. As the institution develops, priorities will need to be developed to address conflicts in use and compliance with state and federal standards.

* The group recommended a systematic solicitation of outside users such that the increased needs of the research groups are adequately accommodated. (As an example, in the initial stages of institutional development, the participation of the Mississippi Research Consortium (MRC) is recommended).

* Recommend keeping a strong link between research, training, and education. The group anticipates a strong link between undergraduate and graduate education by providing research opportunities (such as Research Experience for Undergraduates [REU] programs) courses with research components, and internships. Science education programs should require a field research component. The field station should focus recruiting efforts immediately on the local population of graduate and undergraduate students. The University should establish internships and graduate assistantships allocated to the field station.

* Encourage the UM Office of Research to put on an informational workshop about the UM Field Station to let various departments and programs on the Oxford campus know about the Field Station.

* Encourage departments with field components to incorporate field based experiences in their curricula utilizing the field station as appropriate.

* A long-term goal could be the development of an intense field program [similar to Organization of Tropical Studies course in Costa Rica] in the appropriate departments (e.g. biology, geology, science education, pharmacy, etc.).

* Formulate a management scheme that creates and maintains a diversity of educational and research opportunities. The group recommends a flexible allocation of space for research and educational use. There is a need to develop a management plan for the site which includes representative manipulations in the different habitat types. If logging/fire/haying etc. are important management tools in the

terrestrial habitats that exist, then establish areas where these activities occur on a regular (known) interval. A site management plan should be established with goals in mind for the development of the terrestrial habitat. Interest was expressed in keeping certain areas mowed for bird habitat. The station should continue to mow at regular frequencies so other researchers interested in working in those areas have a record of the management history. As an example, Konza Prairie is a tallgrass prairie research site which is managed at the watershed level to study the effects of fire and grazing on all aspects of ecosystem function. Fire and grazing are the two most important management tools in that part of the Great Plains (and for that ecosystem in general).

What type of management is necessary to sustain the terrestrial habitat types that exist at the station? If this isn't known, it would be interesting to find out. In addition, there are certain types of management which are imposed on the landscape such as logging. Why not have areas which mimic some of the management practices occurring in the region and study their effects? It makes the terrestrial habitat immediately more attractive to researchers to have regularly scheduled large scale manipulations taking place. Demonstrations of various land management approaches [e.g. logging or mowing] should be established. Many Field Stations have demonstration plots or areas where they are carrying on long-term manipulations in small plots to study different aspects of ecosystem function. Wetland succession plots seem like a logical choice for the field station. Once established, they wouldn't take much maintenance and they would provide an additional source of long-term data.

* The group recommends commencement of a comprehensive monitoring program to quantify changes in critical hydrological, ecological, and climatological factors. The group also recommended the development of long term measurements in the following areas:

A. Water:
   a. surface water quality and quantity
   b. spring flow quantity and quality
   c. ground water quantity, quality and elevation

B. Ecological variables including aquatic (surface and ground water), terrestrial, native and exotic species,
   a. plants and algae- identification, biomass, productivity
   b. animals - identification, biomass, and productivity
   c. microbial processes
   d. nutrient cycling
   e. organic matter

C. Climate:
   a. Precipitation - type and amount
   b. wind speed and direction
   c. temperature
   d. solar radiation
   e. barometric pressure
   f. humidity

The group recommended establishing a National Weather Service monitoring program at the field station. The group anticipates the need to establish a rain gauge network at the station.

** The group endorsed research priorities as stated in the Lohr, *et al.* (1995) report as a framework for the development of research at the field station. The group also encourages participation in broader regional and national efforts. To accomplish this, the Field Station needs to incorporate a terrestrial and ground water component for research efforts.

** The field station should develop databases to assess the state of the following components:

a. vegetation
b. soils
c. geology
d. climate
e. surface and subsurface hydrology
f. biological populations
g. past disturbance regimes
h. biological and chemical legacies
i. aquatic systems (water, sediments, hyporheic zone)

* Provide and foster a breadth of research opportunities including individual investigator, collaborative, partnering with other organizations and integrated efforts. Specific efforts should address the human dimensions of sustainable ecological systems.

Long term Agenda

Year One

* Establish long-term climate monitoring.
* Establish long-term water (groundwater, surface water) monitoring to include:

a. spatial/synoptic measurements on a lower time frequency and spatially limited, frequently sampled routine measurements
b. cations/anions, carbon, nitrogen, phosphorus, contaminants, coliforms. Document establishment of long-term vegetation plots and expand current vegetation plots to complete spatial design.

* For biological and ecological components, synthesize historic data and site use to formulate more complete plan for future sampling.

* Host annual meeting and social for past and present researchers, students and staff of the field station to present research and capture oral history.

* Continue development of field station bibliography and continue to develop field station library.

Year Two

* Identify gaps in knowledge of field station ecosystems.
* Use these gaps to identify short-term descriptive studies.
* Initiate ecological long-term studies and database.
* Develop regular education and research activities.

Year Five
* Long-term research and long-term measurements program should be established.
* Research infrastructure needs to be evaluated to determine current and future needs.
* Development of Internet research 'site' (e.g. expansion of web page, routine data available on a restricted basis via Internet).
* Initiate field station network 'node'.
* Have a expanded, functional GIS.
* Initiate ecological/ecosystem modeling.

Year Ten
* Develop endowed research positions.
* Initiate every other year conference series.

Year Twenty
* Publish long-term research as an integrated synthesis volume.

C. Report From the Subgroup on Education

Participants = K. Hollweg, Facilitator; G. Inmon; M. Krasny; B. Papasan; C. Weeks; L. White

1) The following Basic Principles were adopted for UMBFS Education Programs:

* Whenever possible, programs will draw on the field station's ongoing research and research findings.

* Whenever possible the nature of science/process of doing science will be highlighted in education programs.

* On-going research and research findings will be made available to the general public with attention to application for people's everyday lives.

* Whenever possible, The Station will play a pro-active role in recruiting students and teachers from populations that are currently under-represented in field biology and ecological science.

* A comprehensive model program for K-12 will be designed to meet state and national educational standards, and to involve the broadest constituency within the region, addressing needs and providing appropriate learning opportunities to each group. Results will be evaluated to inform program design and document outcomes.

* The comprehensive education program should develop an understanding of basic ecological concepts and the ability to apply those concepts (Lohr, *et al.* 1995).

* Different audiences will be working, mentoring, role-modeling and collaborating with each other on many different levels. (e.g. graduate students working with the public high school students; researchers working with the teachers; high school teachers involved as summer researchers)

* Educational programs will benefit researchers by providing:

(a) opportunities to develop research programs such as
i) a significant contribution to their research program via undergraduates
ii) free field assistance (as teachers or high-quality high school students work on research projects)

(b) opportunities for personal fulfillment such as
iii) opportunities for them to act on their beliefs that high ability high school students should be encouraged to pursue science
iv) their graduate students with opportunities to mentor younger students
v) their graduate students with experiences making presentations to various groups
vi) opportunities for building public support for their research
vii) opportunities to see their research applied to solving real world problems (e.g. by explaining research on pesticides to farmers)
viii) funding or the status that comes with educational grants

2) Criteria For Selecting Projects/Programs Worth Pursuing:

* Ties to the research and draws on unique resources of UMBFS

* Funding Available

* Potential for people directly involved in the project/program to involve numerous other people (e.g. teachers participating in in-service programs will involve their students and/or other teachers in their school. Undergraduate professors participating in projects to improve undergraduate courses will involve their students who may then work with high school or elementary students).

* Project/Programs attract leaders who will support the education program and be instrumental in involving additional constituencies.

* Is high profile and is an attractive opportunity for media to feature the field station.

* Highlights and gives opportunities for current and past participants/users of the field station to be further involved (e.g. graduate students tell about their research at a Science Day or at a Kiwanis Club Meeting).

* Involves new constituent groups with members of the university (e.g. conservation organizations, government agencies, high school students).

3) General Recommendations focused on undergraduate research experience, overall education program, a teacher professional development program, and involvement of several university departments:

There are two efforts that could commence right away for program-building and opportunistic reasons--an undergraduate research program because of how it could build support for the field station among faculty in the biology and other departments on campus, and a teacher professional development program because of the opportunity to work with the North Mississippi Education Consortium.

a) Undergraduate Research Program:

There is a unique opportunity to jump start an undergraduate research program because of the new biology undergraduate research course (BISC 491). How can the Field Station help Biology faculty meet this requirement and enhance the research experience for undergraduates? There are ways the field station might help faculty who need to teach and do research--e.g., if a Research Experience for Undergraduates (NSF-funded REU program) was in place, a graduate student could be hired who might provide some "field" mentoring for students on a daily basis during the summer--serve as the first line of contact and answer many questions of the undergraduate students. Then the undergraduate students would only go to the professors with questions that the graduate student couldn't handle, thus saving the professor's time. It could also provide support and valuable mentoring experience for the graduate students. The REU could also offer seminars for a group of undergraduate students at one time on developing research proposals, writing scientific papers, giving presentations, etc. Then the fall after the

REU the students could sign up for BISC 491 and write up their research paper. There may be other ways that the Field Station could help with professors who are teaching BISC 491. For the students doing an undergraduate research experience, the Field Station provides sites but also if you have an interdisciplinary group of student and faculty researchers, there are opportunities for group research and social activities that the Field Station could provide. The group also addressed the issue of how the Field station can serve to promote interdisciplinary research. Since this is part of the mission of the Field Station (Appendix F.), it seemed that because the field station already has research from many disciplines taking place, it is uniquely positioned to help promote interdisciplinary work. It could for example, require students conducting research at the Field Station to present their research proposal to the interdisciplinary group of researchers that conduct work at the Field Station (participating in such seminars would be a requirement of doing research there) or to the advisory board, the User Committee, or possibly to a group that includes both academics, natural resources managers, and users of the resources.

b) Teacher Professional Development:

There are incredible opportunities now with the new National Standards and Mississippi Science Framework, which apparently parallels the National Standards in calling for inquiry-based science, and for environmental education with a science emphasis, such as can be offered through universities and university field stations. A Teacher Professional Development Program in Collaboration with the North MS Education Consortium (which includes 37 school systems within a two hour radius of the Field Station) is needed. Plan the program in conjunction with leaders (both teacher leaders and administrators) to insure that the course and school-year follow-up sessions are designed to:

** meet National educational standards and state frameworks (e.g. National Research Council, National Science Education Standards (1996), North American Association of Environmental Educators' [NAAEE] Guidelines for Excellence in Environmental Education, MS State Framework)

** engage teachers in inquiry-learning

** introduce teachers to the field station's on-going research and educational resources

** assist teachers in applying what they have learned at their level to their own teaching assignments and in planning age appropriate learning experiences for their students

** support teachers throughout the school year as they implement their plans with their students

Give teachers university course credit and Continuing Education Units (CEU) for the course. Offer the course annually, inviting participants and their principals or science supervisors to return and remain involved in some aspect of the course (e.g. via a poster session to share their successes or course co-instructors or forming teams to support each other within their school system) and helping to teach the next summer.

Pursue funding with the consortium and School of Education to support course planning and delivery. Possible sources: State Eisenhower Funds, School System funds, tuition [see TERC website "http://www.terc.edu/"]

Additionally, university students (both graduate and undergraduates) could collaborate with participating teachers to assist them:

** in facilitating outdoor inquiry in schoolyards and at the field station

** in preparing new field experiences or classroom learning activities

** in teaching special lab sessions

c) Involvement of other University Departments:

It is critical that the Field Station integrate fully at every opportunity with undergraduate courses in appropriate departments. While it is important to think of the science departments (e.g., geology), it is also important to look at the education majors. There is concern that pre-service science teachers never have research experience, yet they will be teaching high school science. The lack of research experience is increasingly critical as science teaching becomes more inquiry based; national standards call for high school students to conduct an original research project before graduating high school. The NSF REU program has language in the Request for Proposals (RFP) urging some REU programs to address this critical need for pre-service science teachers (include pre-service science education students in the REU).

