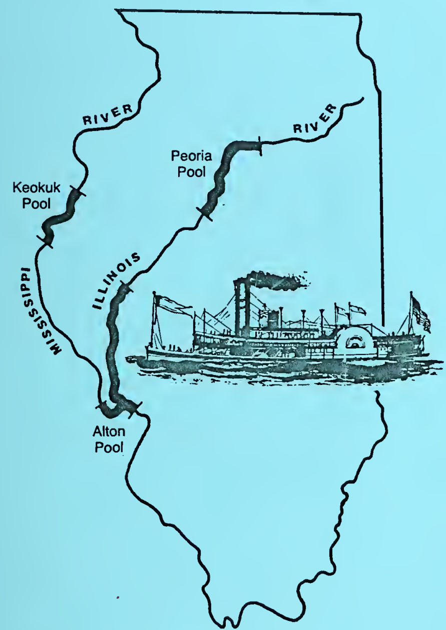
ILLINOIS LARGE RIVERS
NSF LTER



Illinois Natural History Survey
Illinois Water Survey
Illinois Geological Survey
Western Illinois University
Illinois State Museum

Aquatic Biology Technical Series 1985 (6)

Illinois Natural History Survey
Aquatic Biology Technical Report 1985(6)

1985 PROGRESS REPORT

Ecological Structure and Function of Major Rivers in Illinois
"Large River LTER"

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August 1985
Large River LTER Annual Report

Table of Contents

List of Tables and Figures

SECTION 1: ACCOMPLISHMENTS

A. Scientific Accomplishments

Introduction (Sparks)

The third highest flood on the Illinois River in the 140-year record occurred in March 1985. This major event triggered sampling to document changes in the bottom profiles and the flux of water, sediment, and nutrients in the Peoria Pool. Our sampling crews were already busy with the spring maintenance sampling on the Keokuk Pool of the Mississippi River, so our resources were strained to the limit. Fortunately, the Illinois State Water Survey had obtained a grant from the Rock Island District of the U.S. Army Corps of Engineers to study the acute sedimentation problems in Peoria Pool, so we were able to use equipment and personnel from both projects. The sampling and some preliminary results are described in this report.

One side effect of the flood event sampling is an acceleration of the schedule for digitizing map information on our three study sites. The land-water boundaries in the Peoria Pool have been digitized for the sedimentation/flood project. We had already hired Suzanne Miller, with a portion of the $40,000 supplement, to complete digitizing the Pool 26 reaches of the Illinois and Mississippi rivers--the longest and most complex of our sites--so base maps for all our sites should be complete.

The supplement also was used to equip the Water Survey with a minicomputer-based work station, comparable to those already set up at Western Illinois University and the field stations at Grafton and Havana, and to hire a programmer and a graduate assistant in chemistry. The graduate student is working with Richard Cahill (Illinois Geological Survey), analyzing carbon isotope ratios in aquatic plants and invertebrate detritivores, to determine whether we can distinguish autochthonous and allochthonous sources of detritus and their relative contribution to secondary production. He is also measuring the carbon content of sediments and organisms to provide information for our carbon flow model. The programmer assisted Frank Brookfield (Natural History Survey) in writing two versions of our biological model in FORTRAN--one to run on the IBM PC's at the work stations and one on the CYBER. The model and the input matrices have been carefully structured and documented so that they will be easy to add to or change.

Other major developments in our model include the routing of water and sediments in side channels and channel borders and a new capability for modeling nutrient concentrations. The biological model was simplified from 22 to 9 state variables and several simulations were completed.

The Large River LTER contributed two papers to the inter-site symposium on data management at the North Inlet site and participated in several other inter-site workshops and meetings. We will host the workshop on sediment transport mechanics and measurement in Grafton, Illinois on 16-18 September 1985.

The following sections give more details and include reports on activities not highlighted in our previous annual reports, such as the microbial-detritus studies (Henebry and Gorden) and reconstruction of streamflow and precipitation using tree rings and pollen analysis of sediments (Wendland and King).

Core LTER Data Sets (Lubinski)

We conducted a major review of the Large River LTER core data sets and their functions. The goals of this review were to project each future use of core data sets and to identify modifications necessary to insure that they will support syntheses of complex relationships as well as the testing of specific hypotheses, or long-term documentation of key river conditions. Recommendations were made regarding additional measurements to be included during the next 4-year program period. We also agreed on arrangements to further coordinate sampling schedules.

A major product of the review was the categorization of each core data set by the specific hypotheses they will be used to test. Hypotheses were then lumped into general subject areas and a summary table produced (Table 1). Also identified in this table are the data sets that will be used to generate long-term records of river conditions related to each subject.

Microbial Populations and Detritus (Henebry and Gorden)

One of the central hypotheses of the Large River LTER is that there are two major sources of organic matter assimilated in secondary production: allochthonous carbon transported via river currents (particularly during the spring flood) and autochthonous material produced in the beds of vascular hydrophytes. Each of these sources provides substantial organic materials, but in a form that is not readily available to higher trophic level consumers. Our working hypothesis is that microorganisms contribute significantly to the transformation of these materials into forms that are readily ingested and assimilated by higher trophic components. We have addressed this hypothesis in the following studies.

Distribution of Bacterial Populations in Mississippi River Pool 19 and Correlations with Concentrations of Organic Carbon

Because the activities of microorganisms provide usable forms of carbon to higher trophic components, the distribution of bacterial biomass in Pool 19 was examined. Bacterial cells were enumerated by direct epifluorescent counts and biomass was calculated from measurements of cellular dimensions. In summer, bacterial biomass (mg carbon/L) in the water column ranged from 0.05 in the main channel (MC) habitat to 1.13 in the vegetated main channel border (VMCB); bacterial biomass in the VMCB habitat was significantly higher ($P < 0.05$, ANOVA) than in the MC or the nonvegetated main channel border (NVMCB) habitats.

Bacterial carbon (mg/g dry weight) in sediments ranged from 0.00024 to 0.01073, or to a depth of 10 cm, from 24 mg carbon/m^2 in sandy

Table 1. Functions of large river LTER core data sets. A = data will provide direct evidence to test one or more hypotheses; B = data will establish long-term record of river conditions and indicate physical and biological relationships.

	Subject areas			
Core data set	Control of production by physical factors	Sources of organic matter for secondary production	Control of community structure by physical variables	Succession
Water levels (all pools, daily)	A, B		B	B
Discharges (Pool 19, weekly)	A, B		B	B
Sediment, water quality, nutrients, carbon (Pool 19, seasonally)	A, B	A, B	B	B
Main channel water quality (Pool 26, weekly)	B	B	A, B	B
Aerial photographs (all pools, annually and event triggered)	B	B	B	A, B
Land/water, sediment, vegetation maps (all pools, as necessary)	B	B	B	A, B
Bathymetric profiles (all pools, as necessary)	B	B	A, B	A, B
Populations[1] with supplementary water quality and habitat data (all pools, seasonally)	A, B	B	A, B	A, B

[1] Populations include phytoplankton (chlorophyll a), zooplankton, benthic macroinvertebrates, and adult fishes.

sediments (generally found in the MC habitat) to 1073 mg carbon/m^2 in muddy sediments containing hydrophyte roots (in VMCB). Biomass in muddy sediments was significantly higher (P <0.05, ANOVA) than in sandy sediments. Bacterial biomass was highest on the submersed surfaces of hydrophytes, ranging from 0.06 to 4.90 mg carbon/g dry weight on Sagittaria latifolia and Vallisneria americana, respectively. When bacterial biomasses in the water column (assuming a depth of 1 m in each habitat), sediments, and on plant surfaces were combined, the VMCB habitat contained 1.8 times the bacterial carbon in NVMCB and 6.7 times that in MC habitats. This pattern of higher amounts of bacterial carbon in VMCB appears to exist throughout the year, but it is most apparent from August through October.

Distribution and Characteristics of Dissolved and Particulate Organic Carbon

During summer, dissolved organic carbon (DOC) concentrations in Pool 19 were significantly higher (P < 0.05, ANOVA) in the VMCB than in other habitats; particulate organic carbon (POC) concentration was also highest in VMCB. DOC and POC concentrations both correlated significantly (P < 0.01, Pearson) with water column bacterial biomass. Enclosure experiments conducted in the vegetation bed at Nauvoo Flats in the summers of 1983 and 1984 indicated that submersed vascular hydrophytes in the vegetation beds excrete substantial amounts of DOC.

Annually, about 15% of the fine (<1-mm diameter) suspended particulate material (SPM) in Pool 19 was organic. During all seasons, the percentage of SPM consisting of organic matter was higher (up to 28%) in VMCB than in other habitats and often decreased progressively with distance from vegetated areas. Organic nitrogen content and oxygen consumption (as measured in a Gilson differential respirometer) were both higher for fine particulate organic matter (FPOM) from VMCB than that from other habitats. These findings suggest that relatively labile carbon, as DOC, FPOM, and associated bacteria, is produced in vegetated areas of Pool 19, and subsequently it may be transported by waves and currents to nonvegetated areas where is provides substantial nutrition to higher level heterotrophs.

The Illinois River Flood of 1985--Event-Triggered Sampling
(Demissie and Bhowmik)

The third highest flood on the Illinois River in the 140-year record occurred in March 1985. We have good historical data on our study area in the river, Peoria Lake, and the Water Survey obtained supplemental funding from the Rock Island District, U.S. Army Corps of Engineers, to support intensive field data collection in the lake from February to May 1985. The field data collection included the following components: (1) velocity and discharge measurements, (2) sediment concentration and particle size sampling, (3) lake bed material and sediment core sampling, and (4) bathymetric profiling of the lake bed.

Velocity and discharge measurements were made at several locations between Franklin Street bridge near downtown Peoria and Chillicothe (Fig.

1). Velocity measurements were taken across the stream channel and the lake at two different times. The discharge at the Franklin Street bridge was measured nine times during the flood. A flood hydrograph of the Illinois River and the sediment load during that period was generated (Fig. 2). A total of 256 samples were collected for sediment concentration analysis and another 25 samples for particle size analysis. We made 31 attempts to collect bed load samples. Only one measurable sample was collected at the Franklin Street bridge. Boat sampling, however, was successful in collecting six bed load samples with very high organic content, which may require a follow-up study to investigate the nature and transport of bed load in Peoria Lake.

We collected 25 bed materials and 14 core samples for particle size, unit weight, and chemical analyses at the different sampling cross-sections. The results are still being analyzed and will appear in the 1986 annual report and in publications.

Dams and Successional Changes in the Illinois River
(Demissie and Bhowmik)

The event-triggered sampling also enabled us to update the hydrographic information on Peoria Lake and to draw conclusions about long-term successional processes.

Mapping of Peoria Lake and Tributary Watersheds

Peoria Lake and the watersheds of the tributary streams that drain directly into Peoria Lake were digitized from 11 7.5-minute quadrangle maps of the U.S. Geological Survey, starting from Peoria Lock and Dam (river mile 158) and ending at the Lacon Bridge (river mile 186) using the Geographic Information System (GIS) (Fig. 3). It is now possible to produce maps of different sizes and scales, compute the area of the lake, the length of the shoreline, drainage areas of tributary streams, stream length, and other relevant information.

Sediment Rates. In 1903, the lake volume was calculated to be 120,000 acre-feet from the Woermann maps (Table 2). For all practical purposes, the 1903 volume can be assumed to be the original volume of the lake prior to manipulations by man. In 1965, the lake volume was 73,000 acre-feet. Thus, in 62 years, the lake lost slightly less than half of its volume. However, a large percentage of this volume loss occurred just since the completion of Peoria Lock and Dam in 1939, which combined with the reduction in the diversion of Lake Michigan water, served to double the trap efficiency of Peoria Lake. By 1975, the lake volume had decreased by 16,000 acre-feet to a total volume of 57,000 acre-feet. In 1985, the lake volume was only 39,000 acre-feet, which is less than a third of the 1903 volume.

Sediment Distribution. The sedimentation rate in upper Peoria Lake is nearly twice that of lower Peoria Lake. The upper lake has lost about 73% of its 1903 volume while the lower lake has lost 54%. The depth in much of the lake is decreasing and the main channel is shrinking (Table

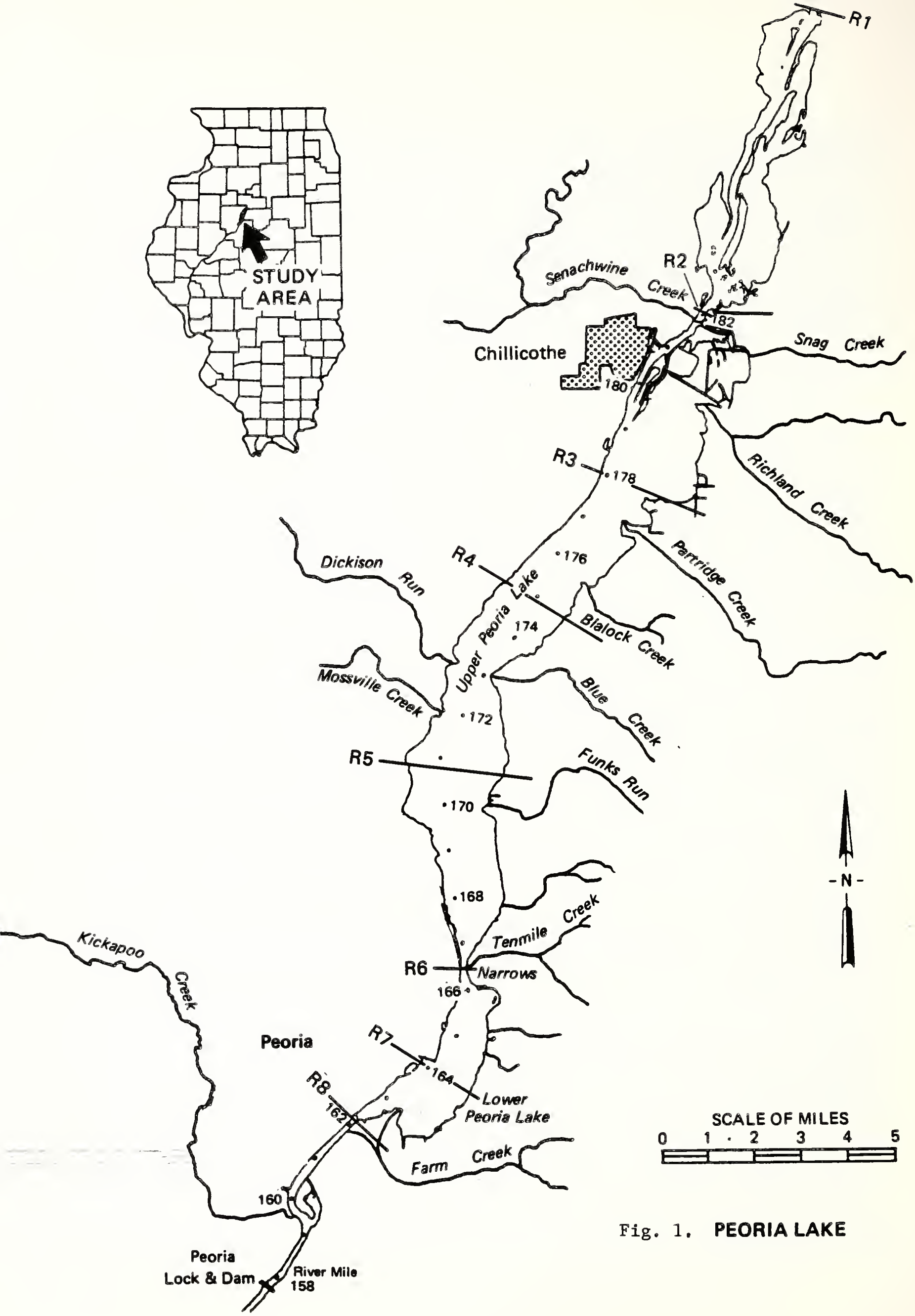

Fig. 1. **PEORIA LAKE**

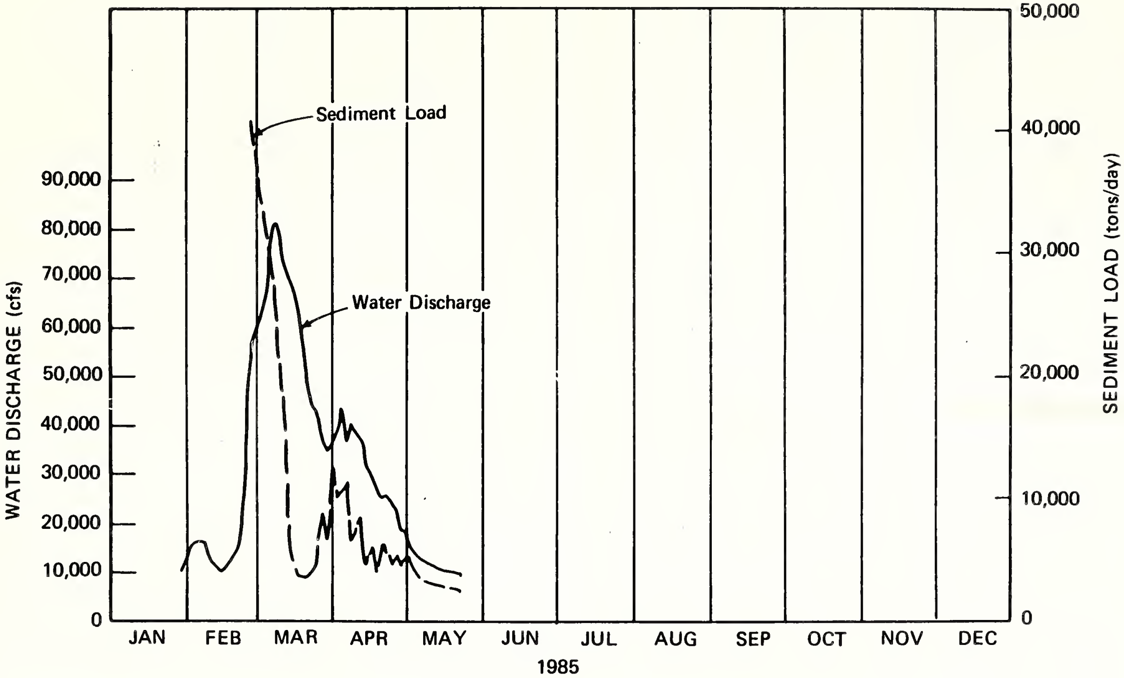

Fig. 2. Hydrograph of the Illinois River flood, Peoria Pool, 1985.

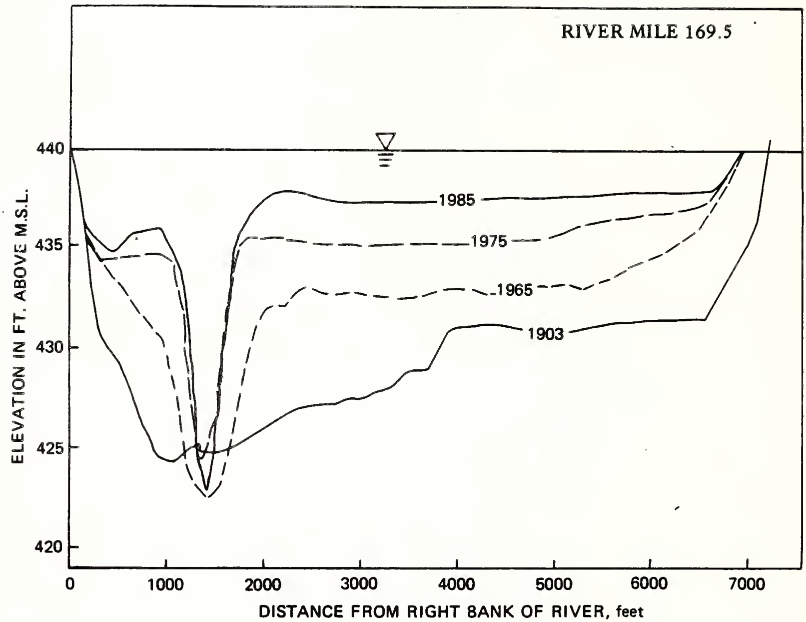

Fig. 3. Historical cross-section of Peoria Lake, Illinois River.

Table 2. Capacity (acre-feet) of Peoria Lake, Illinois River.

Year	Upper lake	Lower lake	Total lake
1903	96,000	24,000	120,000
1965	55,200	17,700	72,900
1975	42,200	14,400	56,600
1985	25,700	13,000	38,700

Table 3. Average depth (feet) of Peoria Lake, Illinois River.

Year	Upper lake	Lower lake	Total lake
1903	7.6	9.8	8.0
1965	4.4	7.2	4.8
1975	3.4	5.9	3.8
1985	2.0	5.3	2.6

3, Fig. 3). The lake capacity is approaching a dynamic equilibrium while the channel capacity does not show any reduction in the rate of capacity loss, implying that the channel will require dredging much more frequently to keep it open.

The 1903 contour for the 5-foot depth shows that much of the lake was deeper than 5 feet, while the 1985 contour indicates a narrow channel that bounces from shore to shore in upper Peoria Lake and close to the western shore in lower Peoria Lake (Fig. 4). If sedimentation continues at the same rate as before and no dredging is performed in the lake, the 1985 contour may reflect the plan form of the future Peoria Lake--a narrow stream channel in the middle of the lake and mud flats and marsh areas on both sides of the channel. The equilibrium conditions expected for the Illinois River within Peoria Lake will be totally different from its original shape, plan form, and character.

Dams and Successional Changes in the Mississippi River (Bhowmik)

The present morphology of any stream or river is the end product of all the natural and man-made influences and constraints that have been imposed on the system from its inception. The mighty Mississippi River is no exception to this process of environmental change. In addition to climatic and natural influences, the river has been altered to insure an adequate navigation channel since 1824 when the removal of snags, shoals, sand bars, and rock ledges began (Solomon et al. 1975).

Pool 19 near Keokuk, Iowa, is one of the 27 pools along the Mississippi River, and one of our three sites for intensive study. This pool extends from Keokuk, Iowa, past Burlington, Iowa, for a distance of 74.5 km. The lock and dam at this location was constructed in 1913 for hydropower development and to facilitate navigation past the Des Moines Rapids; it is the oldest and highest lock and dam (11.6 m) along the river. This is also the longest pool of the entire navigation channel. At the flat pool elevation, the head on the dam is 11.64 m, which is the highest head differential on the Mississippi River except for the Upper St. Anthony Falls Lock.

Alteration of the river by the construction of locks and dams, dikes, and other structural means has initiated some reactions that alter the morphology of the river both immediately upstream and downstream of the locks. The long-term effect is a widening of the river upstream of the dam and a slight narrowing of the river immediately downstream of the dam (Simons et al. 1975). Pool 19 dam has a high storage capacity to inflow ratio, C/I, compared with most of the low head navigation pools and has undergone a predictable successional change that includes initially high trap efficiencies and sedimentation rates, a decrease in sedimentation rates with time as the storage capacity decreases, and the eventual attainment of a state of dynamic volumetric equilibrium. We have also analyzed the trends in capacity loss of this pool in terms of trap efficiencies (Brune 1953) and have observed that Pool 19 may reach a dynamic equilibrium when the C/I ratio reaches a value of about 0.002 (Fig. 5).

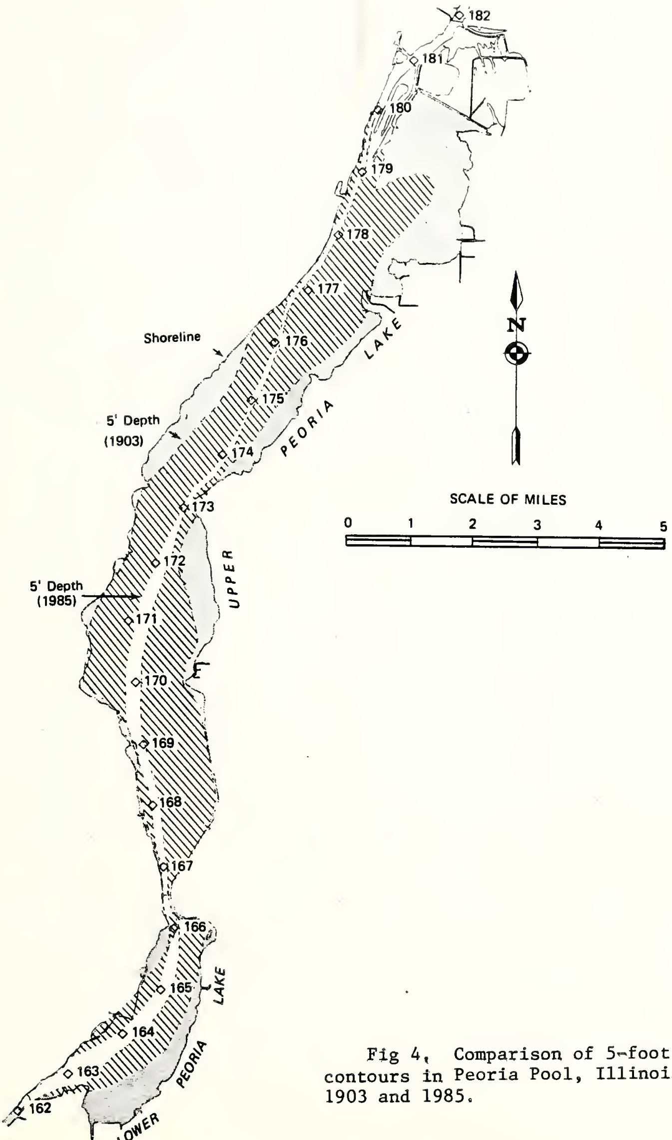

Fig 4. Comparison of 5-foot contours in Peoria Pool, Illinois River, 1903 and 1985.

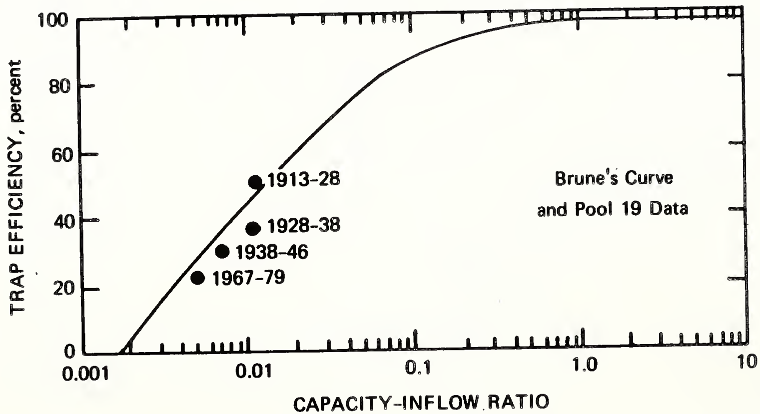

Fig. 5. Trap efficiency of Pool 19, Mississippi River, and a comparison with Brune's (1953) curve.

Within each successive period, the capacity of the pool decreases with corresponding decrease in the C/I ratio and the trap efficiency (Fig. 5). If the trend line for Pool 19 is extended to the point of zero trap efficiency (Fig. 5), that is the average inflow of sediment equals the average outflow of sediment, the C/I ratio would be between 0.002 and 0.0025. At this point, the pool will attain a dynamic volumetric equilibrium. Assuming that the rate of capacity loss changes from 3.46 million cubic meters per year in 1979 to zero when C/I equals 0.002 or 0.0025, then this equilibrium will be attained between 2016 and 2053, and the pool will have lost about 80% of its original capacity.

Extensive sedimentation of the channel border areas will cause the loss of 80% of the pool capacity. Fig. 6 summarizes the progression of the downstream portion of the pool toward an ultimate plan form and shape. This portion of the river will change from a lake-like appearance to a river and floodplain environment. The main navigation channel will not change in position or depth and the river will not return to the pre-dam geometry of rapids and pools. The pool will function more as a deep-incised river instead of a lake. The river will still have channel border habitats with benthic and macrophyte communities, but the habitats will be closer to the main channel and much reduced in area, so the primary and secondary production of the aquatic environment will also be reduced. The predicted morphological changes are the end result of the high dam along the navigation channel which has drastically changed the low water profiles.

Navigation locks and dams are constructed mainly to develop a channel deep enough to allow commercial traffic during the low flow season when the depth of water in the natural river is insufficient to allow 2.75-m draft barges to move safely. This change of the normal low water depths will in turn alter the interactions between the main river and its tributaries. Normally, the low water profile of a main river and its tributaries match at the confluence with minimal backwater effect on the tributaries. However, with an increase in the low water depths in the main river due to the construction of the locks and dams, the tributary mouths are submerged, backwater extends up the tributaries, and the flow velocity is decreased forcing the deposition of sediment loads at or near the confluences, with increased delta and island building (Lane 1955, Wright and Coleman 1972, Solomon et al. 1975, Chen and Simons 1979). The pooling action of the river has accelerated the formation of islands and deltas and the tributary mouths are like miniature versions of the main Mississippi delta.

An example is the confluence of Devils Creek and the Mississippi River about 21 km upstream of Lock and Dam 19 (Fig. 7). Before being dammed, the river at this location was about 1.5 km wide with an average depth of about 1 m. The construction of the lock and dam increased backwater and channel border areas. The 1930 outline shown with a broken line (Fig. 7) indicates the river at this location was about 3 km wide. However, the deeper part of the river still stayed close to the eastern bank. During the last 54 years, Devils Creek Delta has progressed toward the main channel. The shallow offshore area (called Montrose Flats) is now less than 1 m deep and is biologically highly productive with

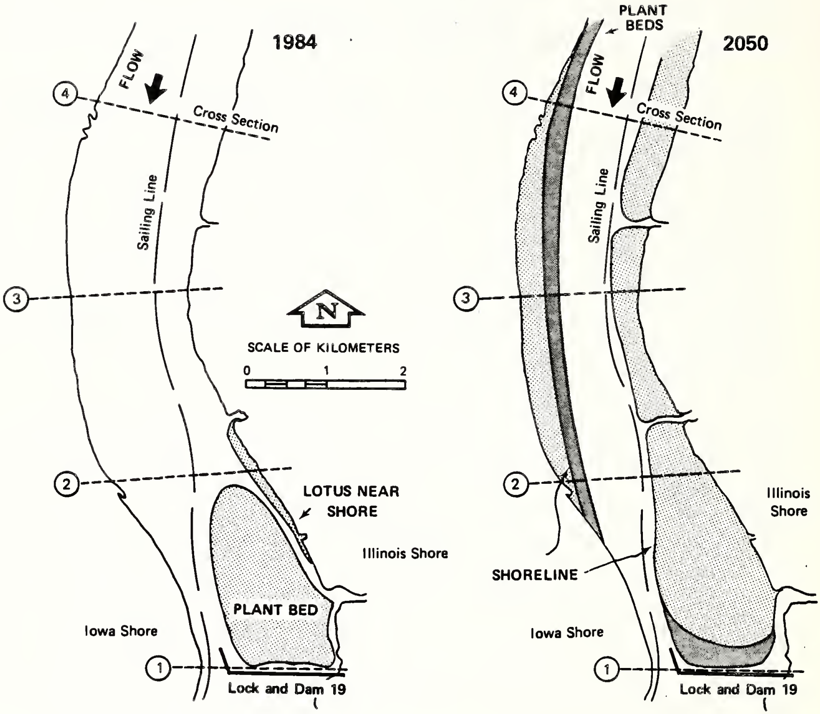

Fig. 6. Mississippi River upstream of Lock and Dam 19 showing 1984 shoreline and vegetation beds on the left and projected future shoreline and vegetation beds on the right.

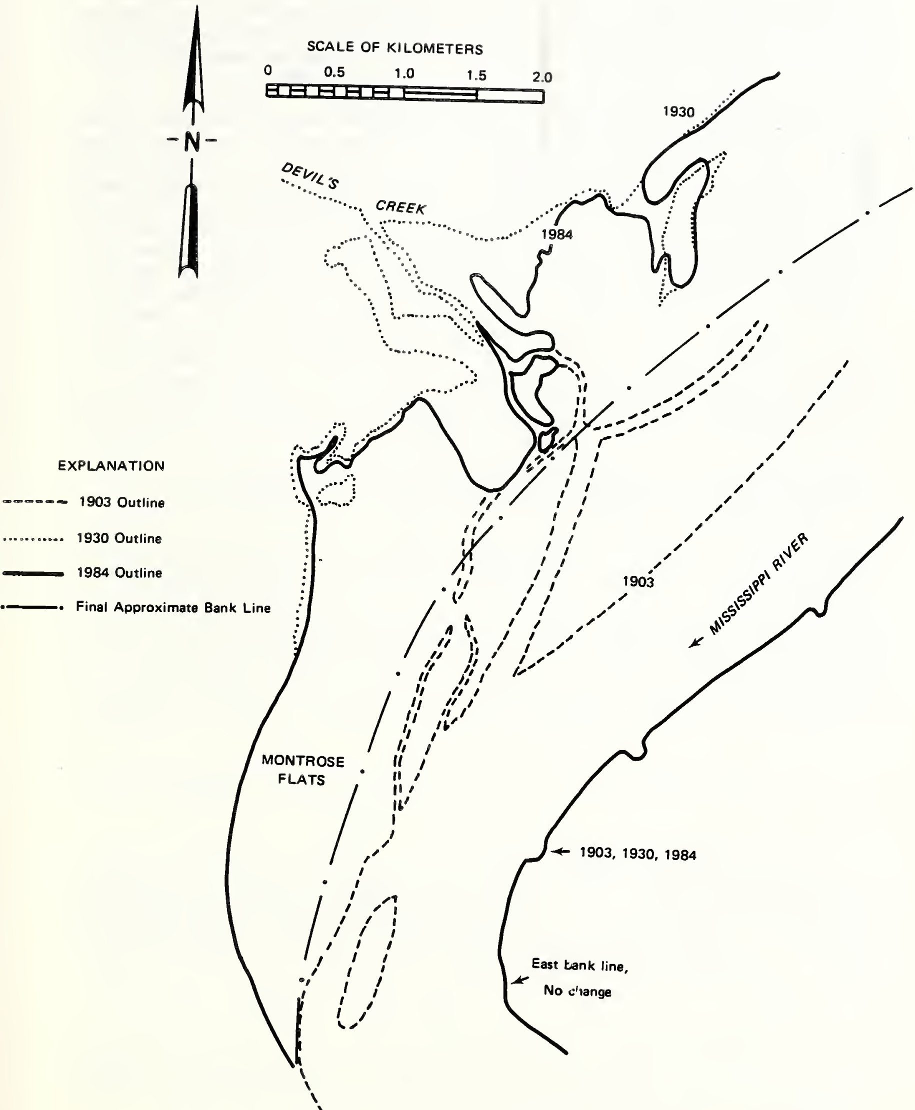

Fig. 7. Past, present, and future delta formation at the mouth of Devils Creek on Pool 19, Mississippi River.

extensive beds of clams and macrophytes. However, the future cross-sectional shape of the river at this location will not bear any resemblance to the present or original cross section. The river will have an incised channel about 6-10 m deep near the east bank, compared with the original shallow and broad channel with a 1-2 m average depth.