Much of what is suggested here could be done in or outside of the REU experience. The REU has the problem that during the research experience, students are paid so cannot receive credit, but they could get the BISC 491 credit the semester after their research and could write up a paper for publication at that time. The REU also offers the advantages of outside funding (visibility, status, and dollars for supplies and to hire a grad student coordinator). Other possibilities are internships and working with BISC 491 students without outside funding.

Marketing and Journalism are other examples of Departments that might have students looking for projects to work off their requirements. Both of these schools should be made aware that tremendous opportunities exist for meeting those requirements at the UMBFS. Examples could include:

(1) Marketing -- Students get real world experience developing brochures, video, news releases, etc. Ultimate goal = Increase public awareness concerning principles of biology and ecology.

(2) Journalism -- Students receive real world communications experience. Ultimate goal = UMBFS receives multimedia exposure and draws new partnerships, sponsors, research, and education opportunities.

d) Overall Education Program:

The Station can play a strong and pro-active role in minority recruitment into the natural and physical sciences. Minority recruitment could involve work with students at The University of Mississippi

[through the NSF-funded Mississippi Alliance for Minority Participation], collaboration with the United Negro College Fund (UNCF) and other Historically Black Colleges and Universities (HBCU) in the region, providing field courses for students and faculty enhancement opportunities for faculty from schools with large populations from under-represented groups, and joint projects with other minority recruitment programs. For example, the students in the Ecological Society of America (ESA)/UNCF SEEDS (Strategies for Ecology Education Development and Sustainability) program could really benefit from Station field courses or highly structured research opportunities that are close to their homes, in familiar environments, and tailored to their educational needs and abilities. Faculty enhancement efforts like the proposed FIRST (Faculty Institutes for Reforming Science Teaching Through Field Stations) project of OBFS/ESA, where field stations play a key role in supporting innovative instruction at the faculty member's own and regional institutions, present cutting-edge opportunities for UMBFS.

It is very important for the education program to be designed and marketed such that it enhances rather than detracts from the research program. This has the implication that more effort should be spent on research internships for high school students, teachers, and undergraduates and graduates, rather than natural history or school visit type programs. The group also emphasized the importance of building comprehensive educational programs rather than what will be viewed as a series of activities. Comprehensive programs would have outside funding (which has an added advantage that you can demonstrate that education can actually bring in major NSF, state, and other dollars, and if scientists are listed as PI's this has a further direct advantage for them--it is essential that the education program be viewed as a high status program with the potential to bring in major outside dollars, and not as a "service" activity for faculty or a series of "feel-good" activities for volunteers and faculty), should be long-term (e.g., a summer teacher research program with year-long follow-up rather than a series of field days), should include an evaluation component that is used to further refine programs. Once you get a few efforts underway, there should be many opportunities to link programs, e.g., one of the Cornell University Teacher Institutes involves undergrads in helping to develop some of the labs, and these undergrads present the labs in high school classrooms over the school year. This provides some really good experiences for the undergrads, and enhances the teachers' and students' experiences. The group also felt that there are going to be some short-term projects at the Field Station which are important for their high visibility, but whenever conducting them, be sure to think about how they can serve multiple functions. A research-based education program may also focus more on high school than elementary audiences, because of the nature of the content (including research process/nature of science) that will be included. When designing programs for a younger audience, again consider linking other audiences, e.g. involving undergrad education students, high school student researchers.

4) Long term Agenda:
Year One 1998
1. Education Coordinator hired [with strong ecological science background]
2. Convert the recommendations from the Planning Workshop Education Subcommittee into a specific strategic plan.
3. Networking and developing partnerships:
    ** Crow's Neck Environmental Education Center (CNEEC)
    ** The University of Mississippi School of Education
    ** The University of Mississippi faculty involved with biology research (BISC 491)
    ** Northern MS Education Consortium

4. One major program conceptualized and proposals submitted for funding. Examples:
   ** Teacher professional development program in collaboration with North MS Education Consortium.
   ** Teacher research opportunities with NSF
   ** REU
   ** Undergraduate faculty enhancement program in conjunction with Ecological Society of America.

Year Two 1999 - through 2004

1. Redesign an existing program or develop a new program that will build towards a comprehensive educational program and will provide a collection of highly visible learning opportunities's that reach each of the following audiences:
   General Public
   K-12 (teacher/students)
   Undergraduate
   Graduate

Particularly when designing short-term awareness level programs, the rationale should be not only the program itself, but also how it fits in with the comprehensive plan. An example of a short term event would be Science Day. You could expand Science Day in the following ways:
   ** Whenever possible activities will tie into research at the FS
   ** Invite more participants with whom you are interested in forming partnerships
   ** Conduct a survey / needs assessment to identify needs, interest and information for building a larger program.

2. Work with a variety of departments (e.g. marketing, journalism) to develop and implement a publications program resulting in two different types of publications:
   Technical
   Non Technical

Both types of publications would articulate the importance and application of biological research going on at the FS.

3. Hire a Science Educator.

4. The UMBFS will promote interdisciplinary research and scholarship among graduate students, undergraduate students and faculty and other audiences. One mechanism to realize this potential would be to require students and faculty conducting research at the station to give a seminar to an interdisciplinary group involved with the UMBFS (e.g. advisory Board, interdisciplinary group conducting research at the station). This group could include stakeholders outside academia (e.g. farmers, etc).

5. Develop mechanism for sustaining ongoing relationships with leaders of diverse constituency groups representing all economic levels of the community.

6. Produce Educational materials such as videos for use with general public, school children/young people.

Years Five 2002 - through 2010

1. Hire an Outreach Specialist [to include 4-H, extension, and publicity]

2. Major assessment of ongoing programs to identity strengths, weaknesses and areas most in need of redesign or development in next 3-5 years.

D. Report From the Data Management and Communication Subgroup

Participants = S. Stafford, Facilitator, R. Darden; G. Easson; C. O'Hara; R. Nottrott; K. Pigott; R. Prach; and M. Römkens

Vision

Given the following, UMBFS is:
* A node on the larger Organization of Biological Field Stations (OBFS) network
* Publicly funded therefore data is public information
* Ecologically sensitive area, requires careful monitoring and management of activities.

Therefore, the Station will:
* Be used for education needs, from K-12 through college teachers and students, with different needs
* Be used for a variety of research needs
* Have uses and needs for information management that will change over time

The vision for the data management and communication system at the UMBFS and CWWR provides a fully integrated information data management, data collection, and communication network to UMBFS users, the OBFS network, the general scientific community, researchers, educators, UM faculty, staff, students, and the general public.

Mission

In 20 years, the UMBFS will be a regionally, nationally, and internationally recognized Biological Field Station. The mission of the UMBFS in the area of Data Management and Communication is to provide a system that encompasses data collection, analysis, organization and long-term storage/archival of databases to facilitate access and dissemination to interested users in a timely manner. Datasets consist of physical, chemical, and biological information for research and educational purposes primarily at sites on the UMBFS.

Goals

To develop a versatile infrastructure for data transmission and communication, capable of accommodating diverse conditions at various locations at the UMBFS.

To devise a well-functioning, versatile, data management system that facilitates productivity and enhances research and educational activities and functions at different levels of operational needs.

To develop technical criteria for data acquisition/retrieval hardware systems adapted to the specific needs and situation at the UMBFS.

To continue to develop and maintain a web page for the UM Field Station.

System Functions

This group focused on three system functions: Administration, Research, and Education. Major components were identified and a list of Short Term (ST) tasks (1-2 year time horizon); Mid-term (MT) Tasks (3-5 years); and Long-Term (LT) Tasks (5-20 years) were described.

Initially, for all three system functions, it is essential to identify data needs and to acquire the necessary hardware, software, and personnel required to support these recommendations. Mid-term tasks include guaranteeing continued funding sources for long-term data acquisition and storage, developing online access to data derived from UMBFS research, and making UMBFS monitoring data accessible to the OBFS network. Long-term tasks involve: developing the full integration of UMBFS into the Long Term Ecological Research (LTER) and OBFS networks, creating a fully integrated comprehensive site map, and continuing the commitment to maintenance and upkeep of UMBFS records.

It is recognized all three system functions, although each has its own primary focus, are not mutually exclusive, but are integrated with each other.

Administrative Database Components

There are various administrative database components providing services and functions to UMBFS users and staff. Examples exist within the LTER network that could serve as prototypes (http://lternet.edu). These components are:

1) Personnel Database
2) Baseline Long-term monitoring data
3) Project Data Catalog
4) Project Data Archive
5) Bibliography
6) Logistical Support
7) Financial Affairs
8) Research Resource Allocation
9) Graphics and Multi-media support

Establishing and maintaining a personnel database for all personnel associated with UMBFS is required for the timely notification of current and potential researchers. As UMBFS transitions from paper to electronic forms, a Project Data catalog will be created allowing for the easy dissemination of UMBFS usage. This needs to be linked with the logistical and personnel components to alleviate scheduling and notification problems. Providing a bibliography of publications derived from UMBFS research, linking this bibliography to a master OBFS bibliography, and maintaining the UMBFS bibliography is an important service envisioned. Maintaining financial records and affairs as well as providing necessary logistical support (scheduling, tracking, notification) is essential to a smooth running operation. There should also be facilities available to researchers and UMBFS personnel for the creation and implementation of visual presentations from research undertaken at UMBFS.

UMBFS also has the responsibility to acquire and maintain baseline long-term monitoring data, integrating both historical and current data. These data should be made available to a wide audience, thus Internet connectivity is important. Not only should this Internet connectivity be made available to a wide audience, but individual researchers should also be able to access and monitor on-going research from remote locations. As a result of this network connectivity, on-line access to both data collected by UMBFS and by individual researchers will be achieved. Researchers at UMBFS should begin to use computer resources through UMBFS while the Field Station should begin designing methodologies to handle diverse data types and to negotiate data access and security issues with individual researchers. Having a data access policy from the beginning will be very important to establishing and insuring an ethic of data sharing and accessibility.

Research

The research function of the data management and communication arm of UMBFS is to provide access to: UMBFS personnel database; baseline, long-term monitoring data; the research related project catalog; and products deriving from the logistical component of the administrative function; UMBFS and OBFS bibliography; graphics and multi-media support. To further research, UMBFS should begin archiving project data for ongoing and past research conducted at UMBFS. By collecting this information, not only will UMBFS provide a necessary long-term data storage platform, but will also provide a central source for a variety of data.

Education

The education function of the data management and communication arm of UMBFS is to provide access to: baseline, long-term monitoring data; UMBFS and OBFS bibliography; UMBFS personnel database; graphics and multi-media support; project catalog (both educational and research related projects); and products deriving from the logistical component of the administrative function.

Staffing Recommendations

Using various guidelines (Gorentz 1992; Michener and Blood, 29 January 1997 memo [Appendix B]; Darden and Römkens, 12 February 1997 memo [Appendix C]), this group sees the UMBFS as currently facing Stage 2 staffing needs, *i.e.* requiring a full time individual for data management and system development. There is an opportunity for this position to be offered as part of the Institutional match for future Facility Funding ventures, *i.e.* NSF, etc. There should always be a strong, open line of communication between the UMBFS/CWWR Director and the Data Manager.

E. Report From the Facilities and Funding Subgroup

Participants = D. White, Facilitator, N. Aspinwall; M. Baker; R. Hastings; L. Knight; and K. Sukanek

PREFACE

Prior to subgroup discussions, the group heard presentations from several Station users, toured the facility including sites of Phase II and III construction, and were given a number of documents including building plans, a copy of the NSF planning grant, and a draft of the UMBFS Advisory Board Subcommittee on Funding and Facilities Outline of Strategic Plan. The outline formed a base for several discussions and is included as an appendix to the report (see Appendix D).

The University of Mississippi Biological Field Station reports to the Associate Vice Chancellor for Research (Office of Research). In order to more fully institutionalize the Station at the Vice Chancellor level of University infrastructure, the group recommend that the name of the facility be changed to "The University of Mississippi Field Station (UMFS)." Renaming should promote broader ownership of the Station to include other departments and colleges as well as the Department of Biology. It should be cautioned that realignment of the Station away from the Department of Biology may have a down side. Without continued strong participation from Biology faculty and graduate students, it will be very difficult to maintain a nationally visible research and university-level teaching program. Realignment also may mean that the station Director will have greater difficulty in being perceived as a member of the Biology faculty. The higher administration to whom she now reports should be sensitive to the potential problems and conflicts with respect to departmental teaching and research publication expectations. Director retention has been a problem at many university-associated field stations because of unrealistic expectations.