Our predictions are based on existing data and information. Flows in the Mississippi River change and the river may go through extreme events, such as floods and droughts. The 1973 flood on the Mississippi River was the second highest flood of record (Bhowmik and Adams 1984) and scoured approximately the equivalent of 1 year of sediment load from Pool 19. Moreover, the 1973 record flood, in combination with the floodplain levees that constrict the river floodplain area (Belt 1975) may have increased sediment deposition in the backwater areas and near the mouth of the river (Wright and Coleman 1974). On the other hand, during the 1977 drought, the sediment load in the river was very low, water was clear with low turbidity, and macrophyte beds expanded rapidly on Montrose Flats. These macrophyte beds, in turn, reduced the flow velocity forcing the deposition of additional sediments. Thus, the stable equilibrium morphology of the river is predictable, but the time to equilibrium depends on extreme natural events (floods and droughts) that could either accelerate or decelerate the long-term trends.

Annual Pattern of Temperature, Precipitation, and Streamflow over the Last Century (Wendland and Miskimen)

The objectives of this component were: (1) to develop a quality tree-growth chronology for a few sites on the Mississippi and Illinois rivers, which would be statistically correlated with temperature, precipitation, and streamflow for the last 40 years, and (2) to reconstruct the same three parameters for the period from 40 years ago to the earliest tree-ring available. The project involved field work to core several tens of trees of one species at each site, preparation and measurement of the cores, correlation of the cores with the three parameters, and actual reconstruction.

The objectives were to be met by several tasks and the progress of each is discussed below.

Location of Sites

With the help of county foresters and others, we located three sites where cores from old trees could be obtained along the Illinois and Mississippi rivers. The age of trees was not as great as hoped but permitted reconstructions back to about 1890 along the Illinois River and about 1910 along the Mississippi River.

Coring Trees

Twenty-one trees were cored (seven cores each) from oak and maple from the Marshall County Conservation Area in late August and early November 1984. This site is located within a few hundred meters of the

Illinois River. Cores were obtained form trees located both on the floodplain (trees on soils saturated by every flood) and also on adjacent slopes several tens of meters above bankfull discharge (trees which experience no flooding). Fifteen oak trees were cored on 1 December 1984 at Big River State Forest in Henderson County along the Mississippi River. Another 12 oak trees were cored in Loud Thunder Forest Preserve in Rock Island County on 2 December 1984. Because the last two sites are located within a few kilometers of each other, the cores were combined and treated as one site.

Determination of Missing or Multiple Rings

Occasionally, trees will grow no annual rings or perhaps two rings during one growing year. These events occur because of disease, insects, or perhaps very unusual weather. Missing or multiple rings were identified by the use of skeletal plots.

Calculation of Annual Tree-Ring Indices

Because different species grow at different rates and because young trees typically grow faster than older trees, actual ring widths are not an appropriate measure of relative growth, either temporally or inter-species. Therefore annual indices are calculated. The index is a dimensionless number from which the "growth curve" (i.e., the propensity for a young tree to grow faster than an older tree) has been removed. A program from the Laboratory of Tree-Ring Research at the University of Arizona was used for this procedure. All oak cores have been subjected to this procedure. The calculation of annual indices is currently being delayed because of problems with the program.

Because one species may grow faster than another, each core's ring widths (in mm) are being converted to an index, which is the width divided by the standard deviation, making the indices of one species comparable to those of another. All trees from the same species and from the site are averaged so that individual idiosyncrasies from one core or tree will be removed.

Correlation between Annual Growth Indices and Temperature, Precipitation, and Streamflow

Using growth indices, temperature, precipitation, and streamflow from the last 40 years, correlations between the annual growth index (dependent variable) and the three independent variables will be determined: (1) monthly temperature and (2) precipitation from the growing season and from several months prior to the growing season, and (3) streamflow data from sites near each of the tree sites. Correlations from the last 40 years of data will permit the reconstructions of the three environmental parameters for years prior to 1945 using the techniques described in Wendland and Watson-Stegner (1983).

Reconstruction of Temperature, Precipitation, and Streamflow from Tree Rings

Reconstructed values of the above three parameters will be determined for those months where statistically significant relationships have been identified. Linear regression will be used for the reconstructions; however, the actual variables used for reconstructions may differ from those used by Wendland and Watson-Stegner (1983). In that study, they assumed that the climate of both the floodplain and the hillside trees was essentially the same, but that the floodplain trees were also susceptible to periodic flooding and saturated soil moisture conditions. They constructed a growth ratio for each year, composed of the floodplain site mean index divided by the hillside site mean index. The ratio tends toward values less than unity during times of frequent or large-scale floods. This characteristic permits reconstruction of flood events based on growth ratios from years prior to the time of flood records. We anticipate that this work will be completed by the end of 1985.

Decadal Pattern of Moisture Stress over the Span of Millenia (King)

Climatic changes that cause replacement of one community by another generally occur on long-term time scales of thousands of years; however, changes of shorter duration, centuries and decades, can also result in subtle shifts in species composition if specific ecological tolerances are exceeded.

The fossil pollen record provides a history of vegetation that is the primary means of reconstructing climatic history for terrestrial environments. Studies of fossil pollen from sites throughout the midcontinental region of North America reveal a sequence of vegetation changes correlated with the large-scale glacial/interglacial cycles, as well as lesser shifts in the plant communities in response to the climatic dynamics of the Holocene (the last 10,000 years). Temperature appears to have been the primary controlling factor during glacial and deglacial periods while precipitation has been the most important climatic variable during the interglacial periods, including the current one. Since the final wasting of glacial ice about 9000 years ago, the vegetation of the Midwest has been controlled by available moisture (effective precipitation) rather than by temperature.

For the past 5000 years, climates have been slowly getting cooler and wetter in the American midcontinent, so that conditions are similar to those that occurred in the area about 9000 years ago. Beginning about 1000 years ago and lasting until about 300 years ago, there was one especially sharp period of hemispheric cooling, known as the little ice age or neoglacial, during which mountain glaciers advanced worldwide. Pine, spruce, and birch increased throughout the Great Lakes region (King et al. 1976). In the following short interval between the end of the neoglacial and the large-scale disturbance of the land and vegetational systems by Euro-Americans, the pollen record indicates a return to slightly warmer conditions and a decrease in boreal pollen indicators. In sites where the sedimentation rate is rapid enough, the pollen record reflects the effects of the mid-twentieth century droughts and the reforestation of abandoned farmlands.

Because of the extent of human disturbance, natural community evolution or climatically related change is masked. By comparing the short-term palynological record with that of the last 1000 years, we may achieve a better understanding of the natural environment. The goal of the palynology component of the Large River LTER study is to develop the short-term history of the vegetation within the basins for the last 200 years. The early part of this period is frequently cited as the model for the natural environment against which the modern disturbed communities can be compared. The difference between them is often considered a reflection of anthropogenically induced ecological change.

Progress to Date

The short-term history is being reconstructed from palynological studies of sediment cores collected from backwater lakes and bays within the river basins as well as isolated natural ponds in the area. The sedimentation rates within these target localities are unusually high due to human activities and have preserved a detailed pollen record of vegetation changes on a time scale not possible with naturally accumulated deposits. The details of the process of land conversion to intensive agriculture and its impacts on the natural vegetation should be preserved in these sediments. Because of the fast sedimentation rate, it may be possible to determine changes on the scale of decades or less. By detailing the changes in the vegetation communities bordering the river, impacts upon both ecosystems can be addressed as to synchronization, direction of community change, and source of impacts. For example, the impacts of agriculture can be separated from upstream events such as urban pollution.

To date, cores have been collected from the Peoria Pool and several backwater lakes upstream on the Illinois River and from within the main channel of the Mississippi River. The Mississippi River cores are composed of coarse sediment and I do not expect preserved pollen in these cores. Although pollen is a silt-sized particle, it acts like a clay-sized particle in suspension and does not settle out except in still water. The cores from the Illinois River will probably be more valuable in terms of palynological information. The final analysis of these cores will be completed this coming year.

Sediment cores have been collected from the Calhoun Point Wildlife Management Area at the confluence of the Illinois River with the Mississippi River. These borings were taken from the modern floodplain surface and include the last few decades of accumulation. In addition, several natural ponds were located in the area which may contain pollen records. Initial attempts to core these ponds have not been successful but I will change methods and try again.

River Ecosystem Model

Hydrodynamic Model (Demissie and Stephanatos)

The hydrodynamic model simulates the physical dynamics of Pool 19 so that the ecological dynamics of the pool can be explained and simulated properly. The hydrodynamic parameters which influence the biological structure and function of different habitats include flow velocity, discharge, water depth, sediment concentration, sediment accumulation or scour, and the transport of nutrient and pollutants. Field data collection alone could not provide all the above information at all places at any time. However, a model that has been calibrated and verified with field data will provide the necessary information for actual or hypothetical conditions.

The hydrodynamic model development for the Illinois Large Rivers LTER has progressed gradually as the results of the models were evaluated and used by the Biological Model. Initially, the model was strictly one-dimensional and the results were satisfactory but did not provide enough detail for the Biological Model. By using a different option in the existing model, it was possible to generate two-dimensional hydraulic information which is compatible with the objectives of the Biological Model.

Water and Sediment Transport Model. After reviewing existing models, we selected the HEC-6 sediment transport model developed by the Hydrologic Engineering Center, U.S. Army Corps of Engineers. The model was used with an alternative format which allows subdividing any reach of the pool into different compartments. However the HEC-6 is not capable of performing nutrient or pollutant transport, so we developed a nutrient and pollutant transport model that will use the HEC-6 output.

The data required to run the HEC-6 model include: (1) cross-sectional profiles, (2) sediment rating curves for the main river and tributary streams, (3) bed material characteristics, (4) water temperature, (5) flow resistance coefficients, (6) operating rules at the downstream dam, and (7) flow hydrographs for the main river and tributary streams.

For Pool 19, 30 cross-sections profiled by the Illinois State Geological Survey (ISGS) in 1983 were used. Sediment rating curves by size fractions were developed for the Mississippi River at Lock and Dam 19, Henderson Creek, and the Skunk River. The bed material characteristics were defined based on samples collected and analyzed by ISGS in 1983.

Water temperature affects the settling velocity of the sediment particles. Because water temperature data were not available at all locations for Pool 19, air temperature was adjusted to reflect the water temperature and used in the model.

The flow resistance coefficients represent the resistance to flow of a given reach of river. They include the effects of channel roughness, shape, and alignment. They vary with discharge and depth. Sufficient hydraulic data were not available to directly compute roughness coefficients, so past experience and literature values were used to approximate them. The relations between Manning's n and discharge used by previous studies on the Mississippi River were used to estimate the resistance coefficients.

For Pool 19, the operating rule is very simple because the water level at the Lock and Dam is maintained near 518.2 ft (MSL) at all times for all discharges.

Finally, the model requires the flow hydrographs for the main river and the tributary streams for the period of simulation. Daily water discharge hydrographs are available for the Mississippi River and the two tributaries, Henderson Creek and Skunk River. However, it is not necessary to run the HEC-6 model for a 1-day time step. Instead the flow hydrograph is divided into discrete units (Fig. 8) to decrease the number of time steps that have to be run. A whole-year hydrograph was reduced to 21 discrete flow values without losing much detail in the flow (Fig. 8). It can, of course, be divided into more segments if needed.

Outputs from the HEC-6 model include: (1) velocity for each compartment at every cross-section, (2) discharge for each compartment at every cross-section, (3) water surface elevations, (4) depth of water for each compartment at every cross-section, (5) sediment concentration and load at each cross-section, (6) change in channel bed elevations, and (7) total sediment accumulation in the pool.

One of the important steps in the hydrodynamic model is the subdivision of the pool into different habitat compartments. Based on habitat, substrate, and hydraulic geometry characteristics, the pool was subdivided into main channel, channel border, and floodplain compartments. For most cases, the flow is within the channel border and main channel compartments (Fig. 9). The hydraulic parameters for each compartment and the flux of material from one compartment to another have to be computed. The flux of water from one compartment to another is calculated from the differences in discharge from cross-section to cross-section.

Nutrient and Pollutant Transport Model. Because of the varying rates of influx of nutrients, either from upstream, lateral, or tributary sources, gradients in nutrient concentrations occur most of the year. Point discharges or spills may create localized areas of high concentrations of pollutants in the future. Pollutants and nutrients can be transported to other areas by advection, due to flow, and by diffusion and dispersion, due to differences in concentrations.

The nutrient and pollutant transport model subdivides a reach of the pool into compartments or stream tubes (Fig. 10). This structure provides the necessary two-dimensional resolution of the study area and enables us to calculate the flux of nutrients and pollutants from compartment to compartment. The initial input data to the model is obtained from the HEC-6 alternative output format. The discharge within each compartment is calculated by using the conveyance factor for each tube (Equation 1):

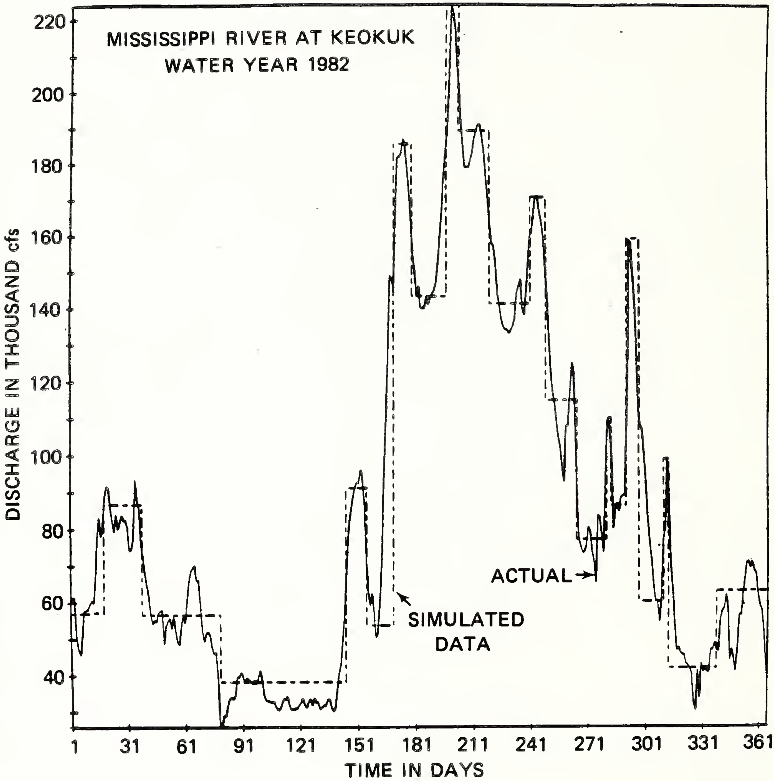

Fig. 8. Discrete units of flow hydrograph for Mississippi River Pool 19, 1982.

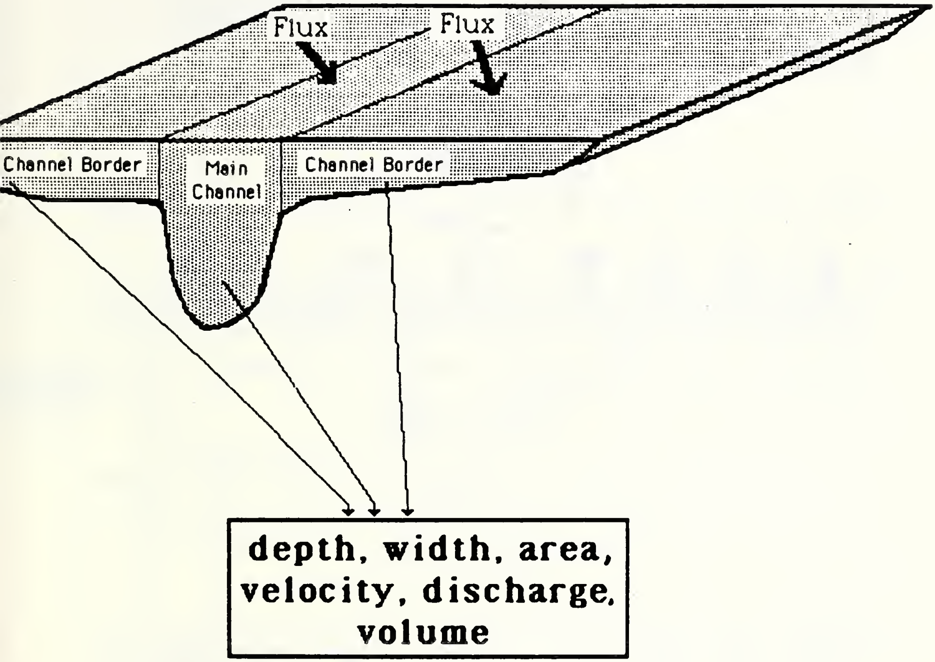

Fig. 9. Main channel and channel border compartments.

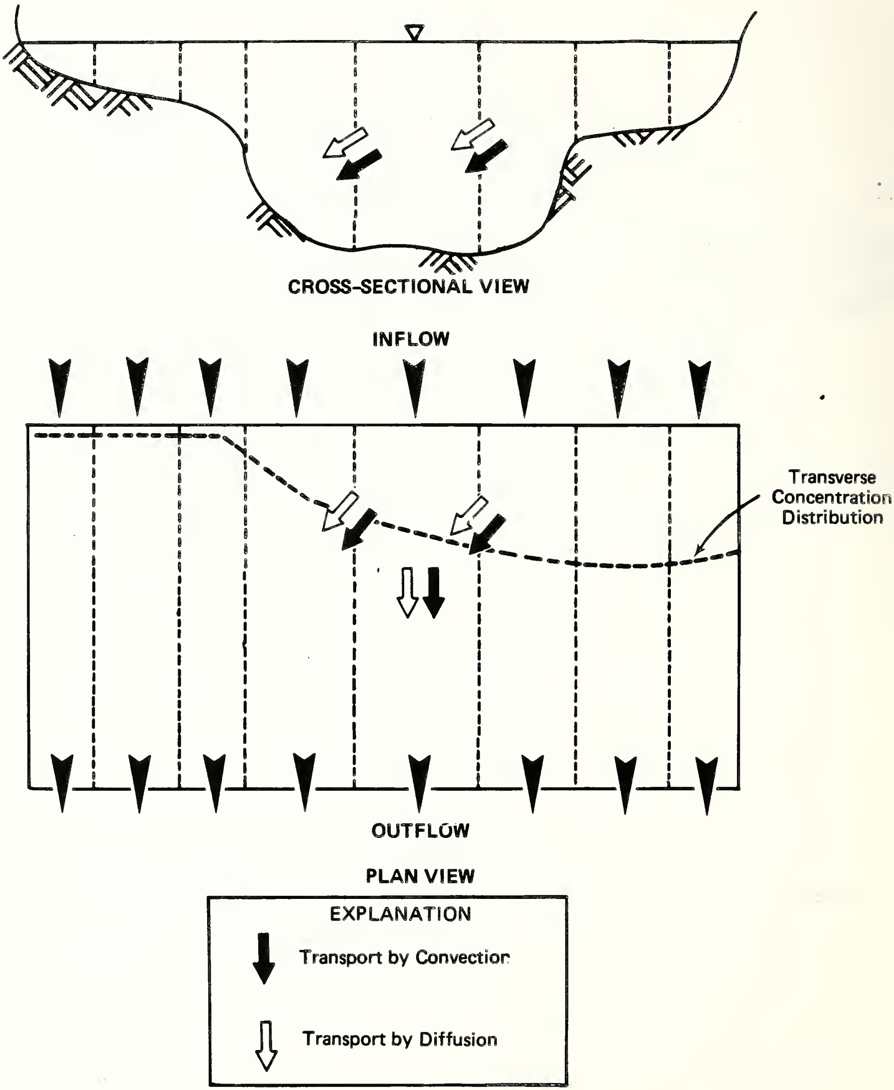

Fig. 10. Compartments for nutrient and pollutant transport.

$$Q_{ki} = Q_i * K_{ki}/K_i \qquad (1)$$

where: Q_{ki} = discharge in compartment ki
Q_i = total discharge at a section
K_{ki} = conveyance of compartment ki = 1.49 A_{ki} $R_{ki}^{2/3}/n_{ki}$
K_i = conveyance of the whole cross-section
A_{ki} = flow area
R_{ki} = hydraulic radius
n_{ki} = Manning's roughness coefficient

The flux of water from one compartment to another compartment, Q_{lk}, is calculated as:

$$Q_{lk} = \frac{\partial Q_{ki}}{\partial x} + \frac{\partial A_{ki}}{\partial t} \qquad (2)$$

where x and t are longitudinal distance and time, respectively, and all other terms are as described above.

Once water discharges and the corresponding velocities are calculated, the transport of nutrients and pollutants are calculated by the following equations. The equations are simplified by dropping the subscripts, but all the equations are used for each compartment.

(a) Transport by longitudinal convection (current) is calculated by:

$$A \frac{\partial c}{\partial t} + \frac{\partial (Auc)}{\partial x} = 0 \qquad (3)$$

where c is the concentration and u is the longitudinal velocity.

(b) Transport by longitudinal diffusion is calculated by:

$$A \frac{\partial c}{\partial t} = \frac{\partial (AE_x \; \partial c/\partial x)}{\partial x} \qquad (4)$$

where E_x is the diffusion coefficient in the longitudinal direction. The transport component is due to the concentration gradient in the longitudinal direction.

(c) Transport by transverse (lateral) convection is calculated by:

$$A \frac{\partial c}{\partial t} + \frac{\partial (Awc)}{\partial z} = 0 \qquad (5)$$

where w and z are the transverse velocity and distance, respectively. This transport component is due to the current from one compartment to another compartment.

(d) Transport by transverse diffusion is calculated by:

$$A \frac{\partial c}{\partial t} = \frac{\partial (AE_z \ \partial c/\partial z)}{\partial z} \tag{6}$$

where E_z is the diffusion coefficient in the transverse direction.

The nutrient and pollutant transport model was used to simulate the transport processes in Pool 19. The initial simulation runs included continuous and pulse (slug) carbon input at the upstream end of Pool 19. The results for a continuous carbon input of 60 $g/m^3\ s^{-1}$ are shown in Fig. 11, where the carbon mass flux is shown throughout the pool for 12.2, 24.2, 42.2, and 96.2 hours after the initiation of the input. The water discharge was assumed to be 1650 $m^3\ s^{-1}$. The front edge of the carbon flux traveled 34 miles in 12.2 hours, and after 42.2 hours (less than 2 days), it had already reached Lock and Dam 19. After 96.2 hours, the whole pool is in a steady state condition. For the same conditions, Fig. 12 shows the change in concentration of carbon at river miles 406.3, 394.9, 382.9, and 373.97, starting from the time carbon entered until 80 hours later. It shows how the carbon moved from the upstream portions of the pool downstream.

In another example, 60 $g/m^3\ s^{-1}$ was introduced once and discontinued with a water discharge of 5120 $m^3\ s^{-1}$ (Fig. 13). After 9.1 hours, most of the carbon is between 11 and 25 km downstream from the source. After 18.1 hours, most of the carbon has moved further downstream and is spread over a larger area. After 30.1 hours, most of the carbon has moved out of the pool with some spread over the pool.

Biological Model (Anderson)

Simplification. The initial approach to the biological model (see our 1983 and 1984 annual reports) has been valuable in that it focused our research on key organisms or groups within the river system. However, this model began to develop into an increasingly complex set of population models which could not answer some basic system-level questions. The expanding number of state variables required more development time and input data than were available. Consequently, a simpler model was developed to help address the following objectives:

(1) Determine sites of carbon production, accumulation, and use within a navigation pool. Sampling has shown that some areas, e.g., the large eddy in the river reach of Pool 19 referred to as Montrose Flats (river miles 375-377), act as retention devices for organic matter. Also some habitat types have a high biomass of heterotrophs while other habitats are areas of high autotrophic production which may fuel the heterotrophs.

(2) Determine turnover time and the seasonal patterns of carbon flow of a navigation pool. Large macrophyte beds undergo seasonal production and senescence, benthic insects show periods of peak growth and mass emergences, and organic matter is periodically redistributed by floods.

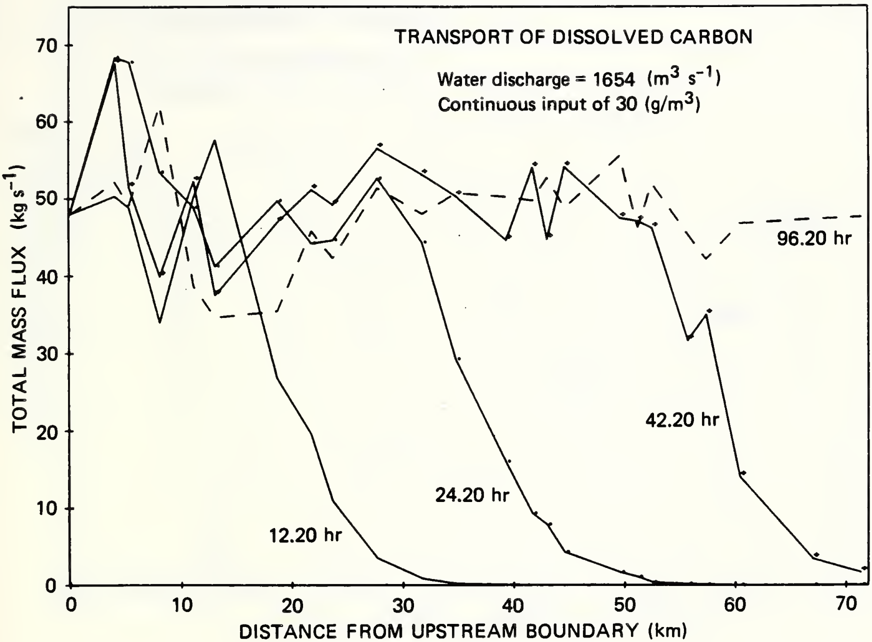

Fig. 11. Carbon transport simulation for continuous input.

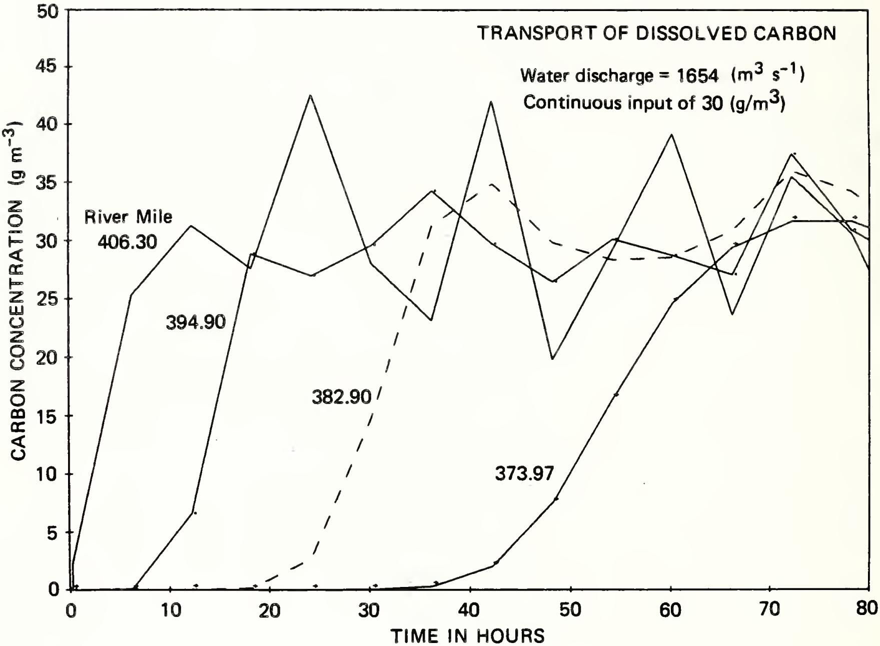

Fig. 12. Carbon transport simulation for continuous input.

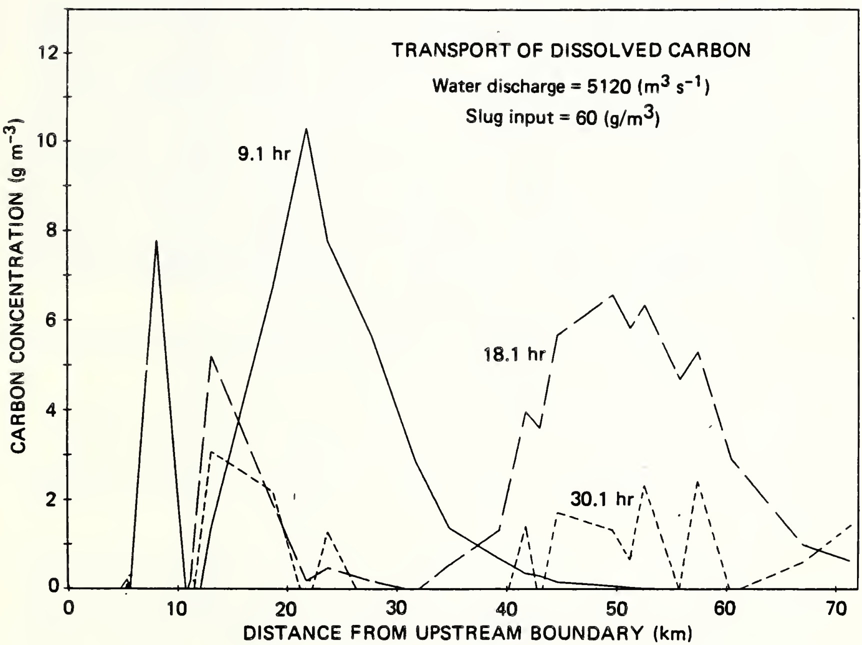

Fig. 13. Carbon transport simulation for slug input.

(3) Examine carbon use by major biotic components of a navigation pool. Use of carbon by major biotic components within habitats may change depending on the life cycle of the dominant organisms.

(4) Evaluate environmental factors that affect carbon movement through a navigation pool. Floods bring not only allochthonous organic matter but also inorganic sediment which affects primary production and feeding efficiencies of consumers. Wind- and boat-generated waves likewise resuspend and redistribute sediments and organic matter.

Model Structure. The simplified model consists of nine state variables with 56 flows (Fig. 14). The state variables are divided into those that occur in the water column (at the top of Fig. 14) and those that occur in the substrate, i.e., "sediment consumers" are consumers which live in the sediment but not necessarily those which ingest sediment (Fig. 14). The model is designed to simulate carbon flow between major biotic components within a habitat of a navigation pool. Due to fast turnover rates in some components, i.e., decomposers, a small time-step of 0.1 day is used. Flows between state variables represent consumptive processes and/or hydrodynamic events. Hydrodynamic events include scouring and mechanical processing of material from the substrate due to increased current velocity. Deposition of material in the substrate occurs when current velocities are low. Information on current velocity and total suspended solids is obtained from the hydrodynamic model and represents one of the links between the two models.

Each flow consists of the mass of the state variable multiplied by a maximum rate constant and modified by a series of functions:

flow = biomass of state variable * maximum rate * modifying functions

All modifying functions are 0 to 1 relationships. For example, Fig. 15 represents the effect of current velocity on rate of movement of organic matter or decomposers from the substrate to the water column--a scouring function.

Simulations. A series of model simulations have been completed using two model packages developed by Dr. Thomas B. Kirchner of the Natural Resources Ecology Laboratory, Colorado State University, and the Experimental Range LTER project. The packages called PREMOD and MODAID convert mathematical statements into FORTRAN, interpret functions, and organize data output. A FORTRAN version of the model has also been developed for use on IBM-PC's at the field stations.

The model is very sensitive to the physical-chemical factors of current velocity, total suspended solids, dissolved oxygen, and temperature. For example, as current velocity decreases, particulate organic matter in the water column settles to the substrate and becomes incorporated in substrate debris (Fig. 16a). The model is also responsive to carbon availability as demonstrated by pulsing the system with dissolved organic carbon (Fig. 16b). Decomposers respond by an increase in biomass, taking up the available carbon. Metabolic demands result in

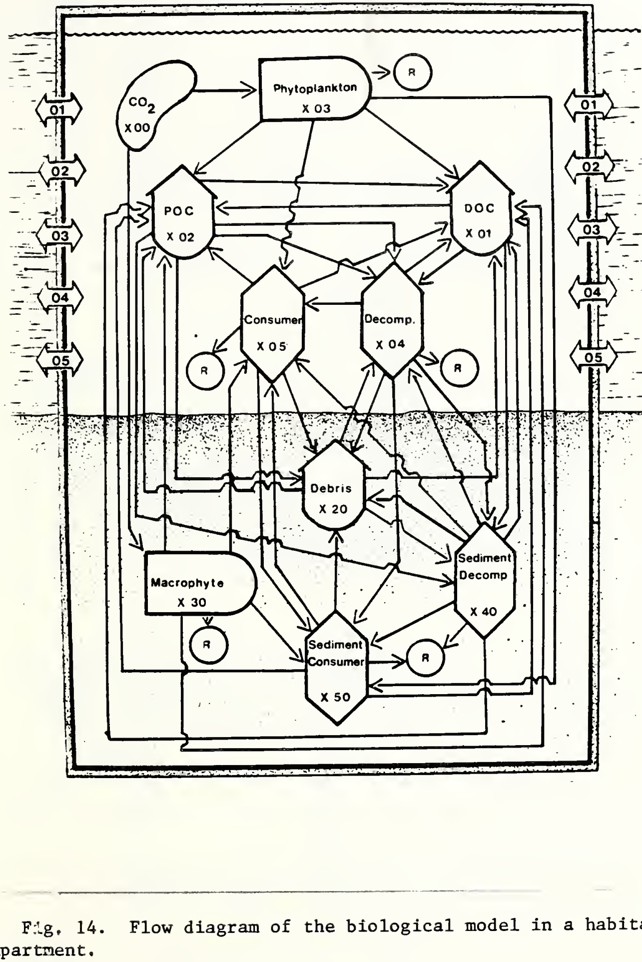

Fig. 14. Flow diagram of the biological model in a habitat compartment.