The following discussion of facilities and funding is predicated on the broader view of the Station's mission at the internal level of the Vice Chancellor. The mission can be thought of as a triangle containing research, education, and environmental management. Within the broader mission, a number of goals had been stated previously for UMBFS [see Appendix F.]. In the Fall of 1995, the User Committee articulated their desire for continued high quality research and training in the context of the social/political/economic fabric of which UMBFS is an integral part.

Therefore, it is expected that UMBFS will become a regionally and nationally important station for field research, teaching, and service (rather than have a solely local focus) over the next 20 years. Teaching, research, and service functions of UMBFS will be determined by the primary physical strengths of the facility and involvement of the faculty. At present the group viewed the dominant feature to be the aquatic resources associated with the 200+ artificial ponds. Terrestrial resources (700+ acres) and terrestrial-aquatic linkages should not be overlooked particularly as they may relate to single and multi-disciplinary research from the departments of chemistry, geology, hydrology, pharmacology, education, etc. These and other departments (e.g., Art, English) should be encouraged to increase their use of the Station for field-related research and educational activities. Multi-disciplinary efforts should be strongly encouraged. The Department of Biology should increase its commitment to and use of the Station and should continue to take a strong role in the development of both the Station and the Center (CWWR).

The higher administration should provide a system of incentives to encourage Station use (e.g., seed-money grants through the Faculty Research Program).

The Center for Water and Wetland Resources (CWWR) should not be allowed to supersede or overwhelm the mission and goals of the Field Station. As indicated below, the Center should have a full-time Coordinator who reports, at least in part, to the Station Director. Twenty years down the road, it is quite possible that CWWR will be only one of a number of centers under the organizing umbrella of UMBFS. The Kellogg Biological Station at Michigan State University, one of the largest and most famous of the inland field stations, provides such a model.

For the Station to succeed, the University higher administration must provide an ethos for the Station that includes the intellectual and financial support for development. Financial commitment must minimally include administrative salaries, utilities, and maintenance of the physical facilities (buildings and grounds). The University higher administration also must remove structural (procedural) barriers that inhibit development and must provide proactive support to promote UMBFS and CWWR success and development.

Based upon the assumptions above, the group is projecting the minimal staff and facilities that will be needed to accomplish the goal of becoming a regional/national/international field station resource over the 20 year development period. A potential 20-year plan is provided in Table 1.

Facilities

Recommendations below are based upon a 20 year plan. The Station Advisory Board needs to develop a 20 year Site Plan that incorporates the facilities suggested below, existing facilities, research agenda, and educational needs. The group recommends that the present "buildings" (on site as of February 1997) be removed once their functions can be moved to a new maintenance building (indicated in Phase III plans). The group further recommended that all new construction be restricted to a limited portion of the grounds in the zone currently designated for Intense Use to minimize needs for future infrastructure (water, sewage, electrical services, phone, computer links, etc.). The Site Plan should stress limited vehicle traffic outside the intense use area to minimize disturbance in experimental areas. New construction on the grounds should conform to a single, agreed upon style; e.g., several field stations have effectively used enameled metal roofs for durability and ease of maintenance.

Table 1. UMBFS Facilities - 20 Year Plan
CWWR Building Plan

Phase 1	current; land preparation; completed 5/97
Phase 2	Education/Visitors Building, completed May 98
Phase 3	Labs & Maintenance Building completed 1999/2000

NEEDS:	Year 1	Year 2	Year 5	Year 10	Year 20
Planning	20 year site plan Unifying theme Work out fire plan/natural disaster All completed Year 1				
Staffing	hire environmental educator (ASAP)	Education/Visitor Center completed Year 2			
Housing bath, primitive housing, family units	Housing Plan (grouped closely together)	Two 4-person units, bath house "State Park" style, toilets, laundry, shower, tankless heaters.	Kitchen/Dining Facility Two 4-person units Two family residences All completed Year 5	Two 4-person units Two family residences	Two 4-person units
Lab/Teaching Space 4-8 "15 person" units		3 available Year 2 - Phase 2 building Outdoor Pavilion/Phase 2	Outdoor Pavilion #2	1-5 additional "15 person"	
Library/Reference Area		Library/Reference Year 2, Phase 2 building			
Auditorium		Auditorium/Large Lecture Year 2, Phase 2 building			
Research Space Analytical Lab	Phase 2 building				
Individual Research Labs (10)			Research Building Research Space/ Offices/Labs		
Student Lounge		Years 2 - 5			

Housing - Without on-site housing for graduate students and visiting researchers, the Station will *remain only a local-use facility*. Housing also may be used for visiting university/college research/teaching field trips. It should be kept in mind that researchers and students visiting field stations do not expect or want "Holiday Inn" type accommodations. A rule of thumb should be simple and practical housing. By example:

Short-term housing: 2-person or 4-person units - Construction should be reasonably priced; kitchen and bathroom facilities are not projected for these units [but need to be built at the same time]. Costs per unit include electricity and air conditioning/heating. Schedule: 2nd year - housing for 8, 5th year - housing for 16, 10th year - housing for 24, 20th year - housing for 32.

Long-term housing ("family" units) for visiting researchers or teachers - Each house is an all-weather unit to include kitchen and bathroom/shower. A minimum of 4 such units (1 and 2-bedroom) should be constructed over the next 10 years. Units should be designed to house visiting scientists for a period of 1 to several months.

Bathhouse - A central bathhouse with laundry facilities should be constructed to serve the short-term housing units. Construction should begin by 2nd year.

Kitchen/Dining Facility - Seating capacity should be about 100. This number matches the lecture hall capacity given in the Phase II construction. The facility would be used for conferences and larger visiting groups where kitchen staff is provided, or for self-access by resident students and visiting scientists. Construction to begin by 3rd-5th year.

Student Lounge - Recreational facility for resident students to include TV/VCR, ping-pong table, etc. Construction to begin by 3rd-5th year. Most field stations have such a facility to act as a recreational outlet for resident and visiting students.

Educational Facilities - Teaching facilities may be divided into (1) K-12 and teacher training and (2) university level courses (including visiting university groups). Space for the first type of teaching activity appears adequate in the Phase II construction plans. Much of the university level educational programs also could use the Phase II facilities. The following features appear adequate within the Phase II and III construction plans: visitor center, administrative offices, seminar/lecture hall.

Field courses - The group recommended construction of some additional teaching pavilions for more field-oriented activities that could be located near the ponds and perhaps in a terrestrial teaching setting. The pavilions should be located near existing infrastructure (electricity, computer link, etc.) with some additional basic toilet facilities.

Library and reference collections (including teaching collections of animals and plants) - Now temporarily located in the conference room in Phase II plans. A permanent location for these facilities needs to be found within Phase II or III construction plans.

Research facilities - Research facilities appear adequate within the Phase III construction. Facilities include office space and individual laboratories.

Analytical Laboratory - The group recommended that consideration be given to a common analytical laboratory as well as consideration of the need for an animal care facility.

NADP Climate Monitoring Station - A National Atmospheric Deposition Program (NADP) climate monitoring station is needed. Climate monitoring should begin as soon as possible.

Miscellaneous facilities

Multipurpose building - A large storage multipurpose building (ca 40' x 100') will be needed to contain equipment and supplies not in use. Facility should contain locked bins where visiting scientists might leave research equipment. Construction as soon as possible. Possible funding as part of a federal match if used to store research equipment.

Infrastructure - Because of erosion and dust problems, all roads in the facilities complex (intense use area only) should be paved and sidewalks should be provided to link cabins and bathhouse. Vehicle traffic should be discouraged in other parts of the station.

Access - Requirements for the Americans with Disabilities Act (ADA) should be applied to a portion of the living facilities (moveable ramps are sufficient in most cases) and other new facilities.

Safety - Develop a fire/natural disaster/emergency plan. All permanent staff should have CPR/first aid training.

ADMINISTRATION

The Station must have the appropriate administrative structure that is responsive to the higher university administration and to the wide variety of Station users. A proposed administrative structure is given in Figure 2.

Director - Must have an academic tenure-track appointment in an appropriately related department. Teaching and research loads could be greatly reduced (perhaps 1 course per year) in first several years. It was suggested that the Director's position might become fulltime at some point in the future. Concern was expressed that without nearly full-time attention to the initial stages of Station development, progress will be significantly hindered. Thus, the group recommended that the University Administration increase upper-level administrative support for the Field Station to allow development of Field Station programs and funding options.

Each of the following positions in bold type would report directly to the Director and would have full-time University support. Positions indicated in italics would be based on soft money or cost recovery.

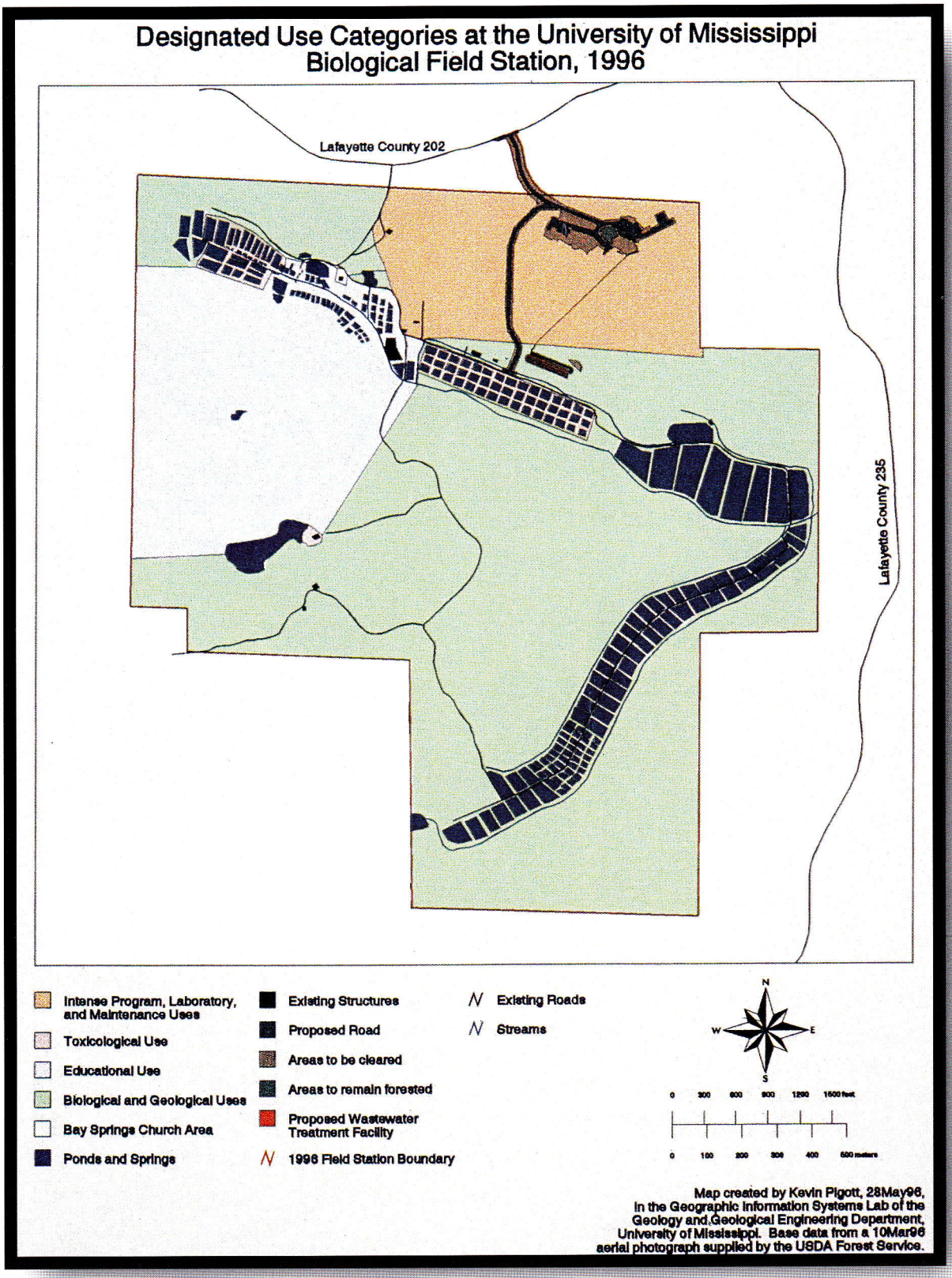

Plate.1 Designated Use Categories at the University of Mississippi Biological Field Station, 1996.