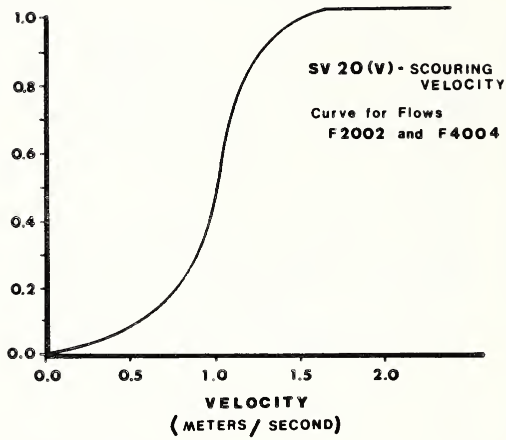

Fig. 15. The 0 to 1 function used to determine the effect of current velocity on flow from debris (X20) to POC (X02) and from decomposers in the substrates (X40) to decomposers in the water column (X04).

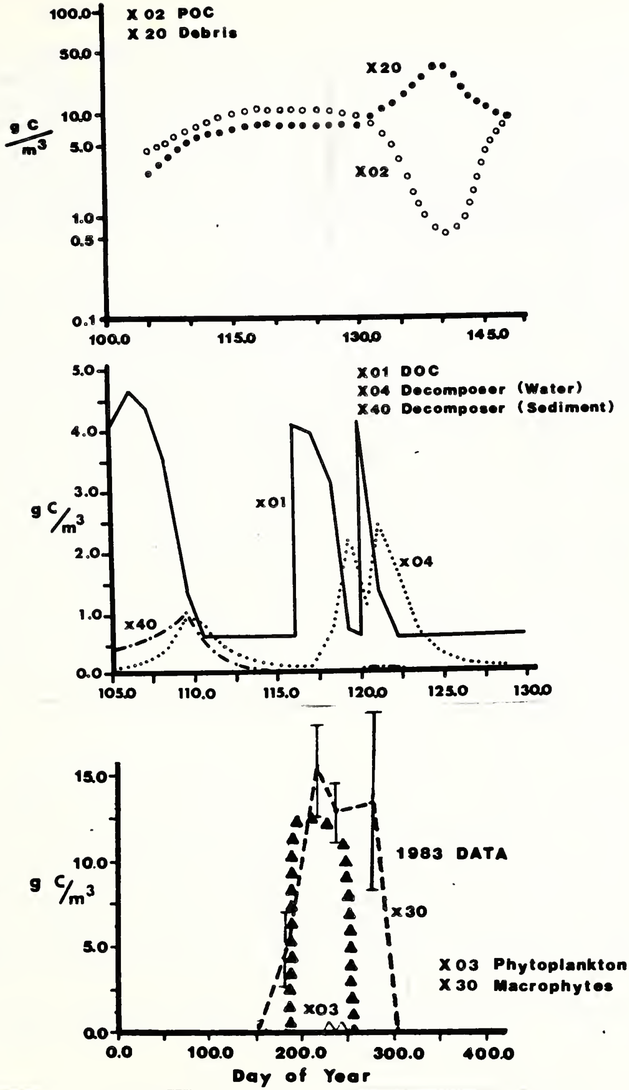

Fig. 16. (a) Model simulation showing increase in debris (X20) with decrease in POC (X02) when current velocity decreases. (b) Model simulation of the effect of pulsed additions of DOC (X01) on decomposers in the water column (X04). (c) Comparison of model simulated macrophyte production (X30) and field data collected from a macrophyte bed in Pool 19 in 1983.

biomass loss from the decomposers unless a carbon source is available. Temporal events, such as the seasonal development of macrophyte beds, have also been simulated (Fig. 16c). The actual biomass of macrophytes persisted much longer in 1983 than the simulated biomass (Fig. 16c) because our simulation was based on data available for two species, lotus (Nelumbo) and duck potato (Sagittaria), which senesce fairly early. When we account for the late season blooms of the duckweeds (Lemna) which are released from shading by the senescence of lotus and for the persistence of submergent macrophytes, the model output will more closely simulate field data.

Model Links. The biological model is designed to simulate carbon flow in a habitat. To simulate carbon dynamics within a navigation pool, the pool must be divided into habitat compartments and the compartments linked. On Pool 19, this has been done by dividing the pool into 30 segments (Fig. 17). Each segment is defined by a bathymetric profile. The segments are then divided into habitat compartments, with the number of compartments in a segment dependent on the variety of habitats within that segment. Each habitat compartment will then have a biological model functioning in it. Movement between compartments is based on the hydrodynamic model and the lateral and longitudinal flows in the water column. Flow of carbon between compartments occurs only for state variables in the water column. In order for sediment decomposers to move between compartments, they must first be scoured into the water decomposer state variable within a compartment. Movement between compartments will be on a daily time step with mass in each state variable of the biological model updated following flows between compartments. In this way, carbon is transferred down the pool with resident times in particular habitat compartments dependent on the biotic and hydrodynamic model links. Carbon will be retained or lost to the sediment in habitats were sediment is accumulating.

B. Methods Manual (Cahill)

The Large River LTER research program involves four independent agencies located in five widely separated areas. Coordination of analytical and field programs and establishment of standard laboratory and field techniques that will be maintained throughout this 30-year study are, therefore, critical. This manual describes 50 LTER field and laboratory procedures for research associated with this project. Designed to be used as documentation of LTER methods, it provides a mechanism for judging the internal compatability of LTER data sets, and when used in conjunction with other LTER site data, also their external compatibility.

The methods manual is being revised to include updated and added procedures. The manual is included in our data sets and documentation file available on the Prime 750.

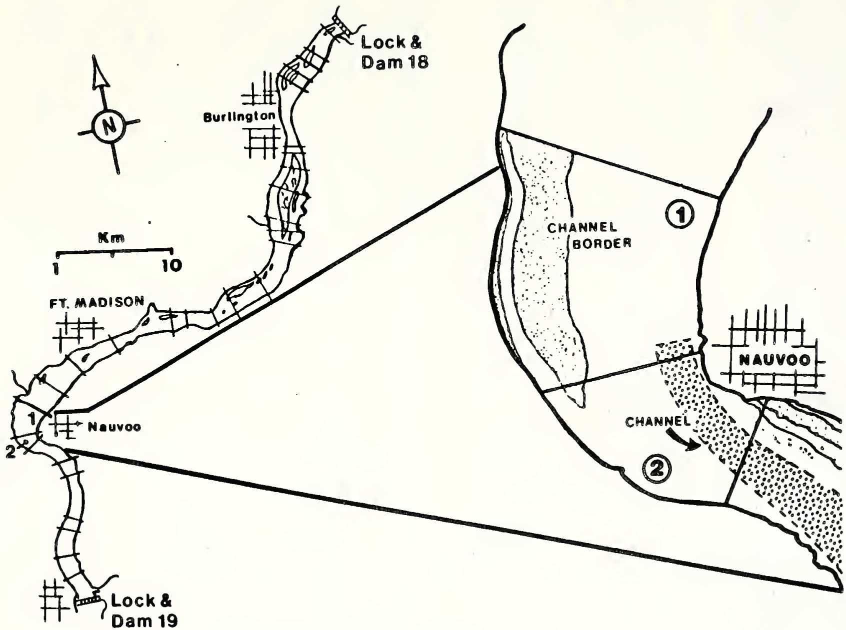

Fig. 17. Map of Pool 19 showing its division into segments and an expanded set of segments with habitat compartments.

C. Data Management and Analysis

Expansion from Data Archiving to Data Retrieval and Analysis (Gross)

In the early years of the LTER program, most sites defined data management as an archival function, which limited the assets that good data management can provide to a project. In 1983, the Illinois Large Rivers site hosted a data management workshop in which many of the sites noted a need for more data analysis. At our site through 1984 and early 1985, the data management program was redesigned to build an information system that uses a geographic information system as a major tool. These terms are confusing but very important.

Data management.--A program of personnel and computer hardware and software devoted to construction and operation of an information system.

Information system.--A system containing data in a form required by the user, accessible to the user, and complete enough to produce the desired results.

Geographic information system.--A cartographic system built around a relational data base management system. In our case, ARC/INFO software for managing geographic information, a Prime 750 computer system, and a data base of natural resource information for Illinois.

At the Illinois Large Rivers site, the evolution in data management has been from an exceptionally strong base of archiving to a highly automated computer system with most data entry at field stations. We began LTER with a strong base of the Illinois Scientific Surveys. The Illinois State Water Survey has massive files of hydrologic and meteorological information and enjoys a high degree of automation; they provided our first data manager. The Illinois State Geological Survey is a 79-year-old organization with one of the largest and most complete sample and well log collections of any state. The Illinois Natural History Survey, our lead agency in LTER, is more than 125 years old with major collections, many based on our river sites. Thus, we began with organizations that have a longer view than the LTER program.

As we strengthened data management, our first data manager, Robert Sinclair, resigned. He was responsible for several research programs and was unable to devote as many hours to LTER as he felt were necessary. Frank Brookfield became our data manager in February 1984. Frank is an expert in information systems, an employee of the Illinois Natural History Survey (INHS), and able to devote more than 50% of his hours to LTER. His salary is paid entirely by INHS and thus his presence is a very large INHS contribution to the LTER program.

In 1984, the NSF equipment supplement was used to purchase a 600-megabyte disk pack for the Prime computer system and four IBM PC's for Grafton, Havana, and Western Illinois University field stations and for the central data management site in Champaign. With this equipment, we were able to maximize data entry, retrieval, and analysis at field stations and then transfer copies of information to the Prime 750 in

Champaign. At the same time, our data manager could concentrate efforts on programming the model, training LTER staff on computer systems, and designing data entry procedures.

In 1985, the NSF supplement for technicians was used, in part, to employ Suzanne Miller to construct the base of the LTER Geographic Information System. Ms. Miller is a graduate student in geography, coming to the LTER program with a double major in biology and geology. As of July 1985, she has completed the base for Mississippi River Pool 19 and is working on Mississippi River Pool 26. We expect to complete this work by December 1985.

An important aside is the parallel development in Illinois of the Lands Unsuitable for Mining Program (LUMP), which is funded by the U.S. Office of Surface Mining. That program has as one of its mandates the development of a natural resource data base for use in informed decisions on coal strip mining. The data base is a Geographic Information System, which is the vehicle for our LTER data management system. LUMP was funded in 1982, soon after we began LTER. LTER needed only to add the disk storage space to the Prime for the storage of LTER data. Since LTER does not pay for computer time or other system support, our 1986 budget request contains only very small requests for computer charges. We pay only for those tasks that require use of a large main-frame machine at the University of Illinois.

Importance of Mapping Techniques and GIS to Large River LTER
(Miller and Gross)

Unlike most ecological research where study areas are small, the Illinois Large Rivers site consists of three very large study areas: (1) Pool 19 of the Mississippi River is contained on nine 7.5-minute USGS topographic maps, (2) Pool 26, at the confluence of the Illinois and Mississippi rivers, is depicted on 20 7.5-minute quads, and (3) Peoria Pool of the Illinois River covers 14 7.5-minute quads. Certain geographic features from these maps (i.e., water-land boundaries, islands, backwater areas, tributaries, floodplains, etc.) are of primary interest to this research and thereby form the basis for mapping work. To that template, we are adding the LTER data, such as geologic maps of bed materials and multiple surveys of aquatic plant beds.

To accommodate the large volume of data generated in creating a total of 43 base maps for the Large River Site, a geographic information system (GIS) has been developed using ARC/INFO. A GIS is a specialized data management system used to store and retrieve cartographic data. At the simplest level, a GIS is a method of managing, analyzing, and displaying map information. ARC, developed by Environmental Systems Research Institute, is the software used to process the geographical information. ARC interfaces with INFO, a commercial data base system from HENCO, which handles the descriptive data.

Processing a map in ARC/INFO starts with the outline of a 7.5-minute USGS topographic map, the base map (e.g., for Pool 19 nine base maps were created). Using the four corners of the base map as reference points, all subsequent displays of information can be related (Fig. 18). The next step is to digitize overlays that will fit onto the base map. These overlays contain specific features or points of interest (e.g., land forms, sampling locations, bed materials, vegetative beds). The overlay map is aligned to the base map by the reference points. Overlays depicting different sets of data may be used alone or in any combination (Fig. 18). The system also allows the combination of base maps so that the entire area can be displayed (Fig. 19).

The advantages of GIS to the Large Rivers site are severalfold. Most of the river research is geographically based. The ability to store and retrieve data in tabular and graphic forms provides flexibility in research. The standardized collection and recording of data create a detailed data base for current and future research.

Knowledge of how data sets are geographically related to other data sets allows researchers to evaluate changes within one site or between sites. Long-term trends can be recorded and current changes within these trends can be evaluated. For example, the sedimentology within each study area is distinct. Pool 19, the intensively studied area, is the most "pristine" and is characterized by accumulating fine-grained sediment. Pool 26 has a coarser bedload and will change with the construction of the new dam. The Peoria Pool, a highly perturbed area as a result of industry, is subject to rapid sedimentation of fine-grained material. The sediment type and trends observed at each pool indicate a dynamic condition within the river. Changes in the environment, either natural or man-induced (e.g., the construction of a new dam), will be reflected in changes in the sediment type, which in turn will affect the long-term trends in sedimentology of the river.

Incorporation of biology, geology, and hydrology into the data base will help to develop an understanding of the river. One current use of data collection sites is the comparison of the biological sampling points to define different habitat areas within the river. This sectioning of the river is being used for the hydrological and biological models.

Procedures and Management (Brookfield)

The last section described some of the changes in data management, provided a brief description of parts of the system, and demonstrated some results of our system. In this next section the data management function is described in more detail.

Configuration of the Site

Champaign. The main system at Champaign is the Prime 750 computer. It is equipped with digitizing boards, plotters, printers, phone line ports, direct access ports, and direct connection to the

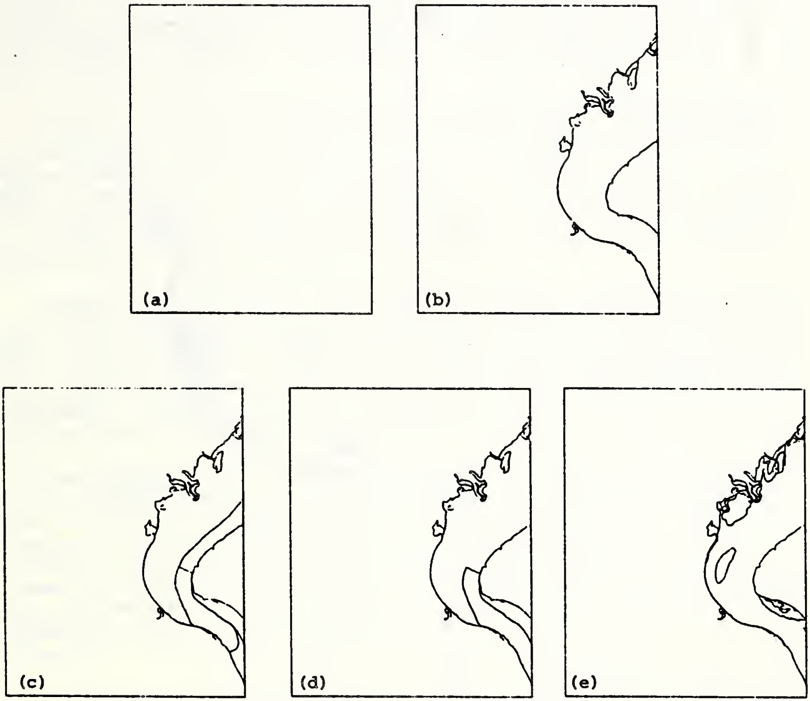

Fig. 18. Computer generated maps of Nauvoo Quadrangle, Pool 19, depicting quadrangle outline (a), water-land boundaries (b), and overlays of bed materials (c), biological habitats (d), and vegetative beds (e).

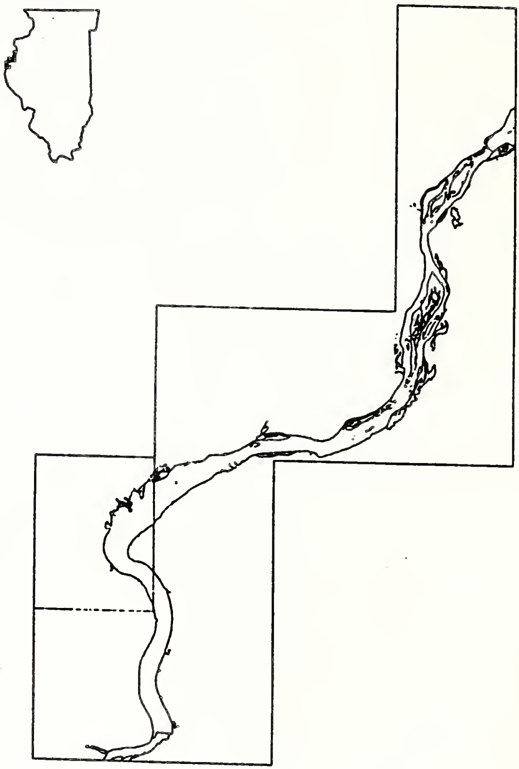

Fig. 19, Plot of Pool 19 shows the location of Nauvoo Quadrangle.

University of Illinois CYBER system. It currently has four disk drives, one of which is dedicated to the LTER project. The direct connections and phone line connections allow input from terminals or personal computers.

Remote Stations. There are three remote stations that are involved in the project--Havana, Grafton, and Western Illinois University at Macomb. The distance from the main system and the long distance phone costs involved in communicating between stations led to the development of a "work station" concept. Under this concept, each station is given enough processing power to store, manage, and analyze their own data.

To do this we have used personal computers. Each station was given an IBM PC, a plotter, a printer, and a modem for phone communications. The primary method of storage at these stations is floppy diskettes. Each station was also given software to run on the equipment, including (1) a FORTRAN compiler, (2) a statistical package, (3) a spread sheet package with graphics, (4) a data base management package, and (5) a word processing package. A complete station was also purchased for Champaign for system development and consulting purposes.

Integration. We have a distributed system; there are multiple copies of data stored in different locations, affording a closeness to the input and processing by people primarily involved with collecting the data. This leads to easier access and fewer entry errors from misinterpretations. Data flow is an important part of the integration of the system. Our data starts with samples that are collected at sites along the Mississippi and Illinois rivers.

In general, these samples can be divided into two parts: a descriptive portion and a chemical portion. The descriptive part is a field data sheet containing location and observational data that are recorded, input, and verified directly at the field station's computer. The physical sample has to be analyzed to produce the chemical data, which is done in Champaign and the results are sent to the field stations to be input and verified. A future short cut in this flow is the direct input of chemical data into the Prime, possibly with the use of direct recording equipment.

After the data are stored in their data base management system, the field stations can do short-term (<1 year) analyses, such as relating to other data sets at the site, sorting, searching, manipulating, or input into other programs.

The next step in the data flow is the transfer to the Prime system, which can be done by sending the data across the phone lines or by sending a diskette to Champaign. To transfer data from system to system as well as program to program, it is converted to ASCII code. ASCII is a standardized bit image form that is recognized by different systems. Because of some confusion in working with two systems and for ease of scientists at field stations, a menu driven program is currently being developed to provide access to the Prime system.

Once added to the system, these data are available for long-term analysis (>1 year), for linkages with data from all remote sites, sorting, searching, manipulations, and input into other programs. Data are also available for use with the geographical information system, which produces base maps and overlays; maps may be updated, stored, and modeled.

Functions of Data Management

The functions of the data management program at the Large River site are: (1) management of geographic information, (2) evaluation of hardware and software, (3) system evaluation and design, (4) access and control of data, (5) documentation, and (6) inter-site activities.

Management of Geographic Information. The previous section of the report described some of the uses of GIS, but they are only the start of the future uses of such a system. Management of this system, especially in the initial design phase, is extremely important. The functions of data management are: (1) training in digitizing, map production, system use, input methods, and input form; (2) coordinating work flow, standardization, and multiple uses; (3) helping develop finished products (refining requirements and production); (4) evaluating future uses (awareness of user needs and desires, awareness of capabilities of current system and future additions); (5) documenting the system; (6) controlling access to system (limiting access to authorized scientists and technicians, assuring that maps are easily accessible and indexed); and (7) developing protocols for digitizing map information.

Evaluation of Hardware and Software. Data management has assumed the responsibility for evaluating hardware and software, keeping the remote systems compatible, and decreasing the burden of hardware and software evaluation on the researchers. Activities include: (1) assuring compatibility between sites (equipment and software lists to allow flexibility but retain compatability); providing technical information about available products; (3) maintaining a file of information on products and local sources of equipment, software, and supplies and establishing good working relationships with local dealers; (4) ordering equipment and software; (5) training staff how to use the equipment and software; (6) and consulting with staff on problems.

System Evaluation and Design. To provide information, each part of the system has to work together in a coordinated fashion. Users' needs have to be known and understood. Each new addition needs to fit in with the rest of the system. The ultimate design of the system will either make the system work at a competent level or make the system fail. The planning and design of an information system requires data management to: (1) define user needs; (2) develop and maintain file structure; (3) develop and maintain access structure; (4) integrate the system across the five participating agencies and individual investigators; and (5) assure that the system is accessible and usable in all phases of the project.

Access and Control of Data. Easy access to information that is on the system is essential. Control of the information is also important, especially with multiple users accessing the system. Updates need to be documented and dated. If someone uses a data set and then it is updated, this could change their results; they need to know what changed and when. Access to unverified data should be limited to the person responsible for verification.

Documentation. The documentation for the data sets is consistent with the requirements established by the LTER data management group in 1982. Basically, documentation has a hierarchical structure.

Data file name and researcher
  Description of data contained in the files
    Exact description and format of data

The first two parts are contained in the data set abstracts and the last is contained in each individual data base. A further addition to this documentation is the Methods Manual written this year.

This information is stored on the Prime system as a file. When the menu-driven system is ready, this documentation will be available in the form of help files and an index. These files must also be kept current.

Inter-site Activities. The LTER data managers meet annually to share information and develop good procedures for management of long-term data sets. Each site has its own computer system. To assist the transfer of data between sites, a matrix of protocols and/or configurations is being compiled. We have offered to store this information on our computer system and make it available to other sites or other scientists. This is a small step to facilitate transfer of data between sites.

Data descriptions for all 11 LTER sites are now being stored on the computer system at the Jornada (Desert) site in New Mexico. These data descriptions are available in machine-readable form and we have asked to transfer a copy to our Prime computer system to make the descriptions accessible to both the LTER researchers and other researchers at the Surveys. By making this information readily available and easily searched, we hope to facilitate inter-site activities.

SECTION 2: SHORTFALLS

The geological portion of the Large River LTER project worked without paid staff in 1984. This was a budget compromise agreed to by all of our principal investigators. We planned to have a geology graduate student for the first 2 years and then again for the last 2 years. It was difficult to keep the program viable in 1984, and we were delayed in finding a replacement student in 1985. For a long-term program, we believe a better approach would be modest but continuous funding, and we will strive to achieve that (Gross).

Tasks beyond the extraction of the tree growth curves from the tree ring chronologies have not been completed because a program must be modified to run on the University of Illinois' CYBER. We will work with a programmer to rectify this problem by October of this year (Wendland).

The resignation of the long-time laboratory assistant, who identified and counted pollen in sediment cores, and increased administrative duties of Dr. James King have caused unforeseen delays. The cores have been taken and the palynological analysis will be completed this next year (King).

We were justly criticized by our External Advisory Committee for not establishing a better publication record. We met as a group on 8-10 April 1985 at the Horn Field Campus of Western Illinois University, outside Macomb, to outline synthesis papers involving multiple authors and to commit to a schedule for manuscript preparation and submission. Our list of publications this year includes eight papers that have been submitted, are in press, or have already been published in refereed national or international journals, and four book chapters in press. Our rate of submission is accelerating and we expect a much lengthier list in 1986 (Sparks).

Our scientists at field stations still cannot directly tap the potential of the Prime computer and the Geographic Information System at Champaign. We can download files from the mainframe to the IBM-PC's, but telephone costs prohibit interactive sessions. Because of the costs, the field station staff do not use the systems often enough to remain fluent in the commands used by the Survey's and University of Illinois' mainframes and the statistical packages of SPSS and SAS. The Surveys are working on a public access system that will provide interactive menu-driven access to the Prime, but the problem of telephone costs remains. We are using software packages such as LOTUS, RBASE, and SYSTAT for analysis of small data sets, or subsets, on the PC's, and we are requesting assistance from the data manager at Champaign for merging and analysis of large files on the Prime (Sparks).

SECTION 3: PROJECT PLAN

A. History of Perturbation (Gross, Cahill, King, Wendland, Grubb, and Autry)

Bed materials in the Mississippi and Illinois rivers range from fine-grained muds to coarse gravels. Maps of these materials are a predictive tool in ecosystem modeling, and for that reason, geologic maps have been completed for two of our three sites. The third site, Peoria Pool of the Illinois River, will be mapped from sampling done largely for other projects. By 1986, the geological component of the Large Rivers LTER will move from mapping to predictive modeling--a study of the geomorphic evolution of the sites.

Geomorphic systems are in a state of dynamic equilibrium. This equilibrium is episodically disrupted as thresholds of stability that define the system are exceeded. These thresholds are governed by the synergistic effects of principal geomorphic variables.

A geomorphic model of these rivers, the proposed Ph.D. thesis of Mark Grubb, will identify the relative importance of intrinsic and extrinsic geomorphic variables, such as geology, geomorphology, climate, hydrology, and vegetation, in the evolution of the middle Mississippi and Illinois rivers. With a time scale of a few thousand years, less than the post-glacial but much greater than the engineering modifications of the rivers, the diversity of data requires an integrated approach combining geomorphology, pedology, fluvial sedimentology, hydrology, and geochemistry to model these rivers.

If a coherent model of geomorphic evolution can be devised, it will be possible to locate the present fluvial system in relation to critical geomorphic thresholds and to define the age, mode of formation, and long-term stability of various ecological compartments, such as backwater lakes. Ideally, the model would allow general predictions to be made in regard to the future evolution of this segment of the Mississippi fluvial system.

^{210}Pb and ^{137}Cs are being used to date sediment cores collected in Peoria Lake. When combined with chemical analysis, the history of trace metal loading in the area will be documented. Analysis of sediment pore waters is underway to establish if there is a gradient in metal concentrations in the sediment column.

The organic carbon content of sediment will be measured in surface samples and cores in areas of intensive biological sampling to determine the temporal and spatial patterns of accumulation and redistribution of organic matter.

Carbon isotopic ratios will be measured in aquatic plants and a series of key consumers at several locations to establish what proportion of the consumption is based on detritus derived from macrophytes.

Reconstruction of temperature, precipitation, and river flow from tree rings and pollen analyses will be completed.

B. Hydrologic Studies (Adams)

Suspended sediment monitoring of selected tributaries will be continued. With the gages installed on Burlington Island, the depth and direction of overflowing water during floods will be observed. Burlington Island is our representative floodplain.

Water and suspended sediment measurements will be made periodically in the Devils Creek to Nauvoo reach to provide validation data for the mathematical models. These measurements will be coordinated with intensive measurements of flow patterns in and around the macrophyte beds. Wind-generated waves can resuspend plant debris, break off senescing plant parts, and move nutrients in and out of the beds. A wind velocity recorder, wave gages, current meters, and sediment traps will be installed for these measurements. Both wind- and boat-generated waves will be measured. These field data will be coordinated with the biological sampling and collected at several times before, during, and after the macrophyte growing season.

Relevant results from the Quincy Bay sedimentation study will be incorporated into the description of the geomorphic succession in navigation pools and associated backwaters. The Peoria Lake sedimentation project will also contribute to the knowledge of the changes along the Illinois River.

Mathematical modeling will proceed in several areas. The HEC-6 model will be applied to the 32-km long Peoria Lake reach of the Illinois River. The Pool 19 transport model will be expanded to include particulate as well as dissolved organic matter. Two-dimensional modeling will begin for a selected reach (Montrose Flats or Nauvoo Point). Wind-generated currents will be included if this does not entail full three-dimensional modeling. If time allows, models for resuspension and transport of sediment and particulate organic matter will be assessed for inclusion in the two-dimensional model.

C. Ecosystem Structure and Function (Anderson and Sparks)

Maintenance sampling of macroinvertebrates, zooplankton, phytoplankton, fish, and drift will continue in major habitat types at all three study sites. This sampling will be done in conjunction with water chemistry, physical parameters, and carbon sampling to maintain and extend long-term data sets. In addition, site-specific sampling of invertebrates to measure rates of secondary production and food sources (using gut analyses and carbon isotope ratios) will be done at Burlington Island, Ft. Madison, Nauvoo-Montrose Flats, and Keokuk on Pool 19. Some of these collections will be triggered by storms or floods.

We will sample organic matter, nutrients, sediment, and water fluxes for periods of 1 week several times during the macrophyte growing season to test our hypothesis that macrophyte beds continually supply high quality detritus to offshore consumers during the low-flow period when supplies from autochthonous sources reach seasonal lows. The sampling will be coordinated with hydrologic sampling to determine whether wind- and boat-generated waves and secondary currents are the transport mechanism.

Further work on the model will first involve fine tuning maximum rate constants and function arrays. Validation of the model will be completed using data collected on Pool 19. Connection of all compartments in Pool 19 will be completed and a total pool simulation will be run. Following this final link of the hydrodynamic and biological model, simulation to predict successional processes in Pool 19 will be attempted. The model will be applied to other pools as a test of generality. Work will also continue on population models for key organisms, such as fingernail clams and burrowing mayflies.

SECTION 4: MOST SIGNIFICANT ACCOMPLISHMENTS

We successfully "captured" a major event--the Illinois River flood of March 1985, the third highest in the 140-year record. We were able to start sampling well before the crest because of the flood predictions provided by the National Weather Service. One of the agencies participating in the LTER, the Illinois State Water Survey, had a grant from the U.S. Army Corps of Engineers to take some of the same measurements we needed, so we were able to pool staff and equipment from both projects and do more sampling than either project could have done alone (Sparks).

The hydraulic component of our large river model can now simulate water flow into lateral areas and movement of dissolved nutrients. The biological component has been simplified from 22 to 9 state variables, and several simulation runs have been completed. The programmer hired with the budget supplement has written well documented versions of the biological model in FORTRAN. One version runs on the Prime mainframe computer and another on the IBM PC's (Demissie, Anderson, Brookfield, Sparks).

Anthropogenic contributions of Ni, Pb, P, and Zn to the sediments in the Illinois River are declining, when concentrations in sediments deposited between 1953 and 1965 are compared to the period 1976-1982. In contrast, it appears that sedimentation rates in Peoria Lake (which reflect land use in the drainage basin of the Illinois River) have not changed when recent periods (1963-1982, 1954-1982) are compared to the long-term average for 1939-1982. Sedimentation rates determined by ^{137}Cs and ^{210}Pb are in good agreement with those obtained by traditional bathymetric techniques (Cahill and Gross).

Digitization of the land-water boundaries of Pool 26, Illinois and Mississippi rivers, the longest and most complex of our three sites, will be completed and the point coordinates stored in our geographic information system this year. We can now add overlay maps depicting bathymetry, substrate type, sampling locations, and vegetation. It is especially important to document present boundaries in Pool 26 because the new dam will become operational in approximately 2 years and we want to follow the resulting geomorphic and successional changes (Miller and Gross).

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APPENDIX A.

Changes in Personnel

Ms. Deborah Casavant completed an M.S. degree with an LTER thesis at the University of Illinois and moved to Boston University, where she is pursuing a Ph.D. degree in geology.

Mr. Mark Grubb joined the Large Rivers LTER as a half-time research assistant on the geological aspects of the project. He came to us after receiving an M.S. degree in geology at Colorado State University. He will be writing a Ph.D. thesis on the geomorphic evolution of the Large River LTER sites.

Dr. James King was on sabbatical leave from his position at the Illinois State Museum for the spring semester of 1985.

Mr. Frank Brookfield, the computer programmer provided to the LTER project by the Natural History Survey, accepted a new position with the Hazardous Waste Research and Information Center at the Illinois State Water Survey starting in July 1985. He will continue working part time on the LTER project until January 1986. Dr. Ken Lubinski and Mr. Jack Grubaugh from the Natural History Survey will supervise and coordinate data management at the field stations. Dr. David Gross will continue to direct the map digitizing and use of the geographic information system.

The appointment of Ms. Lisa Miskimen, research assistant with the tree ring project, has expired. Remaining work for this project will be completed with continued contributions from her, the assistance of a programming consultant, and Dr. Wayne Wendland.

APPENDIX B.

External Advisory Committee

This appendix consists of the written report of the External Advisory Committee (EAC) following a review of the Large River LTER project, 20-22 February 1985, integrated and edited by Chairman Colbert Cushing. The response to the EAC report is in Appendix C.

The members of our External Advisory Committee are listed below. Dr. Daryl Simons joined the Committee in 1983; the others have been members since the inception of the LTER project in the spring of 1982. The chair has rotated each year, from Wayne Minshall, to Richard Wiegert, to Colbert Cushing, to James Eckblad, who will be Chairman of the 1985/86 meeting in Champaign, Illinois, 10-12 February 1986. The members of the Committee have paid particular attention to their charge to advise our group, and we are grateful for much personal help from each member, not reflected in the summary documents in this Appendix. We look forward to their continuing assistance in the future.

Colbert E. Cushing Chairman, 1984/85	Environmental Sciences Department Batelle-Pacific Northwest Lab. Richland, WA 99352
James Eckblad Chairman, 1985/86	Department of Biology Luther College Decorah, IA 52101
G. Wayne Minshall Chairman, 1982/83	Department of Biology Idaho State University Pocatello, ID 83201
Daryl B. Simons	Engineering Research Center Colorado State University Fort Collins, CO 80523
Richard Wiegert Chairman, 1983/84	Department of Zoology University of Georgia Athens, GA 30601

Report from Chairman Cushing following the
External Advisory Committee Review of 18-20 February 1985

This is the third report by the External Advisory Committee following a presentation of formal progress reports, informal discussions, and displays by members of the Large River LTER Research Team. They gave us an impressive performance. For the most part, the review team was satisfied with their progress; our summary of the project's status follows:

Positive Attributes

The EAC discerns a marked improvement in the program and the people involved during the past 17 months. The project to us is impressive in both scope, integration, and output, and essentially appears to be leading to valuable scientific contributions.