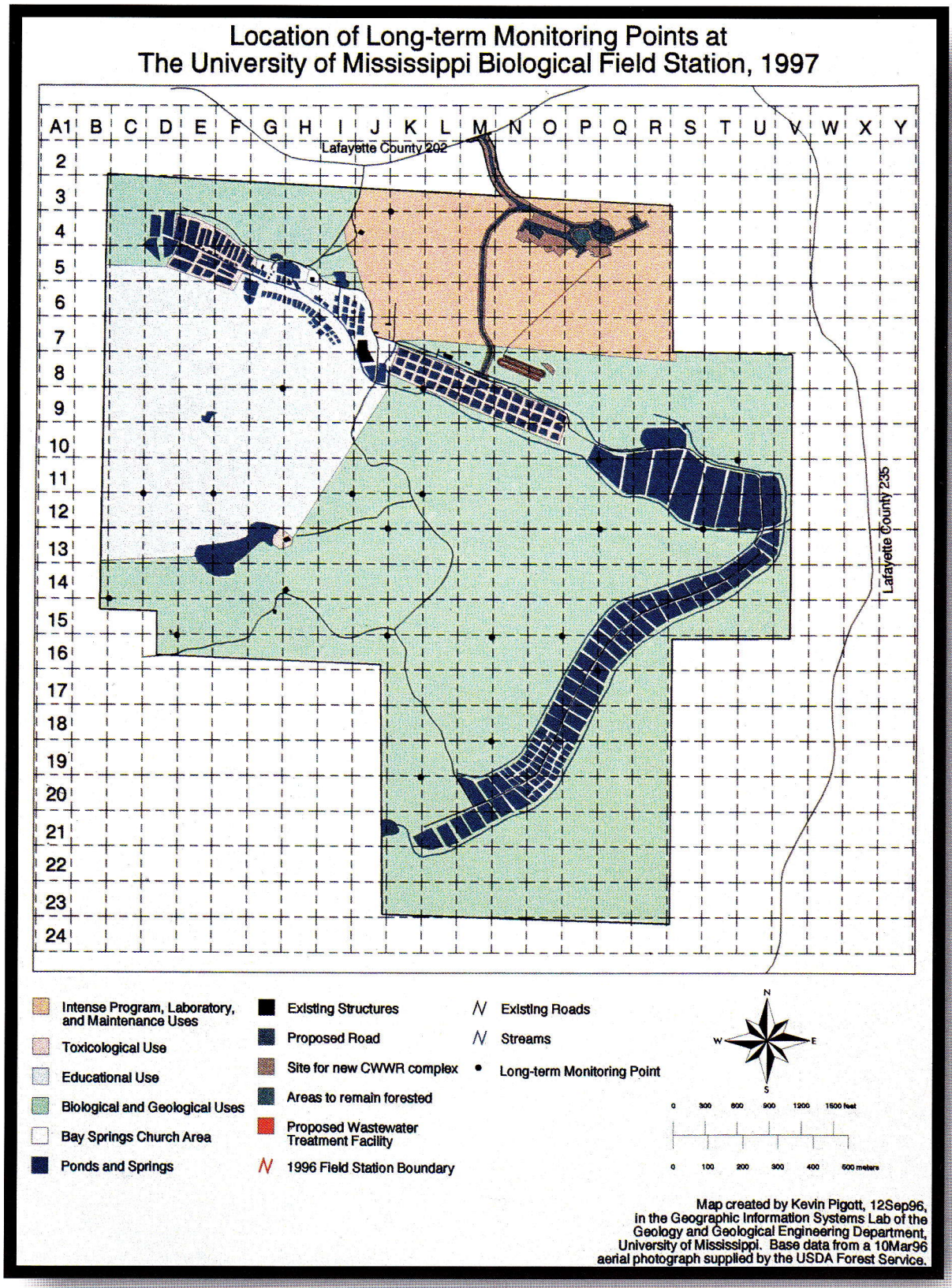

Plate 2. Grid for Terrestrial Research at The Unvieristy of Mississippi Biological Field Station, 1996

Plate 3. Aerial Photograph of Experimental Ponds and Mesocosms at UMBFS (looking south). Photograph taken by Kevin R. Pigott, 15 April 1997.

Plate 4. Aerial Photograph of Experimental Ponds and mesocosms at UMBFS (western portion). Photograph taken by Kevin R. Pigott, 15 April 1997.

Plate 5. Current Structures at UMBFS. Photograph taken by Marjorie M. Holland, October 1995.

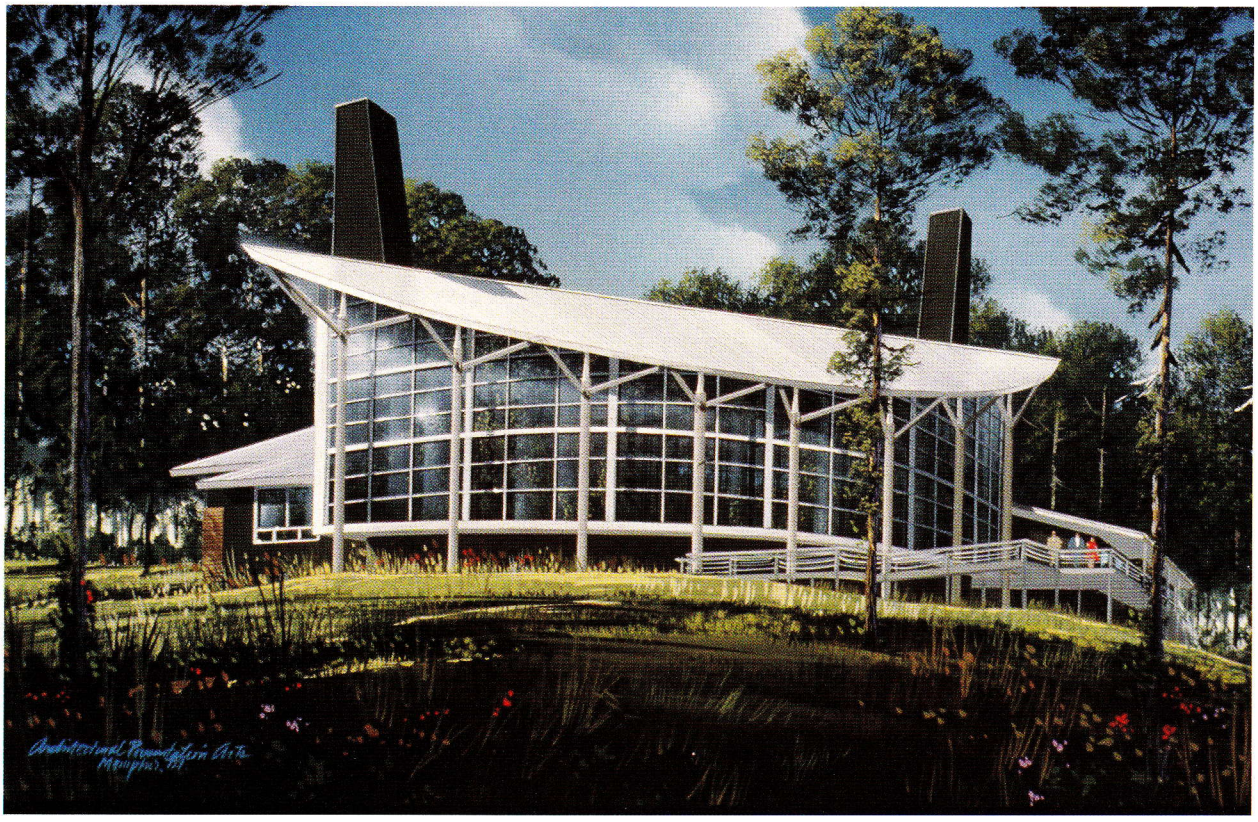

Plate 6. Proposed Center of Water and Wetland Resources - UMBFS. Photograph taken from artist's rendering of Foil/Wyatt Architect (Jackson, MS) Plans.

Plate 7. 1957 map of UMBFS.

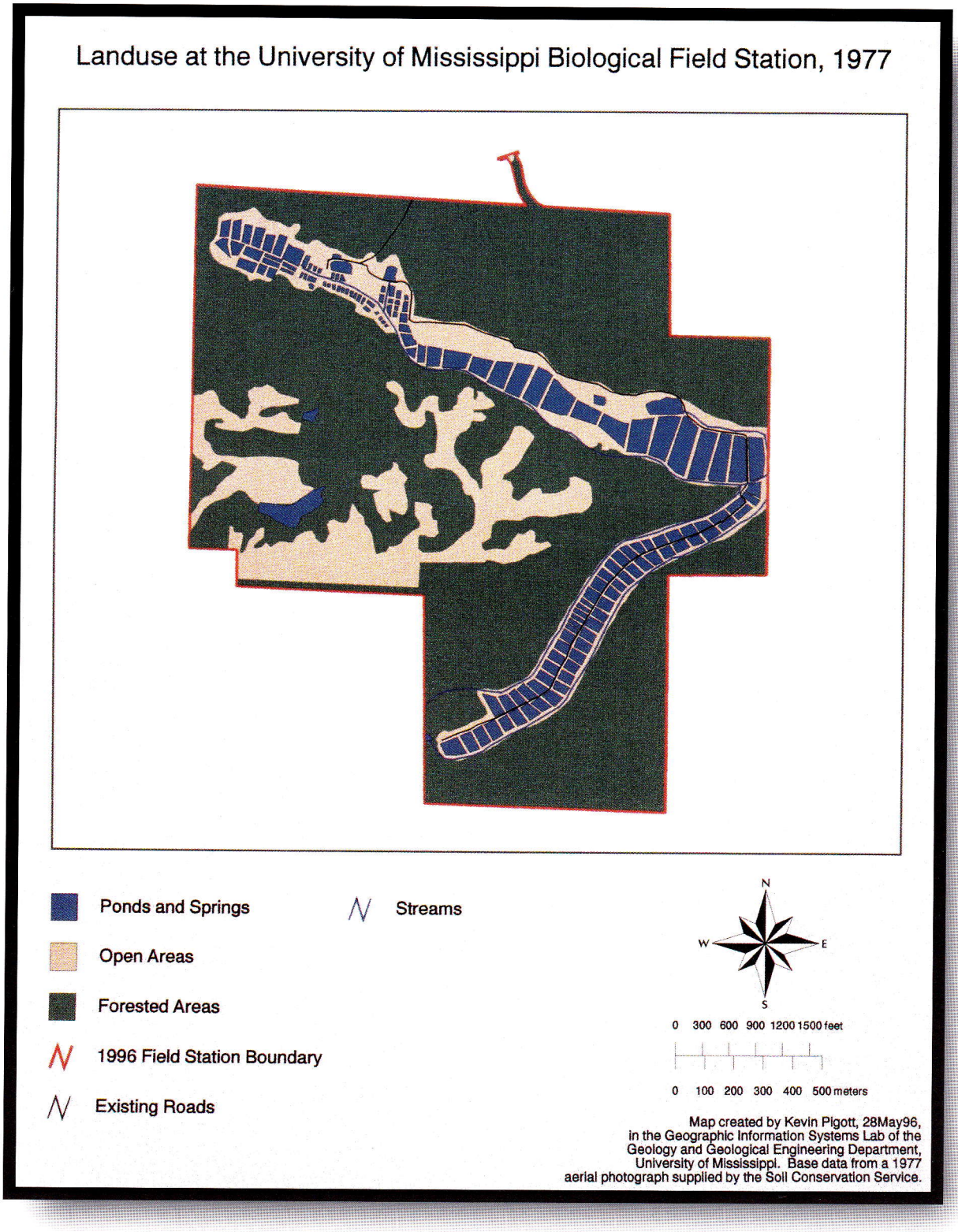

Plate 8. 1977 Map of UMBFS.