The group has matured, both individually and as a team. This was illustrated by the presentations which were professional, with clear statements of objectives and results. Strengths in the program were selected and well highlighted; weaknesses, however, were downplayed but still apparent in some aspects and these will be addressed later. The team showed much more integration among the groups than was apparent during the previous extramural reviews. Individuals displayed greater confidence. In short, you appeared to have confidence in yourselves, your research, and the direction the project was going. The production of the methods manual, with up-datings, and the publication of the Annual Report with plenty of time for us to study it prior to the meeting are indications of how much the scientists are on top of the project.

We are particularly pleased with the progress in modeling and use of the model as a guide for the research. As soon as the model is running on the IBM microcomputer, we'd like to see you make it available to outside scientists, both for their use and for the input from them you would receive in exchange. One suggestion would be to write it up, with documentation, as a preliminary model "tool" and send it in to Ecological Modeling. Then the submitted manuscript could be distributed, with program if the latter cannot be published as part of the paper.

The Core Data Sets seemed appropriate, but we were unsure as to where they were leading--more about this below. The data management program reorientation has been accomplished in a most significant manner and looks like it now provides the needed information.

We were encouraged by your apparent efforts to interact with regard to data synthesis with other LTER sites as indicated by your reference to Marty Gurtz's work and we encourage positive follow-up.

In reference to Section 3 of the Annual Report, the Project Plan, we were frankly more encouraged by what we heard during the review than in what we read. We would suggest that you make a greater effort to formalize these plans, such as the work on the Illinois River perturbations. Here, the baseline data and Core Data Sets should be of great help.

It's good to see the computer equipment at the different sites--obviously a great help in your efforts. We recommend obtaining an 8087 math coprocessor (about $165 each) for each IBM machine and a compiler that will address this chip, and a 5-10 megabyte hard disk for each site. We suggest getting the removable rather than the fixed disks to facilitate exchange of programs and data.

Weaknesses

More effort to involve outside scientists in the site work should be made. The research is at a level now where others would be interested in participating in the on-going studies, and by so doing, add stature to the Large River LTER and provide useful insight into various aspects of the research.

One aspect of the project which was not adequately expressed might be stated, "What's the main message at this point?" This will be particularly important in focusing your efforts at writing the renewal proposal. We did not gain the impression of a strong central theme or "main message" in the presentations. In this respect, we would suggest that a combination of Chapter 4 of the Annual Report, Most Significant Accomplishments, and what we heard in the presentations should form a solid basis for a good renewal proposal.

The publication record of the Large River LTER is extremely weak for the time you've spent in the study. The book concept is good and should be pursued. The EAC believes that there has perhaps been an overemphasis on posters, verbal presentations, etc., at the expense of getting papers submitted to and published in the open literature. A conscious effort should be made; assign some papers, set some hard deadlines, and see that they are met.

Some of the model graphic symbols for compartments need correcting. Also, in relation to the model, we would suggest a continued vigilance with your coefficients. These should be refined, as possible, with complete and current documentation as to their derivation; use of outside reviewers may help in this aspect. Here again, getting these into a manuscript would be a tremendous step forward and would put the Large River LTER head and shoulders above the other LTERs with respect to modeling.

Summary

The EAC was extremely pleased with the review. The pluses far outweighed the minuses this time. The research team has come a long way since the first review and now shows signs of maturity and productivity. We feel confident that continued efforts to improve, refine, and publish your results will provide valuable scientific information.

We appreciate the time and hospitality shown us and look forward to continued association with the group.

APPENDIX C.

Response to the External Advisory Committee

Comment 1. Write up the large river model for Ecological Modeling

Sparks presented a paper, co-authored with Anderson, Grubaugh, Demissie, and Adams, "An integrated hydrodynamic/biological model for the upper Mississippi River," at the symposium on river basin modeling at the annual meeting of the International Society for Ecological Modeling, Gainesville, Florida, 12-15 August 1985. Presenters were encouraged to submit manuscripts to Ecological Modeling and we are preparing one now.

Comment 2. Formalize project plans, including the main message for the renewal proposal, and clearly relate the core data sets to the plan

Our principal investigators have revised and formalized our major hypotheses and research questions at meetings on 8-10 April and 7 May 1985. We critiqued our baseline measurements and related them to our hypotheses on 8 July 1985. We will distribute a draft version of the renewal proposal to the External Advisory Committee before the next committee meeting on 10-12 February 1986 and we plan to devote most of the meeting to a critical review of the proposal.

Comment 3. Purchase 8087 math coprocessors, compatible compilers, and 5-10 megabyte hard disks for each of the LTER work stations

Done.

Comment 4. Do more to involve outside scientists

We will meet in January 1986 with researchers from Louisiana State University who work on the lower Mississippi River and the delta to discuss collaborative research. We will include funding in our renewal proposal to support a short-term outside investigator. We have applied to NSF for a facilities support grant to expand the field laboratory at Havana to accommodate outside scientists.

Comment 5. Strengthen publication record

Section 2: Shortfalls describes the steps we have taken to increase our rate of publication, including a writing workshop in an isolated location, with no telephones but with electrical outlets to run four word processors. We have established a manuscript submission schedule and are exerting pressure on each other to meet deadlines.

Comment 6. Model. Correct graphic symbols, refine and document coefficients, use outside reviewers, and publish

See comment 1 above. We are correcting the symbols and refining the coefficients. We plan to review the model with Richard Wiegert in October at the University of Georgia.

APPENDIX D.

Current and Pending Support

	A	B	C	D	E	F
	Supporting agency	Project title	Amount (x$1000)	Period covered	Man-months	Research location
J. R. Adams						
A. Current support						
1. LTER	NSF	LTER on MI and IL rivers	259/yr	01/15/82-01/14/87	4/yr	MI and IL rivers
2. Horseshoe Lake	IDOC/USFWS	Sedimentation investigation of Horseshoe L.	107	10/01/83-06/30/85	1	Horseshoe L. Alexander Co.
3. Kankakee Dam	IDOC	Field verification of discharge capacity of Kankakee Dam	11.6	11/01/84 12/31/85	1	Champaign/Kankakee
B. Proposals Pending						
1. Environmental effects of oil field brines	ENR	Inventory of impacted areas, problem assessment	96	09/85	2	Champaign

	A	B	C	D	E	F
	Supporting agency	Project title	Amount (x$1000)	Period covered	Man-months	Research location
<u>N. G. Bhowmik</u>						
A. Current Support						
1. LTER	NSF	LTER on MI and IL rivers	259/yr	01/15/82-01/14/87	2/yr	MI and IL rivers
2. Highland-Silver Lake	USDA	Watershed erosion and sedimentation	70/yr	01/82-10/85	0.5	Highland-Silver Lake
3. Horseshoe Lake	IDOC/USFWS	Sedimentation investigation, Horseshoe Lake	107	10/01/83-06/30/86	1	Horseshoe L., Alexander Co.
4. Watershed	City of Sprgfld	Hydrologic investigation of Lake Springfield	50	03/85-02/86	0.5	Springfield, IL
5. Cache River	IDOC	Hydraulic investigation of Cache River	96	06/85-06/86	1.5	Cache R., IL
6. Quincy Bay	IDOC	Sedimentation investigation of Quincy Bay	100	11/84-09/86	1.0	Quincy, IL
B. Proposals Pending						
1. Erosion prone	ENR	Identification of erosion prone areas	60	07/85-06/86	1	Illinois
2. Sediment quality	ENR	Sediment quality of Illinois streams and lakes	140	09/85-12/86	1	Illinois
3. Sediment removal	USGS	Sediment removal from impoundments	159	08/85	2	Illinois

	A	B	C	D	E	F
	Supporting agency	Project title	Amount (x$1000)	Period covered	Man-months	Research location
<u>M. Demissie</u>						
A. Current support						
1. LTER	NSF	LTER on MI and IL rivers	259/yr	01/15/82-01/14/87	2.5/yr	MI and IL rivers
2. Horseshoe Lake	IDOC/ USFWS	Sedimentation investigation, Horseshoe Lake	107	09/83-08/85	3	Horseshoe L., Alexander Co.
5. Cache River	IDOC	Hydraulic investigation of Cache River	20	06/84-06/85	2	Cache R., IL, Champaign
B. Proposals pending						
1. Erosion prone	ENR	Identification of erosion prone areas	60	07/85-06/86	4	Champaign
2. Sediment quality	ENR	Sediment quality of Illinois streams and lakes	140	09/85-12/86	4	Champaign

	A	B	C	D	E	F
	Supporting agency	Project title	Amount (x$1000)	Period covered	Man-months	Research location
D. L. Gross						
A. Current support						
1. LTER	NSF	LTER on MI and IL rivers	259/yr	01/15/82 01/14/87	2	MI and IL rivers
2. LUMP	US Off. Surf. Min.	Illinois program	69	07/01/84-06/30/85	2	Illinois
3. SSC	Univ. Res. Assoc.	Environmental screening for Fermilab	80	05/01/84-12/31/86	3	Illinois
4. SSC	ENR	Environmental atlas	16	07/01/85-12/31/85	1	Illinois
B. Proposals pending						
1. LUMP	US Off. Surf. Min	Illinois program	75	07/01/85-06/30/86	2	Illinois
2. SSC	ENR	Environmental screening for Fermilab	100	07/01/85-12/31/86	3	Illinois

	A	B	C	D	E	F
	Supporting agency	Project title	Amount (x$1000)	Period covered	Man-months	Research location
<u>R. A. Cahill</u>						
A. Current support						
1. LTER	NSF	LTER on MI and IL rivers	259/yr	01/15/82-01/14/87	3	MI and IL rivers
2. CRSC	Ctr. Res. Sulfur in Coal	Na, Cl, and S in Ill. coal	70/yr	09/01/85-08/03/86	2	Illinois
B. Proposals pending						
1. ANTHRO	NSF	Pan Carib. sources of exotic lapidary materials	568/3 yr	01/86-12/89	1	Illinois

	A	B	C	D	E	F
	Supporting agency	Project title	Amount (x$1000)	Period covered	Man-months	Research location
R. V. Anderson						
A. Current support						
1. LTER	NSF	LTER on MI and IL rivers	259/yr	01/15/82-01/14/87	3/yr	MI and IL rivers
2. FAP 408	IDOT	Biol. survey from IL 79 to IL 107, Pike Co.	27	01/01/85-12/31/85	1	Pike Co., IL
B. Proposals pending						
1. Woody debris	NSF	Role of woody debris in floodplain river system	266/yr	01/01/86-12/31/88	3	WIU, Grafton
2. SEM	NSF	Request for SEM	78	01/01/86-12/31/86	0	Illinois

	A	B	C	D	E	F
	Supporting agency	Project title	Amount (x$1000)	Period covered	Man-months	Research location
K. S. Lubinski						
A. Current support						
1. LTER	NSF	LTER on MI and IL rivers	259/yr	01/15/82-01/14/87	6	MI and IL rivers
B. Proposals pending						
1. Woody debris	NSF	Role of woody debris in floodplain river system	266/yr	01/01/86-12/31/88	2/yr	Grafton, Pool 26

	A	B	C	D	E	F
	Supporting agency	Project title	Amount (x$1000)	Period covered	Man-months	Research location
R. E. Sparks						
A. Current support						
1. LTER	NSF	LTER on MI and IL rivers	259/yr	01/15/82-01/14/87	7.4	MI and IL rivers
2. Fleeting area	NMFS	Effects of barge fleeting on mussel beds	39	10/01/82-12/31/86	1.0	Illinois R.
3. Habitat survey	Com. Ed.	Habitat quality and water quality of Des Plaines R.	60	07/85-06/86	2.0	Des Plaines R.
B. Proposals pending						
1. Facilities	NSF	Expansion of facilities for visiting scientists and new staff at Havana	100	01/01/86-01/01/88	1.0	Havana, IL
2. Toxicity of river sediments	Com. Ed.	Toxicity of sediments in upper Illinois River	30	07/01/86-06/30/87	1.0	Illinois R.
3. Control of Asiatic clam	Com. Ed.	Temperature, chlorine, and carbon dioxide tolerances of Asiatic clams	30	07/01/86-06/30/87	2.0	Havana, IL

Abbreviations

Com. Ed.	= Commonwealth Edison Co., Chicago, IL
Ctr. Res. Sulfur in coal	= Center for Research on Sulfur in Coal
ENR	= Illinois Departmen of Energy and Natural Resources
IDOC	= Illinois Department of Conservation
IDOT	= Illinois Department of Transportation
NMFS	= National Marine Fisheries Service
NSF	= National Science Foundation
Univ. Res. Assoc.	= University Research Association
USDA	= U.S. Department of Agriculture
USFWS	= U.S. Fish and Wildlife Service
USGS	= U.S. Geological Survey
US Off. Suf. Min.	= U.S. Office of Surface Mining

APPENDIX E.

Collaborative Research and Liaison Activities

The following grants are directly linked to the Large River LTER or use our data bases (Anderson):

1. Characterization of mussel populations in shallow channel border areas, Mississippi River, Pool 19. Drs. R. V. Anderson and M. A. Romano, Western Illinois University. Funded by Illinois Department of Conservation, $1,000.

2. Aquatic macrophyte succession in Pool 19, Mississippi River and its effect on the consumer community. Dr. J. D. Ives, Western Illinois University. Funded by Western Illinois University Research Council, $4,392.

3. The ecology of pools 19 and 20, Upper Mississippi River: an ecological profile. Dr. L. A. Jahn, Western Illinois University. Funded by the U.S. Fish and Wildlife Service, $9,988.

4. The breeding biology of wood ducks in the Nauvoo Flats of the Keokuk, Pool, Mississippi River. Dr. F. C. Bellrose, Illinois Natural History Survey. Funded by the Illinois Department of Conservation and Wildlife Management Institute, $9,000.

Quincy Bay (Adams). The Illinois Department of Conservation funded an investigation of the sedimentation patterns and sources of sediment in Quincy Bay. This type of bay-backwater area is common along the Illinois River but uncommon along the Mississippi. An analysis of changes in the morphology of Quincy Bay will contribute to our LTER study of the successional changes resulting from dam construction. This project will be completed in fall 1986.

Sediment Budget of Peoria Lake (Sparks). The Rock Island District of the U.S. Army Corps of Engineers provided $50,000 to the Illinois State Water Survey for an analysis of the acute sedimentation problem in Peoria Lake, a natural mainstem lake of the Illinois River. The mean low water level of the lake was raised in the 1930's by a low navigation dam. This is one of the three sites for the Large River LTER research, and both studies will benefit from an exchange of information. Equipment and staff from both studies were pooled to measure the effects of the March 1985 flood--the third highest flood in the 140-year record on the Illinois River.

Upper Mississippi River Basin Association (Sparks). The UMRBA has continued the long-term loan of approximately $50,000 of equipment to the Large River LTER project. Major items are the Motorola MiniRanger III and the Marsh-McBirney oceanographic current meter.

Dendrochronology (Wendland). Dr. Wendland is participating with other LTER dentrochronologists in the United States to identify common problems and share information. Although several individuals have been identified, little more has been done to date. Dr. Wendland will attempt to organize the group to identify common interests and to improve information exchange.

Sediment Transport Workshop (Adams). An intersite workshop on sediment transport mechanics and measurement has been scheduled for 16-18 September 1985 at Pere Marquette State Park, Grafton, Illinois. Dr. D. B. Simons, a consulting engineer from Ft. Collins, Colorado, has agreed to be keynote speaker and consultant to the workshop. Each participating site will present a review of sediment or erosion processes at their site. Small groups will then address several topics of interest. It is expected that one or more groups will consider arid climate erosion and soil creep and mass wastage on steep terrain. A summary report will be prepared and published so that the results of the workshop will be readily available to all LTER sites and other scientists pursuing similar ecological research.

Joint Meeting of Mississippi River Researchers (Sparks). Richard Sparks, Large River LTER, and John Day, Center for Wetlands, Louisiana State University, have organized a meeting of scientists from the two groups at Baton Rouge during the week of 13 January 1986. Principal investigators from each site will describe their research. We hope to generate at least one cooperative research project that we can include in our renewal proposal and a format for an annual meeting of researchers working on the upper and lower Mississippi River. In the past, communication between the two groups has not been adequate, and it will be exciting to see what new ideas may be generated by bringing people together who work on the river systems from the headwaters at Lake Itasca to the delta.