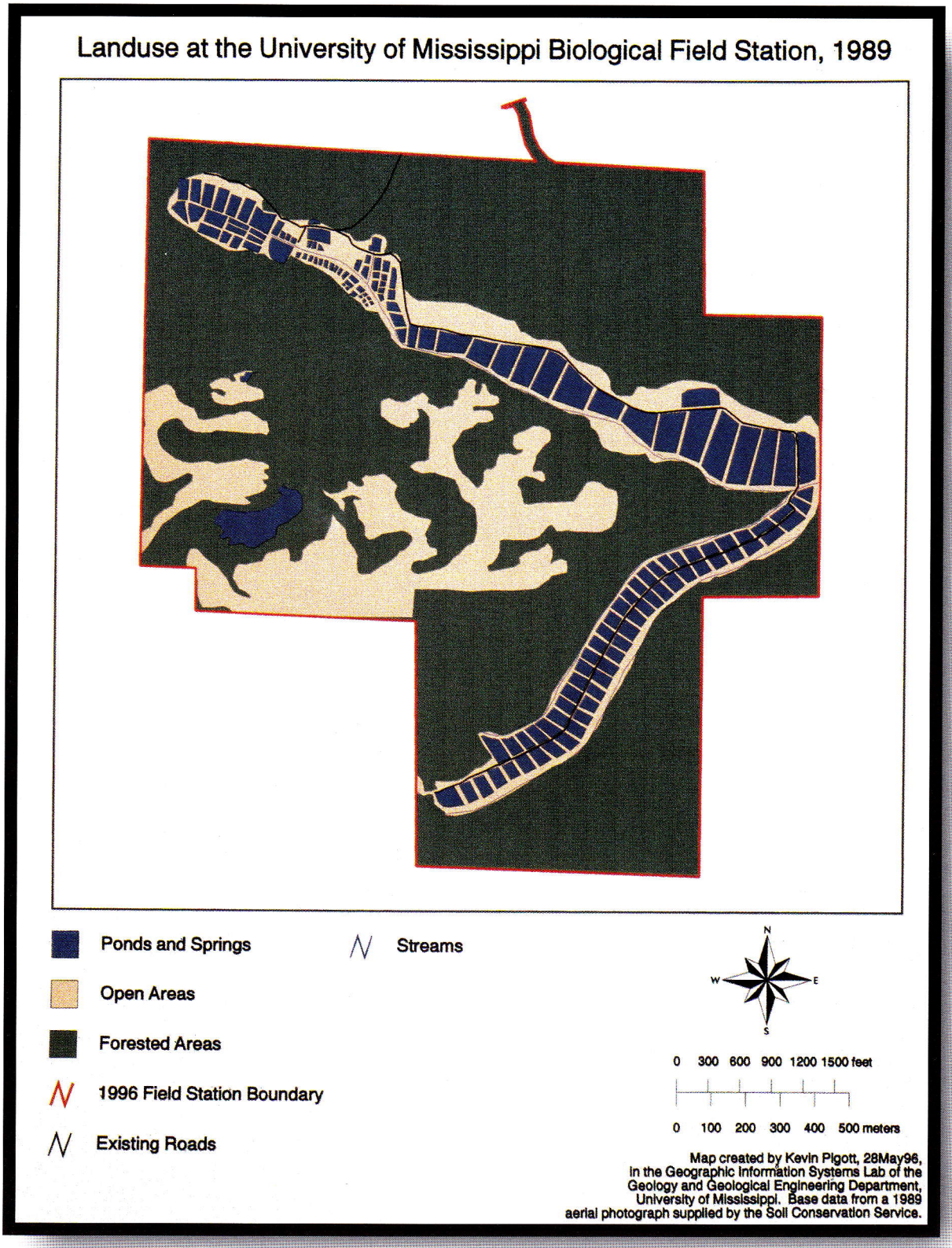

Plate 9. 1989 Map of UMBFS.

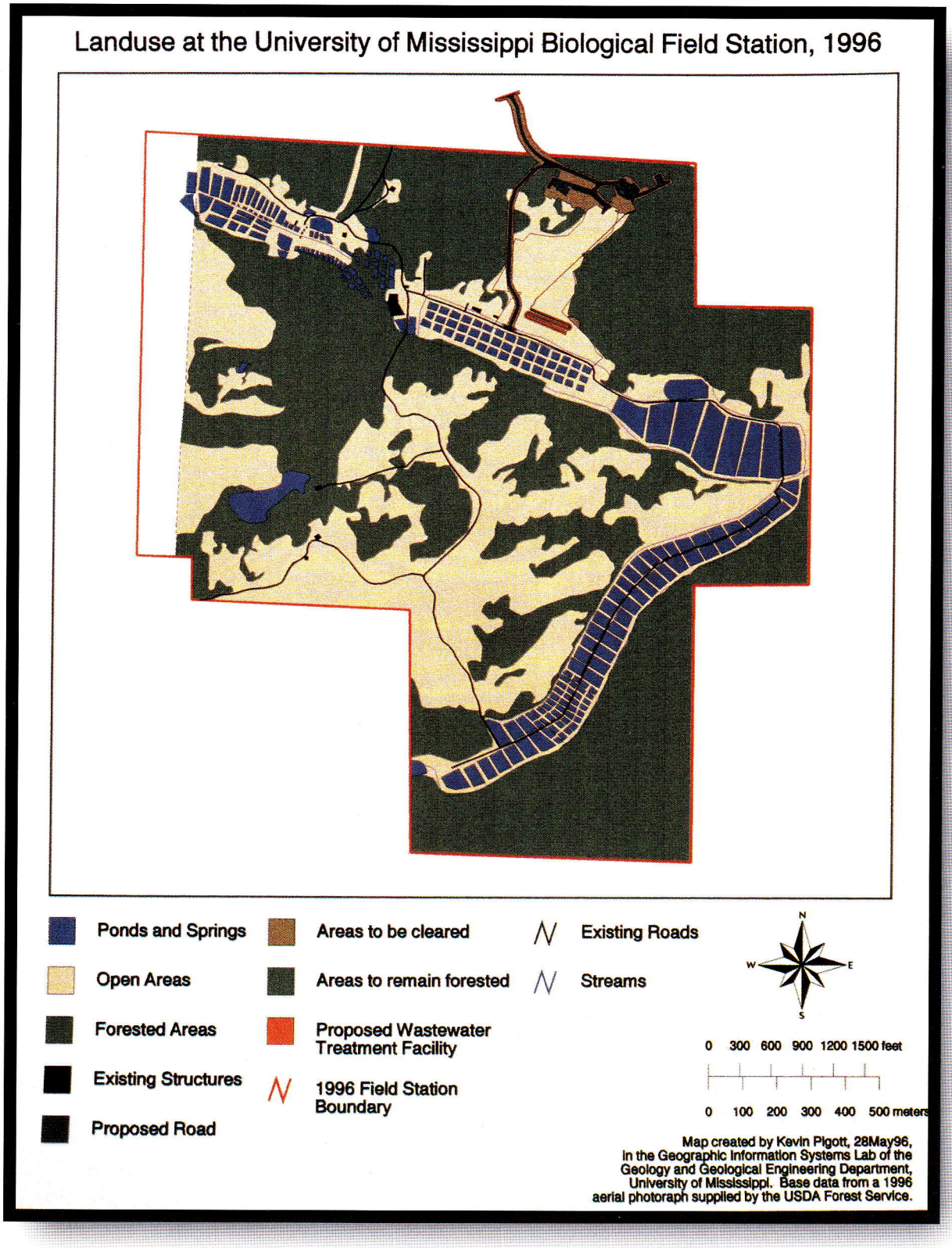

Plate 10. 1996 Map of UMBFS.

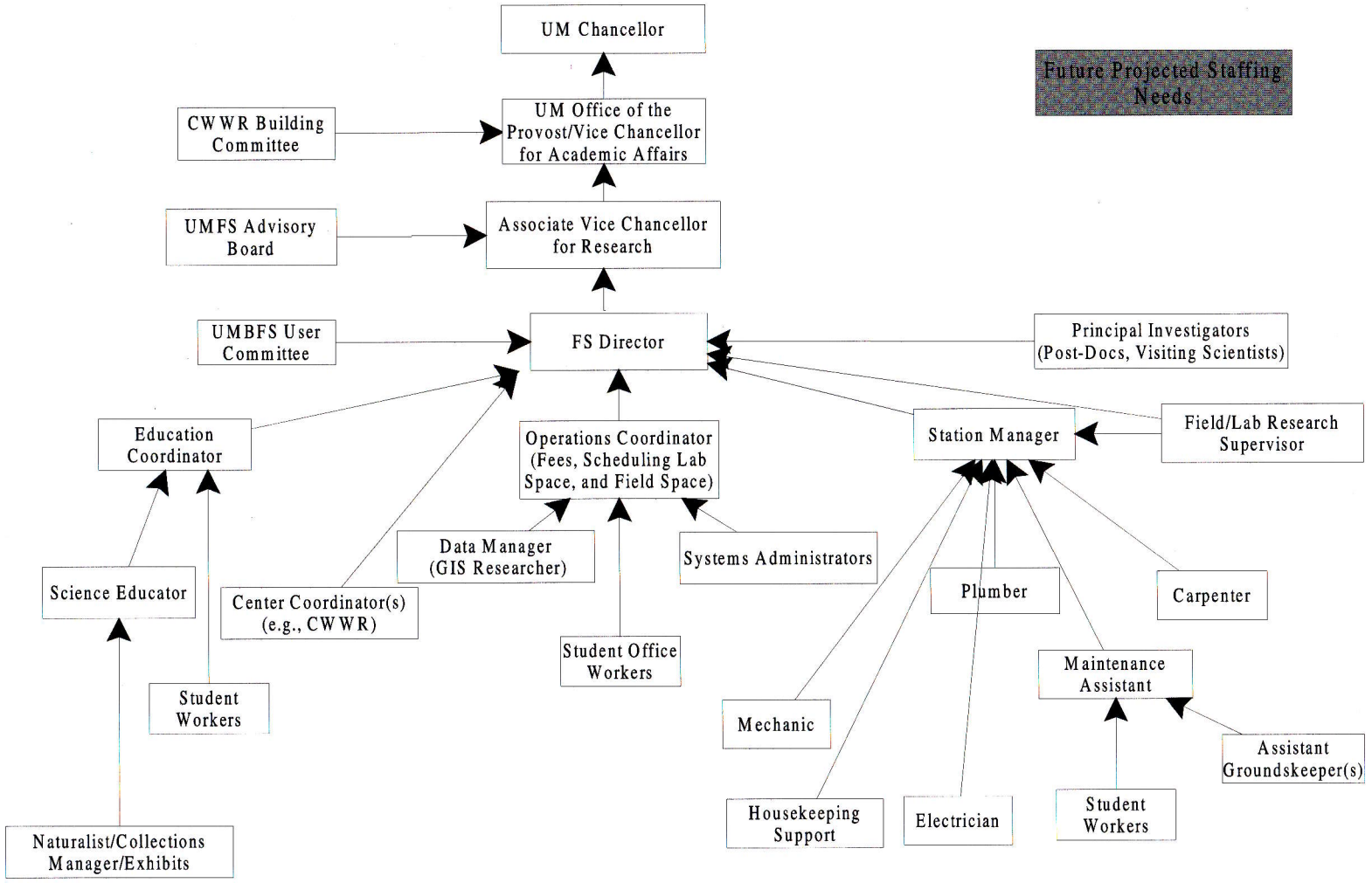

Figure 2. 20 Year Plan Administrative Flowchart - UMBFS

Operations Coordinator/Manager - Full-time appointment. (University funds)

Data Manager - Eventually full-time, may be soft money/hard money mix. It is possible that the Operations Manager might also serve as data manager in coordination with a Field/laboratory Supervisor at least until a data management strategy has been developed. It is yet to be determined at this time in the Station's development if a full-time data manager is warranted even as field stations begin to form a network of long-term data. With the exception of some LTER and very large field stations, the data manager also has other assigned duties.

Systems Administration - May be part time, may be soft money/hard money mix.

Education Coordinator (Ph.D. level) - Full-time with 0.5 appointment as faculty in School of Education. (University funds--most support for science education is best accessed through the School of Education)

Science Educator - Soft money or cost-recovery as needed

Outreach Educator - Soft-money or cost recovery as needed

Coordinator for CWWR (Ph.D. level) - Full-time with 0.5 appointment as faculty in appropriate department (e.g. Biology, Geology, or Pharmacology) (University funds)

Station Manager - Full time, university funds (positions here assume that the University's Physical Plant management will maintain the infrastructure and buildings at the Station.)

Maintenance Assistants *[Grounds Keepers, plumber, carpenter, electrician, mechanical, housekeeping support].* Maintenance Assistant should be full-time, university funds. Other positions will be funded as needed; may be paid with soft-money, hard money or cost-recovery as needed.

Field/laboratory supervisor or "Research Resource Specialist" (Master's level). Person will supervise laboratory and field research needs including the monitoring program. This is a senior technician (with scientific training and experience) who facilitates the use of the site by visiting groups and individuals. Should interface with the Operations Manager and Station Manager but report to the Director. Full-time. University and soft money support. For the time being, field monitoring equipment can be supervised by graduate student assistants.

FUNDING

The appended plan (see Appendix D) from the Advisory Board's Subcommittee on Funding and Facilities provides a very good outline for addressing fund raising, particularly for major facilities and infrastructure, and is not reiterated here. Instead, the group pointed out some additional issues. Research and teaching activities at the Station, where feasible, should be self-supporting and generate margin income to help defray Station operational costs. It should be noted that the cost of the facility is relatively minor compared with the potential benefits, particularly compared with similar costs for on-campus facilities. Tangible and intangible benefits include the high public visibility a field station provides, attraction of researchers and students from other regional and national universities, a base for K-12 education and teacher training, promotion of interactions and affiliations with state and federal agencies, and leadership in local to global environmental issues. The above benefits are expected to lead to generation of extramural funding. It should be kept in mind that field stations themselves do not conduct research or teaching; field stations provide the infrastructure for research and teaching by individuals.

Funding for facilities - Funding opportunities should be integrated between matches and granting agencies. By example, in the NSF special competition for field stations and marine laboratories, the match for researcher facilities may be student or educational facilities supplied through University funds. By example, NSF awards for researcher housing may be matched by short-term housing and a bathhouse. A storage facility for research equipment may be appropriate for NSF funding. Foundations should not be overlooked in the same venue where similar matches might apply.

Funding for day-to-day operations - A user fee schedule must be established for cost recovery, and it should be expected that researchers and educators using the Station will have user fee costs built into their grants. All external activities should be cost sufficient, i.e., will not utilize Station or University funds. Profits can be generated from most of these activities (e.g., field trips by local educational groups should pay at least a minimal fee). Other income generation might include T-shirt, coffee cup, and other visitor center souvenirs; IMS support (outdoor museums); consortium fees; also dining hall and food services can be very profitable. To be effective, the Station must begin to maintain data on visitation as part of its income generation strategy.

F. Synthesis from Workshop Chair (Susan Lohr)

Prior to Dr. Susan Lohr's synthesis, workshop participants were joined by members of the UMBFS Advisory Board (see Appendix E). Susan Lohr then opened the session by stating that the one theme that all four groups at the workshop felt strongly about, was that the Field Station should be a nationally and internationally recognized facility. She then asked the group to focus on what the strategy should be to reach this goal. Several participants noted that the first thing the Field Station needs is a significant institutional commitment from the University or it will not go forward.

Susan Lohr recommended that programs requiring long term funding not be initiated unless the University has agreed to fund them. She stated that Education programs should be started because those types of programs can probably pay for themselves. For example, Charles O'Hara mentioned the idea of having a series of "how to" workshops at the Field Station to bring in revenue. Frank Harris commented that there are several Foundations that have funds available for Field Stations. Susan Lohr suggested that UMBFS work closely with the UM development office to pursue these avenues. David White stated that the Biological Field Station could be a recruitment tool for the University. In fact, the Field Station could offer "pretty pictures" of the Field Station to use in University development materials.

The next area discussed was user fees for the Field Station. Overall operating costs need to be determined, and then fees set. Susan Lohr suggested that other Field Station's fee structures be obtained for comparison. Field Station services should not be freely provided. In the beginning, fees can be waived to encourage use of the Field Station. Susan Lohr also stated that there are other avenues to pursue to enhance revenue such as food services, corporate retreats, and educational programs. Marjorie Holland mentioned the Friends of the Field Station solicitations that would be going out in the newsletter that month (February 1997). It was recommended that the Advisory Board contribute to the UMBFS "Friends." Susan Lohr also stated that to secure long term financial security, a Field Station endowment is needed and priorities established for that endowment. Susan Lohr also stated that the Field Station should not be guided by the funding opportunities. Field Station users need to apply for funding opportunities that fit into the overall philosophy for the Field Station. The overall user group twenty years from now needs to be anticipated with the aim of having scientists with national reputations conducting work at the UM Field Station. When this is accomplished, UMBFS' goal of becoming a nationally recognized facility will be achieved.

Elizabeth Blood asked two important questions: 1) why would someone want to come to the UM Biological Field Station outside of the regional area? and 2) does the Field Station want to stay regionally focused or become a national facility? Susan Lohr stated that UMBFS needs to be nationally prominent to increase funding opportunities. Tracy Benning stated that the Field Station's most appealing feature is the two hundred ponds that offer excellent experimental replication possibilities. Research opportunities mentioned were: terrestrial/aquatic interfacing possibilities; only facility in this habitat; watershed in vicinity; restoration ecology availability; regional opportunity to conduct research here without having to travel far; wetland restorations research possibilities; not a lot of research has been conducted in this area; work on neotropical migrants; database systems potential. Elizabeth Blood urged the University to make the investment in base line monitoring equipment to insure that the UM Field Station gets off "on the right track." David White mentioned that this was the first thing that Murray State did to get their Field Station started.

To gain national recognition, Susan Lohr stressed that the next critical step in developing UMBFS would be to have undergraduate and graduate summer field courses offered at the Field Station. It was further noted the Biological Field Station serves as an umbrella organization and that the CWWR is one center within that umbrella. Just prior to concluding the meeting, the group recommended unanimously that the word "Biological" be deleted from the name so that from this point on the FS will be known as The University of Mississippi Field Station.

G. Summary of Key Recommendations from Planning Workshop on the Future Development of The University of Mississippi Biological Field Station and Center for Water and Wetland Resources

The Vision articulated during the workshop has four components as follows:

The **overall vision** for UMBFS is to become a regionally, nationally, and internationally important station for field research, teaching, and service over the next 20 years; as a first step, there will continue to be a tight link between educational and research programs, and investigators from many different departments within The University of Mississippi (UM) will be encouraged to work at the Field Station; in addition, colleagues from other Mississippi Institutions of Higher Learning as well as from neighboring states will be encouraged to utilize the opportunities afforded by the Station for field research.

A **second component of the vision** is for research and teaching activities at the Station, where feasible, to be self-supporting and to generate income to help defray Station expenses.

A **third component of the vision** is for the UM Field Station to become one node within the larger network of all Field Stations collecting long-term data throughout North America; the UM Field Station will foster collaborations with other Field Stations and Marine Labs, and become an active participant in other networks.

A **fourth component of the vision** is to continue the focus on current UM research strengths, but over time to incorporate the six research priorities (fundamentals of basic biology and ecology, assessing environmental change, maintaining biodiversity, sustainable ecological systems, predictive management, restoration and rehabilitation) identified for Field Stations and Marine Laboratories nationwide [Lohr, *et al.*, 1995] into more projects at the UM Field Station; however, initially the focus on current UM research strengths will continue.

Given this vision, the following recommendations were offered by workshop participants:

* commence comprehensive monitoring program to quantify changes in critical hydrological, ecological, and climatological factors;

* change the name from the University of Mississippi Biological Field Station to The University of Mississippi Field Station;

* develop an overall site management plan with goals for understanding ecosystem function of the terrestrial habitat, to include recommendations for management necessary to sustain current terrestrial habitat types;

* host an annual gathering where results of research efforts conducted at the Field Station can be presented, discussed, and summarized; and (preferably on the same day) offer tours of research projects by scientists actively engaged in work at the Field Station for the general public;

* maintain a strong link between research, training, and education;

* whenever possible education programs will draw on the Field Station's ongoing research and research findings;

* whenever possible, The Station will play a pro-active role in recruiting students and teachers from populations that are currently under-represented in field biology and ecological science.

* multi-disciplinary efforts should be strongly encouraged;

* design and implement a comprehensive education program that meets state and national educational standards and involves the broadest constituency possible.

* recognizing the need for the University Administration to increase its financial commitment to the Field Station (FS), the following specific suggestions were offered:

** institutional barriers within UM that impede the facilitation and development of the FS need to be removed in order for the FS to realize its full potential with enthusiastic support and encouragement from the UM administration;

** institutionalize a long-term base level monitoring program at the FS by providing support for some graduate student Research Assistantships based at the FS;

** institutionalize a long-term educational component at the FS by providing support for both of the following positions: (a) a full-time education coordinator for the Field Station, and (b) a joint faculty appointment between the School of Education and the Field Station;

** design a comprehensive model program to meet state and national educational standards, involving the broadest constituency possible, addressing needs and providing appropriate learning opportunities to each group;

** institutionalize a long-term data management component at the FS by providing support for a full-time position for data management and systems analysis;

** increase upper-level administrative support for FS to allow adequate development of FS programs and funding options;

** higher administration should provide a system of incentives to encourage station use (e.g., seed-money grants through the Faculty Research Program)

** over time, hire a separate coordinator for the CWWR complex;

* recognizing the heightened visibility and national recognition that implementation of the VISION above will bring the FS, the following recommendations for facilities were made:

** development of a 20-year site Facilities plan for the UM Field Station;

** after construction of the CWWR complex, removal of present "buildings" (on site as of February 1997), and shifting of current functions to the new CWWR complex;

** restriction of all new construction to grounds around new CWWR complex to minimize needs for additional infrastructure;

** construction of short-term housing (2-person or 4-person) units;

** construction of all-weather long-term housing ["family" units] for visiting researchers or teachers;

** construction of a central bathhouse with laundry facilities to serve short-term housing units;

** construction of teaching pavilions for field-oriented activities that could be located near ponds and in a terrestrial teaching setting;

** construction of a common analytical laboratory and animal care facility;

** creation of a NADP climate monitoring station with climate monitoring beginning as soon as possible;

** identification of a permanent location for a library and reference collection within the Phase 2 construction plans;

** construction of a large multipurpose building (40' x 100') to contain equipment and supplies not in use; facility should contain locked bins where visiting scientists might leave research equipment;

** because of erosion and dust problems, all roads in the facilities complex (intense use only) should be paved and sidewalks should be provided to link cabins and bathhouse. Vehicle traffic should be discouraged in other parts of the Station;

** construction of a kitchen/dining facility with seating capacity for 100;

** construction of a student lounge for resident students to include TV/VCR and ping-pong table;

** construction should follow ADA guidelines, and ADA should be applied to a portion of the living facilities;

** identification of flat space for recreational area (volleyball net);

** development of a fire/natural disaster/emergency plan should begin as soon as possible; all permanent staff should have CPR and first aid training.

As summer field courses are developed and advertised, more papers on work at UMBFS are published, and lodging facilities are constructed, it will be easier to attract additional nationally-recognized researchers to work with those already based at the Oxford campus. Regional, national, and international recognition will come as UMBFS maintains its solid science base, disseminates attractive literature about the Station, establishes a track record of informative field courses, and constructs comfortable housing.

In addition, the group viewed the Biological Field Station as an umbrella and the CWWR as one center within that umbrella. In the future, there may be possibilities for other centers based at the Field Station.

III. Observations of operations at other Field Stations

A portion of the 1996 NSF funds were used for program and planning development of UMBFS. Funds allowed staff to travel to and investigate the operation, organization, and structure of other North American field stations noted for their sound balance of research and training activities. While each field station is unique, there have been efforts to define some critical features of successful long-term programs (Strayer, *et al.* 1986) from which we can learn. Noting the location of UMBFS in the mid-South USA, Field Station staff chose to visit some of the other field stations and marine labs in adjacent states, with a view toward possible future collaborations. Therefore, as a major aid in planning physical design, organizational structure, and future operational focus of UMBFS, we have visited other Field Stations or Marine Labs within a few hours drive including: Gulf Coast Research Laboratory, Meeman Biological Field Station, Dauphin Island Sea Lab, Ouachita Mountains Biological Station, and Reelfoot Lake Research Center. Over the last twelve months, we have also visited other Field Stations throughout the country including: Flathead Lake Biological Station, Hancock Biological Station, Highlands Biological Station, Institute of Ecosystem Studies, Sevilleta Field Station, White Mountain Research Station, and University of Oklahoma Biological Station. As a result of these visits, we have compiled a table summarizing key components of other stations (Table 2).

Based on conversations with workshop participants and personnel at other Field Stations, the following definition of a field station has been developed:

* a facility where long-term data [e.g. weather, vegetation, water quality] are collected and stored;

* a facility where graduate, undergraduate, and post-graduate field research can be undertaken;

* a facility that hosts upper-level undergraduate and graduate level courses [e.g. for biology students, geology students, federal or state agency personnel, K-4 teachers] on topics that are best presented at that facility;

* a facility that provides a service to the surrounding community [e.g. ecological programs for general public, hosts groups with similar missions, provide Nature Trail for public];

* a facility that serves as a barometer against which spatial and temporal environmental changes can be measured; several similar facilities pool information to characterize regional, national, and international trends.

Table 2. Summary of visits to other Field Stations or Marine Laboratories by The University of Mississippi Biological Field Station Staff [1 September 1996-30 August 1997]

Station	Affiliation	Yrs. Open	Number of Staff	Station Size	Primary Base of Financial Support	User Fees	Facilities	Education Programs	Primary Research Focus	Data Management	Vision for Future
Flathead Lake Biological Station	The University of Montana	98	18 FT 2 PT	32 hectares	Grants, Contracts, and The University of Montana	*Mtg Rooms *A/V *Lodging *Meals	Labs for Rsch. & Ed. Rsch. Vessel Housing (100) Museum	Summer undergraduate-graduate	Limnology	Well-developed	International-national
Highlands Biological Station	The University of North Carolina	70	3 FT 5 PT	7 hectares	State of North Carolina	*Housing *Laboratory/ Research Space	Labs for Rsch. & Ed. Classrooms Conf. Room Herbarium Library Housing (40)	Summer upper level undergraduate-graduate	Ecology, Southern Appalachian species systematics and taxa	Developing	National-regional
Gulf Coast Research Laboratory	University of Southern Mississippi	50	150 FT	5 hectares	State of Mississippi	*Educational Programs *Lodging *Meals	Labs for Rsch. & Ed. Classrooms Library Auditorium Rsch. Vessels Housing (72)	Summer K-Ph.D.	Marine Biology	Well-developed	International-national
University of Oklahoma Biological Station	The University of Oklahoma	48	5 FT Field Station 2 FT Physical Plant 5 PT	10 hectares	The University of Oklahoma	*Lodging *Meals *Courses	Housing (216) Rec. Room Commissary Labs for Rsch. & Ed. Library Greenhouses Boathouses	Summer Jr./Sr. High	Ecology, Natural History, Taxonomy, Evolution, & Morphology	Informal (up to each P.I.)	Local-regional
White Mountain Research Station	University of California	45	6.5 FT	Lease from USDA Forest Service	University of California	*Lodging *Meals *Laboratory/ Research Space	Housing (100)	Year round K-Ph.D.	High altitude physiology Geology Ecology	Developing	National-regional
Ouachita Mountains Biological Station	Private	35	2 PT	121 hectares	Private	Voluntary	Laboratory Kitchen Housing (20)	None	Used mostly for class field trips	None	Local-Regional

Station	Affiliation	Yrs. Open	Number of Staff	Station Size	Primary Base of Financial Support	User Fees	Facilities	Education Programs	Primary Research Focus	Data Management	Vision for Future
Meeman Biological Field Station	University of Memphis	29	3 FT	402 hectares	University of Memphis	*None	Labs for Rsch. & Ed. Conf. Room Housing (15)	Summer undergraduate-graduate	Wildlife Ecology, Plant Community Ecology, & Population Ecology	None	Local
Dauphin Island Sea Lab	Marine Environmental Sciences Consortium	25	70 FT 10 PT	15 hectares	State of Alabama	*Educational Programs *Lodging *Meals	Labs for Rsch. & Ed. Classrooms Housing (150) Rsch. Vessels	Year round K - Ph.D.	Marine Biology, Benthic Ecology, Substrates, & Coastal Ornithology	Well-developed	International-national
Hancock Biological Station	Murray State University	24	5 FT 9 PT	30 hectares	State of Kentucky [Secondary support through Center for Reservoir Research]	*Laboratory/ Research Space *Office Space *Lodging *Chemical Analyses	Classrooms Rsch. Labs Housing (60-70)	Year round K-Graduate level	Aquatic Ecology and Bio-geochemistry	Well-developed	International-national
Institute of Ecosystem Studies	Private (formerly The New York Botanical Garden)	14	80 FT 40 PT	782 hectares	Cary Trust	*Courses *Lodging	Labs for Rsch. & Ed. Conf. Room Auditorium (150) Housing (36)	Year round K-Ph. D.	Ecology/ Ecosystem Studies	Developing	International-national
Reelfoot Lake Research Center	The University of Tennessee	10	1 PT	1 hectare	State of Tennessee	*Lodging	Lab for Rsch. Housing (18)	Summer K - 12 workshops	Limnology & Plant Ecology	None	Local
Sevilleta Field Station	The University of New Mexico	6	1 FT on site	5 hectares	University of New Mexico [secondary support through Long Term Ecological Research Network]	*Lodging *Conferences *REU	Library Conf. Room Labs for Rsch. & Ed. Housing (48)	Summer Undergraduate-graduate	Ecology, Biology, Geology, Hydrology, Anthropology, & Atmospheric Science	Well-Developed	International-national

Table 3. Overview of UMBFS Accomplishments (1995-1997)

- 1995 - 1996
  - Join OBFS and attend September 95 meeting in Wisconsin
  - Establish User Committee
  - Establish Advisory Board
  - Develop UMBFS land use plan
  - Host Groundbreaking Ceremony for CWWR
  - Host first K-4 teacher workshop
  - Develop 4 Sesquicentennial proposals
  - Develop and submit proposal to National Science Foundation (NSF) Field Station and Marine Laboratories (FSML) competition
  - Submit proposal to USDA for final installment of CWWR Funds
  - Hire ½ time undergraduate secretary

- 1996 - 1997
  - Attend 1996 OBFS meeting in California
  - Hire ½ time graduate student research assistant
  - Host first Science Day
  - Hire Operations Coordinator
  - Disseminate first Newsletter
  - Host NSF-funded planning workshop and develop workshop report
  - Submit proposal to NSF FSML competition
  - Develop proposal for CWWR education building furnishings and lab equipment
  - Oversee Phase I construction for CWWR complex
  - Develop and submit progress reports on CWWR construction to USDA
  - Sign Memorandum of Understanding with Crow's Neck Environmental Education Center

A. Participation in data management workshop

The members of the Organization of Biological Field Stations (OBFS) have decided to begin working on mechanisms to network OBFS member stations for sharing data and other information. To get the stations substantially down that road, OBFS co-sponsored a workshop ("Data and Information Management in the Ecological Sciences") and a special session ("Long-Term Research in Ecology: Cross-Site Collaborations for the Future") in Albuquerque, New Mexico in early August. The purpose of the workshop was to provide basic training on information management, protocols for data archiving and relevant technology. The special session was to help begin to understand what kinds of long-term data stations should be gathering to advance ecological research and monitoring. These meetings provided the groundwork for getting all OBFS stations up to speed on data management, which has been a long-term goal of OBFS. UMBFS was represented at both the workshop and the special session; conversations during both meetings reinforced the need for the UMBFS/CWWR complex to support applications that can readily interface with LTER and OBFS sites throughout the world.

B. Priorities for UMBFS over the next five years

In reviewing the many thoughtful recommendations offered by workshop participants, an overview of UMBFS accomplishments over the last two years has been compiled (Table 3), and some priority recommendations are offered for development of UMBFS over the next five years (Table 4). None of the suggestions offered during the workshop are being discarded: it is envisioned that those not currently listed as priorities will be woven into the fabric of future UMBFS programs as human and financial resources allow. Further priorities will be set at regular meetings of UM personnel and the UMBFS Advisory Board.

IV. Conclusion

The University of Mississippi Biological Field Station is at a critical point of development. The ultimate goal is for the Field Station to be a regionally, nationally, and internationally recognized facility for field research, teaching, and service within the next 20 years. The funds provided by NSF have enabled UMBFS to further define a mission and strategic objectives that will guide UMBFS on its path to becoming a nationally recognized facility as well as becoming one node within the larger network of all Field Stations collecting long-term data throughout North America.

Table 4. Priorities for future development of UMBFS (1998-2002)

- 1997 - 1998
  - Develop and implement user fee structure
  - Host first Science Conference
  - Host 2nd Science Day
  - Hire Plumber and second graduate student research assistant
  - Develop and test alpha version of database management system
  - Host first FS summer courses [e.g. hydrology, K-4 Env. Ed] with CNEEC
  - Disseminate second Newsletter
  - Develop short Nature Trail
  - Advisory Board reviews policy for development of Master Site Plan
  - Commence collection and storage of weather data
  - Develop fire/natural disaster/emergency plan for existing structures

- 1998 - 1999 Committee
  - Establish small data management Steering Committee
  - Host Open House for CWWR Education Building
  - Hire Data Manager and Education Coordinator
  - Host second Science Conference
  - Host 3rd Science Day
  - Disseminate 3rd Newsletter
  - Host 2nd set of FS summer courses
  - Award first Ralph Powe scholarship for outstanding Graduate Student Research
  - Construct first teaching pavilion for UMBFS visitors
  - Develop UMBFS educational strategic plan
  - Implement database management system

- 1999 - 2000
  - Hire 4 graduate student research assistants [e.g. biol, geol, computer science & education]
  - Host fall Science Conference
  - Host 4th Science Day
  - Establishment of library and reference collection in first CWWR building
  - Develop long Nature Trail with interpretive materials
  - Disseminate 4th Newsletter
  - Host 3rd set of FS summer courses
  - Hire Associate Director for CWWR complex
  - Hire receptionist for CWWR complex
  - Award second Ralph Powe scholarship

Table 4. Priorities for development of UMBFS (1998-2002) (continued)

- 2000 - 2001
  - Continue all positions established in previous years
  - Continue all programs instituted in previous years
  - Host Open House for CWWR Laboratory complex
  - Build two long-term housing ("family") units
  - Develop a comprehensive fire/natural disaster/emergency plan for entire facility
  - Construct second teaching pavilion for UMBFS visitors
  - Implement Mississippi Field School, including a variety of ecological programs, with personnel from Crow's Neck Environmental Education Center

- 2001 - 2002
  - Continue all positions established in previous years
  - Construct four two person short-term housing units
  - Construct kitchen/dining facility and bathhouse
  - Evaluate research infrastructure to determine current and future needs (* this is envisioned as an opportunity to bring in outside people for a five-year external review; annually an internal review will be conducted)

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Appendix B. Michener and Blood 29 January 1997 memo

GUIDELINES

DATA MANAGEMENT

W. K. Michener and E. Blood

A well-designed and operational data management system can significantly enhance research and administrative productivity at field stations. Successful data management programs typically start at a small-scale and expand incrementally once specific milestones are reached. Several basic tenets that can facilitate successful development of an institutional data management system include:

- start now and start small
- build upon past successes
- keep it simple
- build consensus among users

Like any other component of a research program, data management is highly dependent upon personnel. It may, therefore, be instructive to examine three stages of data management implementation that vary in terms of personnel allocation, capability, and technical sophistication. Again, most successful data management programs, including those that are most sophisticated, proceed in logical stages from a very simple baseline. The three hypothetical stages used in this example are based on: (1) <1 FTE (full-rime equivalent), usually 0.25-0.5 during initial development (2) approximately 1 FTE; and (3) 2 FTE or more.

Stage 1

Personnel -- Part-time graduate student undergraduate student and/or secretarial support may be employed for stage 1 tasks. Generally, it is best if one senior staff member administers the data management system (assigns tasks, oversees progress, etc.).

System capabilities -- Data management system responsible for managing institutional data (e.g., lists of site users, site visitors, papers based on research at site, past and ongoing research projects, vendors, housing schedules, species lists, etc.).

Technical description (hardware/software) -- A basic data management system for handling institutional data can reside on a standalone PC. Software may initially include a word processing package (e.g., MS WORD) and a spreadsheet (e.g., EXCEL). As databases grow, PC-based database management software (e.g., PARADOX) can be added. Management of reference lists may be accomplished using one of several bibliographic databases (e.g., REF1 1, Papyrus, etc.). Initial computational environments typically do not have a high degree of network connectivity, as network maintenance requires higher skill levels and personnel commitments.

Administrative issues -- It is generally desirable to prioritize data management tasks based on their potential utility to the greatest number of users. Often, sites benefit from having a steering committee (3-5 individuals including one or more scientists and administrators, i.e. the site stakeholders) that helps establish policies, priorities, and procedures. Specific administrative issues that must often be dealt with during stage 1 include: (1) prioritizing data management tasks; (2) developing site and data acknowledgment policies; (3) developing policies for obtaining reprints based on work done at site; and (4) initiating a long-term development plan.

Stage 2

Personnel -- Assigning a full-rime individual to data management can greatly facilitate system development and enhance functionality. A recently graduated biology student with computational skills/interests may be sufficient for a developing data management program.

System capabilities -- As the computational environment (hardware and software) expands at an institution, there is an increasing need for intra-site networking (e.g., Local kea Network), hardware and software trouble-shooing, and more sophisticated software (e.g., a DBMS such as Paradox or Access, SAS or SYSTAT for data analysis and graphics, etc.). A modest LAN can facilitate data sharing and archival, as well as sharing of peripheral devices (printers, plotters, etc.). Often, personnel associated with the data management system are involved in establishing and maintaining a climate station (and resulting database) and connecting laboratory instrumentation to PCS. During stage 2, attention is also often devoted to developing institutional databases (e.g., climate, water quality, etc.) that may be useful to the broad community of site users (university and visiting scientists, graduate students, etc.).

Technical description (hardware/software) -- A site in the second stage of development frequently has several PCS, printers, one or more plotters, and archival hardware (read-write optical disk, tape, etc.). Offsite communication may be accomplished using high-speed modems and dial-up local access to an Internet provider.

Administrative issues -- Formal archival (back-up) procedures should be adopted for institutional databases. Attention should be paid to developing data catalogs (reference list of site-specific data sets) and metadata (data documentation) guidelines and protocols for high priority data sets. Several critical issues generally arise during stage 2 that deserve concerted attention and discussion including: (1) desirability of a site GIS (geographic information system; (2) need for a dedicated communication line (e.g., Tl) for constant Internet access; (3) need for a fully functional SQL-based DBMS (e.g., ORACLE, etc.); (4) need for multiple hardware platforms (PCS plus UNIX stations); (5) need for software, especially statistical, support (6) etc. Personnel requirements associated with these system enhancements should be thoroughly addressed. For example, GIS implementation can be especially cosily for a developing station and may detract resources and attention from more critical tasks. Salary and personnel issues generally arise during stage 2. As DM systems become more sophisticated, there is an increasing need for more highly skilled employees. Frequently, data management personnel turnover at field stations becomes an issue requiring administrative attention.

Stage 3

Personnel -- As the scope of data management and the size of the organization increase, there is a concomitant need for additional personnel. Frequently, a full-rime systems administrator, a data manager, and one or more part-time support staff (data entry, PC support etc.) are required for larger operations.

System capabilities -- A stage 3 data management system might support intra- and inter-site networking, a file server(s), centralized archival facilities, fully networked laboratory instrumentation, and other more sophisticated operations.

Technical description (hardware/software) -- The computational environment might consist of PCS and UNIX workstations, multiple peripheral devices, automated data backup systems, a dedicated Internet link, UNIX-based SAS and other software for data analysis, and a laboratory information management system (LIMS) for the analytical laboratories.

Administrative issues -- Costs (hardware, software, maintenance contracts) and personnel issues (salaries, additional employees) are often issues that require considerable administrative attention.

Appendix C. Darden and Römkens 12 February 1997 memo to Dr. Marjorie Holland.

DATA ACQUISITION, STORAGE, AND RETRIEVAL

R. W. Darden and M. J. M. Römkens

There are several important criteria that must be addressed in developing a data acquisition/ retrieval system for study sites such as the Biological Field Station. These include:

1) Number and types of variables
2) Data collection rate, i.e. minute or hourly reading, significant change in variable, etc.
3) Availability of manpower for data collection versus the time frame in which data is needed.
4) Budget for funding (desired versus essential).
5) Availability of A/C power, telephone lines.
6) Expertise level of researchers in electronics, computer programming, communications.

The data loggers on the market today provide a relatively inexpensive method for collecting a wide range of data, data rates, and retrieval methods. Some suggestions for this type equipment are included.

Many of the data loggers on the market share several important features that should be considered before deciding on a particular brand. Some of the things to look for are:

A. Flexibility and Versatility - Data loggers should be able to measure almost any sensor, apply mathematical functions to the measurements, and process data over time.

B. Expandability - one data logger should be cost efficient enough to read a small number of sensors and yet expandable to read hundreds of sensors.

C. Low Quiescent Power Drain Systems should be powered by alkaline D-cells or sealed rechargeable 12 VDC batteries, with recharge capability from either solar panels or 110-230VAC.

D. Fully Supported Communications Between Data Logger and PC - Connect to the data logger directly, or via telephone, radio, network, cellular phone, short haul modem, or practically any combination of these to receive data, send and retrieve programs, or set the data logger clock. Also, support of data retrieval via satellite for very remote applications is desirable.

E. Measure Most Sensors - The equipment must be capable of interfacing to a wide range of commercially available sensors.

F. Built-in Calculations Processing - The data logger should do most of the data reduction to save storage space and post-processing work (e.g., maximum, minimum, total, average, standard deviation, etc.

G. Operating Temperature/environment Ranges: The data logger should be capable of operating in adverse weather conditions for prolonged periods.

DATA TRANSMISSION AND COMMUNICATION

R. W. Darden and M. J. M. Römkens

There are several levels of communication that may be used dependent in the location and proximity of research site relative to available transmission facilities.

Telephone

A Telephone Modem at the data logger enables a PC with a Hayes-compatible modem to contact the data logger at any time and supports most telecommunications functions. Modems operate at 300 or 1200 BAUD. A cellular telephone package allows complete telecommunications functions in areas served by cellular telephone companies.

Many vendors provide voice synthesizer modem, which allows a data logger to transmit, by voice, real-rime or historical data stored in the data logger.

Radio Telemetry

Enables a PC to communicate with a large number of data loggers on a single frequency. Transmission distances are typically 25 miles line-of-sight for UHF or VHF radio (user must acquire their own FCC-approved frequency). Repeaters can serve to extend transmission distances.

Short Haul Modems

A short haul modem package is the easiest link for communicating with one data logger over longer distances. This system uses a short haul modem at both PC and data logger, and a two twisted-pair cable for a direct connection. Typically this system will operate at 9,600 BAUD up to 8.4 miles; at 1200 BAUD up to 11.2 miles.

Satellite

For remote one-way data transmissions using either the GOES or Argos satellite systems. Restrictions apply to the type of applications allowed for these networks, and the amount and riming of data transfers.

Multidrop Interface

Links up to 200 data loggers on a single COAX cable with total cable length of up to 3 miles.

On-Site Options

You can connect your PC to a data logger in the field by typically using a serial connect with appropriate software and download data collected in the data logger to a laptop manually. You can increase the final storage space for your data logger by attaching a solid state storage device. Storage modules are available for up to 1 megabyte extra data. To get more storage, add multiple storage modules or use PCMCIA cards to store up to 4 Mbytes of data per card. When you need to retrieve data, simply pick up the storage device and take it back to the office to extract the data, or download the data to your laptop while out in the field.

Appendix D. The University of Mississippi Biological Field Station Advisory Board Sub-committee on Funding and Facilities Outline of Strategic Plan, Dr. David Arnold, chair, 17 December 1996.

Mission

The mission of the Subcommittee on Funding and Facilities is to assure the availability of quality onsite facilities and equipment needed to accomplish the mission and goals of UMBFS and CWWR.

Goals

A. To identify and make plans for facilities and equipment needed for UMBFS and CWWR to fulfill their mission and goals.
B. To procure funding for needed facilities and equipment.

Initial Funding and Facilities

A. Phase I - Overall Site Work and Road Construction. Funds available; construction/contract award in progress
B. Phase II Building - Visitor Center/Education Building. Funds substantially available; final funding increment ($1.5 million) submitted to the Institutions of Higher Learning (IHL) Trustees for inclusion in 1996 legislative funding request
C. Phase III Building - Three Laboratories, Greenhouse and Maintenance Building
D. Equipment for visitor Center/Education Building:
    1. Identification of needs substantially complete
    2. Cost estimate needed (work in progress)
    3. Need to formulate and conduct fund raising effort (see V. below)

Future Facilities

A. Over time, periodically consider adequacy of facilities/equipment and determine need for additions/modifications. Input from User's Committee essential to this process.
B. Develop preliminary plans and cost estimates for identified needs
C. Identify funding resources and formulate plans for raising funds to cover shortfall (see below)

Funding/Fund Raising

A. Funding will be sought through normal channels; University budget process including legislative appropriation if applicable
B. Funding will be sought through National Science Foundation grant programs and/ or U.S. Department of Agriculture funding (or other applicable federal sources)
C. Fund Raising Program
    1. Funding needs over and above funds available through normal state and federal support channels will be sought through fund raising efforts
    2. Each fund raising effort, whether project specific or for ongoing programs, will consist of the following essential steps:
        a. Prepare a description and preliminary plans for the project or program in sufficient detail to (i) convey a clear understanding of the need and purpose to an audience (to be determined as appropriate) and (ii) obtain a reasonably accurate estimate of the funding need.
        b. Prepare presentation materials for purpose of "selling" project/ program to an audience; use white paper brochure, flyer, slide presentation and/or videotape as appropriate.

c. Consider segmentation of giving needs and whether recognition by giving level is appropriate.

d. Identify potential sources of funds and subdivide by category:
   - (i) Business/Industry
   - (ii) Agriculture
   - (iii) Government agencies
     - Grant sources
     - Users of BFS services
     - Surplus equipment sources
   - (iv) Private foundations
   - (v) Individuals

e. Plan and conduct fund raising campaign
   - (i) Use resources of University Advancement office, Public Relations Department, etc.
   - (ii) Coordinate with University's overall Sesquicentennial Campaign

Construction costs may be used as a match to other grants.

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Appendix F. Mission and Goals for UMBFS

In the Fall of 1995, the User Committee adopted several goals to guide development of the UMBFS. They are:

* to provide the infrastructure to support nationally and internationally-recognized research on basic and applied questions relating to northern Mississippi habitats; to increase our knowledge and improve our management of these and similar habitats throughout the region;
* to provide quality undergraduate and graduate courses in field-oriented ecological disciplines.
* to host educational programs such as inservice workshops, school environmental programs, and education-oriented seminars;
* to serve the local and regional community through public workshops, conferences, meetings, and special public events exploring natural, historical, and cultural features of northern Mississippi; and
* to foster collaboration with other organizations with similar missions.

Mission

The University of Mississippi Biological Field Station has a mission to provide opportunities for a broad range of research and training for a diverse user constituency. Activities in both research and education will focus on an integrated programmatic approach for meeting these responsibilities. Emphasis will be placed on integrating research with training exercises in "hands on" field experiences for individuals of a wide range of ages. An especially important part of the Station is the Center for Water and Wetland Resources. It is the goal of the Center, with support facilities available at the Station, to provide the best possible aquatic/wetlands/terrestrial research and education program possible.