1986 Budget
Long Term Ecological Research (LTER) on the Illinois and Mississippi Rivers

	Administration	Data Management	Geology	Hydrology	Ecosystem Structure	Ecosystem Function	Line Totals
A. Senior personnel (man-mo.)							
1. D. L. Gross (2.0)	-	-	-	-	-	-	-
2. R. A. Cahill (4.0)	-	-	-	-	-	-	-
3. W. M. Wendland (0.5)	-	-	-	-	-	-	-
4. J. R. Adams (5.0)	-	-	-	-	-	-	-
5. N. G. Bhowmik (2.0)	-	-	-	-	-	-	-
6. M. Demissie (3.5)	-	-	-	8,788	-	-	8,788
7. K. S. Lubinski (8.4)	-	-	-	-	-	-	-
8. R. W. Gorden (1.5)	-	-	-	-	-	-	-
9. R. E. Sparks (7.4)	-	-	-	-	-	-	-
10. P. G. Risser (0.7)	-	-	-	-	-	-	-
11. R. V. Anderson (3.0, 1.8)	-	-	-	-	-	7,875	7,875
Total senior personnel (40.8)	-	-	-	8,788	-	7,875	16,663
B. Other personnel (total no.)							
1. (0) Post-doctoral	-	-	-	-	-	-	-
2. (4) Other professionals		(1)20,475		(1)17,000	(2)18,519	-	55,994
3. (3) Graduate students	-	-	(2)17,428	(1) 9,600	-	-	27,028
4. (0) Undergrad. students	-	-	-	-	-	-	-
5. (1) Secretarial	(1)11,603	-	-	-	-	-	11,603
6. (2) Other	-	-	-	-	-	(2)27,571	27,571
Total, other personnel	11,603	20,475	17,428	26,600	18,519	27,571	122,196
TOTAL SALARIES AND WAGES	11,603	20,475	17,428	35,388	18,519	35,446	138,859
C. Fringe benefits	1,456	2,570	56	3,268	2,324	4,449	14,123
TOTAL SALARIES AND BENEFITS	13,059	23,045	17,484	38,656	20,843	39,895	152,982

		Administration	Management	Geology	Hydrology	Ecosystem Structure	Ecosystem Function	Line Totals
D.	Permanent equipment	-	-	-	-	-	-	-
E.	Travel - domestic	2,729	-	2,000	5,500	1,500	1,500	13,229
	foreign	-	-	-	-	-	-	-
F.	Participant costs	-	-	-	-	-	-	-
G.	Other direct costs							
	1. Materials and supplies	1,200	-	1,831	500	810	2,137	6,478
	2. Publication/page charges	2,000	-	-	1,000	-	240	3,240
	3. Consultant services	2,123	-	-	-	-	-	2,123
	4. Computer services	-	-	-	1,500	-	-	1,500
	5. Subcontracts	-	-	14,631	-	-	-	14,631
	6. Other	1,900	-	800	3,300	2,500	14,856	23,086
	Total other direct costs	7,223	-	17,262	6,300	3,310	16,963	51,058
H.	Total direct costs (A-G)	23,011	23,045	36,746	50,456	25,653	58,358	217,269
I.	Indirect costs	6,742	6,752	13,699	20,506	7,516	17,099	72,314
J.	Total direct and indirect costs	29,753	29,797	50,445	70,972	33,169	75,457	289,583
K.	Residual funds	-	-	-	-	-	-	-
L.	Amount of this request	29,753	29,797	50,445	70,962	33,169	75,457	289,583
					Allotment for 1986			289,583
					Request exceeds allotment by			0

SUMMARY PROPOSAL BUDGET

FOR NSF USE ONLY		
PROPOSAL NO.	DURATION (MONTHS)	
	Proposed	Granted
AWARD NO.		

ORGANIZATION
Board of Trustees, University of Illinois

PRINCIPAL INVESTIGATOR/PROJECT DIRECTOR
Richard E. Sparks

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title; A.6. show number in brackets)	NSF FUNDED PERSON-MOS. CAL.	ACAD	SUMR	FUNDS REQUESTED BY PROPOSER	FUNDS GRANTED BY NSF (IF DIFFERENT)
1. D. L. Gross				$ 0	$
2. R. A. Cahill				0	
3. R. V. Anderson			3.0	7,875	
4. M. Demissie	3.5			8,788	
5. (7) OTHERS (LIST INDIVIDUALLY ON BUDGET EXPLANATION PAGE)					
6. (11) TOTAL SENIOR PERSONNEL (1-5)	3.5		3.0	16,663	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (0) POST DOCTORAL ASSOCIATES				0	
2. (4) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	46.0			55,994	
3. (3) GRADUATE STUDENTS				27,028	
4. (0) UNDERGRADUATE STUDENTS				0	
5. (1) SECRETARIAL-CLERICAL				11,603	
6. (2) OTHER				27,571	
TOTAL SALARIES AND WAGES (A+B)				138,859	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				14,123	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A+B+C)				152,982	
D. PERMANENT EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $1,000; ITEMS OVER $10,000 REQUIRE CERTIFICATION)					
TOTAL PERMANENT EQUIPMENT				0	
E. TRAVEL 1. DOMESTIC (INCL. CANADA AND U.S. POSSESSIONS)				13,229	
2. FOREIGN				0	
F. PARTICIPANT SUPPORT COSTS 1. STIPENDS $ 2. TRAVEL 3. SUBSISTENCE 4. OTHER					
TOTAL PARTICIPANT COSTS				0	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				6,478	
2. PUBLICATION COSTS/PAGE CHARGES				3,240	
3. CONSULTANT SERVICES				2,123	
4. COMPUTER (ADPE) SERVICES				1,500	
5. SUBCONTRACTS				14,631	
6. OTHER				23,086	
TOTAL OTHER DIRECT COSTS				51,058	
H. TOTAL DIRECT COSTS (A THROUGH G)				217,269	
I. INDIRECT COSTS (SPECIFY) 45% of 48,215 = 21,697; 29.3% of 152,923 = 44,806; 21.5% of 27,028 = 5,811					
TOTAL INDIRECT COSTS				72,314	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				289,583	
K. RESIDUAL FUNDS (IF FOR FURTHER SUPPORT OF CURRENT PROJECTS GPM 252 AND 253)				0	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				$ 289,583	$

PI/PD TYPED NAME & SIGNATURE*	DATE	FOR NSF USE ONLY		
R. E. Sparks *Richard E. Sparks*		INDIRECT COST RATE VERIFICATION		
INST. REP. TYPED NAME & SIGNATURE*	DATE	Date Checked	Date of Rate Sheet	Initials - DGC / Program

NSF Form 1030 (10-80) *Supersedes All Previous Editions*

*SIGNATURES REQUIRED ONLY FOR REVISED BUDGET (GPM 233)

Budget Explanation

Long-Term Ecological Research (LTER) on the Illinois and Mississippi Rivers

15 July 1985

	Man-mos.	Funding requested
A. Senior personnel		
1. D. L. Gross	2.00	0
2. R. A. Cahill	4.00	0
3. W. M. Wendland	0.50	0
4. J. R. Adams	5.00	0
5. N. G. Bhowmik	2.00	0
6. M. Demissie	3.50	8,788
7. K. S. Lubinski	8.40	0
8. R. W. Gorden	1.50	0
9. R. E. Sparks	7.40	0
10. P. G. Risser	0.70	0
11. R. V. Anderson	3.00	7,875
(11) Total senior personnel	39.80	16,663
B. Other personnel		
2. (4) Other professionals	46.00	55,994
3. (3) Graduate students	25.00	27,028
5. (1) Secretarial	12.00	11,603
6. (2) Other	19.00	27,571
(10) Total other	102.00	122,196
Total salaries and wages	141.80	138,859
C. Fringe benefits		
0.32% of 27,028		87
12.551% of 111,831		14,036
Subtotal		14,123
Total salaries and benefits		152,982
D. Permanent equipment		0
E. Travel (all domestic)		13,229
F. Participant support costs		0

G.	Other direct costs		
	1. Materials and supplies		6,478
	2. Publication, page charges		3,240
	3. Consultant services (external advisory committee)		2,123
	4. Computer services		1,500
	5. Subcontracts (Western Illinois University)		14,631
	6. Other		23,086
	Water analyses	12,051	
	Sediment analyses	3,000	
	Telephone equipment, maintenance, slip rentals reactor fees, etc.	8,035	
	Subtotal		51,058
H.	Total direct costs (A-G)		217,269
	Exclude WIU subcontract (14,631) and computer services (1,500) = 16,131		
	Modified total direct costs		201,138
I.	Indirect costs		
	29.3% of 152,923 (field stations)		44,806
	45.0% of 48,215 (on campus)		21,597
	21.5% of 27,028 (graduate students tuition)		5,811
	Subtotal		72,314
J.	Total direct and indirect costs		289,583
K.	Residual funds		0
L.	Amount of this request		289,583

APPENDIX III

SUMMARY 1986
PROPOSAL BUDGET

FOR NSF USE ONLY		
PROPOSAL NO.	DURATION (MONTHS)	
	Proposed	Granted
AWARD NO.		

ORGANIZATION: Illinois Natural History Survey, U. of Ill..
WIU subcontract budget

PRINCIPAL INVESTIGATOR/PROJECT DIRECTOR: Richard V. Anderson (WIU)

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title; A.6. show number in brackets)	NSF FUNDED PERSON-MOS. CAL.	ACAD	SUMR	FUNDS REQUESTED BY PROPOSER	FUNDS GRANTED BY NSF (IF DIFFERENT)
1. Richard V. Anderson				$	$
2.					
3.					
4.					
5. ( ) OTHERS (LIST INDIVIDUALLY ON BUDGET EXPLANATION PAGE)					
6. ( ) TOTAL SENIOR PERSONNEL (1-5)					
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. ( ) POST DOCTORAL ASSOCIATES					
2. ( ) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)					
3. (1) GRADUATE STUDENTS $500 / month				6000	
4. ( ) UNDERGRADUATE STUDENTS					
5. ( ) SECRETARIAL-CLERICAL					
6. ( ) OTHER					
TOTAL SALARIES AND WAGES (A+B)				6000	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)					
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A+B+C)				6000	
D. PERMANENT EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $1,000; ITEMS OVER $10,000 REQUIRE CERTIFICATION)					
TOTAL PERMANENT EQUIPMENT					
E. TRAVEL 1. DOMESTIC (INCL. CANADA AND U.S. POSSESSIONS)				3100	
2 FOREIGN					
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $					
2. TRAVEL					
3. SUBSISTENCE					
4. OTHER					
TOTAL PARTICIPANT COSTS					
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				2351	
2. PUBLICATION COSTS/PAGE CHARGES					
3. CONSULTANT SERVICES					
4. COMPUTER (ADPE) SERVICES					
5. SUBCONTRACTS					
6. OTHER					
TOTAL OTHER DIRECT COSTS				2351	
H. TOTAL DIRECT COSTS (A THROUGH G)				11451	
I. INDIRECT COSTS (SPECIFY) 53% X A+B ($6000) = $3180					
TOTAL INDIRECT COSTS				3180	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				14631	
K RESIDUAL FUNDS (IF FOR FURTHER SUPPORT OF CURRENT PROJECTS GPM 252 AND 253)					
L AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				$ 14631	$

PI/PD TYPED NAME & SIGNATURE*	DATE	FOR NSF USE ONLY		
Richard V. Anderson *Richard V. Anderson*	7-3-85	INDIRECT COST RATE VERIFICATION		
INST. REP. TYPED NAME & SIGNATURE*	DATE	Date Checked	Date of Rate Sheet	Initials - DGC
A. Riley Macon A. Riley Macon, Director of Research & Tech.	7-3-85			Program

NSF Form 1030 (10-80) *Supersedes All Previous Editions*

*SIGNATURE... [illegible] QUIRED ONLY FOR REVISED ... ET (GPM 233)

WESTERN ILLINOIS UNIVERSITY (subcontract)

BUDGET JUSTIFICATIION - 1986

	NSF Requested	WIU Contributed
A. Senior Personnel		
Richard V. Anderson		
Budget year 1985-86, 10% of academic time (.9 months) X $2624		$ 2362
Budget year 1986-87, 10% of academic time (.9 months) X $2834		2551
B. Other Personnel		
Graduate Student (1)		
12 months X $500	$ 6000	
Total Salaries and Wages	6000	4913
C. Fringe Benefits		
R. V. Anderson		
Retirement: 8.131% X $4913		400
Insurance: $85 X 1.8 months		153
Total of A + B + C	6000	5466
D. Equipment	----	----
E. Travel		
Travel to field sites and one national professional meeting	3100	300
F. Participant Support Costs	----	----
G. Other Direct Costs		
1. Material and Supplies		
Collection bottles, oils, slides paper, glass ware, filters, chemicals for sample processing	2351	200
6. Other - Aerial photographs		400
Total Other Direct Costs	2351	600
H. Total Direct Cost	11451	6366
I. Indirect Cost		
53% X A + B ($10,913) = $5,784	3180	2604
J. Total Direct and Indirect	14631	8970

Total Request $23,601

Ecological Structure and Function of Major Rivers in Illinois
"Large River LTER"

1986 Renewal Proposal

Long-Term Ecological Research Program
National Science Foundation
Washington, DC

Richard E. Sparks, Project Director
Illinois Natural History Survey

Project Period: 16 January 1986 - 15 January 1987
Funds Requested: $289,583

Richard E. Sparks
Richard E. Sparks, Project Director
Illinois Natural History Survey

Stanley A. Changnon
Stan Changnon, Chief
Illinois State Water Survey

Paul G. Risser
Paul G. Risser, Chief
Illinois Natural History Survey

H. J. Stapleton
H. J. Stapleton, Secretary
Research Board, Univ. of Illinois

Morris W. Leighton / JHL
Morris Leighton, Chief
Illinois Geological Survey

J. J. Kamerer
J. J. Kamerer, Asst. Director
Business Affairs, Univ. of Illinois

28 August 1985

University of Illinois
at Urbana-Champaign

Grants and Contracts Office

105 Davenport House
809 South Wright Street
Champaign
Illinois 61820

217 333-2186

August 29, 1985

U of I Ref. No. 85-NSF-S-1945

Data Support Services Section
NATIONAL SCIENCE FOUNDATION
1800 G Street, N.W.
Washington, D.C. 20550

Attn: Long-Term Ecological
Research Program

Title: Ecological Structure and Function of Major Rivers in Illinois.
Amount: $289,583.00
Period: Jan. 16, 1986 - Jan. 15, 1987
Principal Investigator(s) Richard E. Sparks
Department State Natural History Survey
Type of Request: ___ New Request, ___ Supplement, xxxx Continuation, ___ Renewal of Existing Award 1-5-50174 through 1-5-50178;
Revision of Original Proposal Transmitted on ___
Proposal Number ___

Enclosed are copies of the referenced proposal. This proposal has been reviewed by the proper University administrative officials and has been approved for submission.

Your consideration will be appreciated. Any contract or grant supporting the above described project must be issued in the University's corporate name, The Board of Trustees of the University of Illinois, Urbana, Illinois 61801.

Any questions of a non-technical nature regarding this proposal should be addressed to Willie Dozier at the above telephone number.

Sincerely,

Wm. D. Morgan / E. J.

Wm. D. Morgan, Associate Director
Grant and Contract Administration

WDM:ef

Enclosure

cc: T. L. Brown, Vice-Chancellor
for Research

Sue Hale

ATTACHMENT TO PROPOSAL TRANSMITTAL LETTER

(The following General Information is provided to assist potential Sponsors. It is recognized some information may not be applicable to this specific proposal and, if inappropriate, should be disregarded.)

1. The Board of Trustees of the University of Illinois reserves the right to negotiate the terms and conditions of any definitized Contract/Grant which may result from this proposal application.

2. Any resulting Contract/Grant should indicate the University's legal corporate title "The Board of Trustees of the University of Illinois, Urbana, Illinois."

3. All contractual correspondence should be mailed to:
   University of Illinois
   Grants and Contracts Office
   105 Davenport House
   809 South Wright Street
   Champaign, Illinois 61820

4. University Contract/Grant Negotiators*:

   a. Mr. Willie J. Dozier   b. Mr. Wm. D. Morgan

   *Each may be reached by telephone at (217) 333-2186, same address as (3) above.

5. Cognizant Federal Administrative Agency:
   Office of Naval Research
   536 South Clark Street
   Chicago, IL 60605
   ATTN: Mr. John W. Michalski
   Administrative Contracting Officer
   (312) 353-6072 or 886-5423

6. Cognizant Federal Audit Agency:
   Defense Contract Audit Agency
   Resident Auditor
   911 South 6th Street, Room 201
   Champaign, IL 61820
   (217) 333-0998

7. Contract/Grant payments should be mailed to:
   University of Illinois
   252 Administration Building
   506 South Wright Street
   Urbana, IL 61801   EIN # 1-37-6000.511W

8. The following predetermined indirect cost rate has been currently negotiated with the Office of Naval Research.

Research Indirect Cost Rate	Graduate Research Asst.	Period
42.2%	18.6%	7/1/84 - 6/30/85
45.0%	21.5%	7/1/85 - 6/30/86

LTER ADMINISTRATION

SUMMARY PROPOSAL BUDGET

FOR NSF USE ONLY		
PROPOSAL NO.	DURATION (MONTHS) Proposed	Granted
AWARD NO.		

ORGANIZATION
University of Illinois - Natural History

PRINCIPAL INVESTIGATOR/PROJECT DIRECTOR
R. E. Sparks

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title; A.6. show number in brackets)	NSF FUNDED PERSON-MOS. CAL.	ACAD	SUMR	FUNDS REQUESTED BY PROPOSER	FUNDS GRANTED BY NSF (IF DIFFERENT)
1. R. E. Sparks 4.00 mo				$ 0	$
2. P. G. Risser 0.20 mo				0	
3. R. W. Gorden 0.25 mo				0	
4.					
5. ( ) OTHERS (LIST INDIVIDUALLY ON BUDGET EXPLANATION PAGE)					
6. ( ) TOTAL SENIOR PERSONNEL (1-5)					
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. ( ) POST DOCTORAL ASSOCIATES					
2. ( ) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)					
3. ( ) GRADUATE STUDENTS					
4. ( ) UNDERGRADUATE STUDENTS					
5. (1) SECRETARIAL-CLERICAL				11,603	
6. ( ) OTHER					
TOTAL SALARIES AND WAGES (A+B)				11,603	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS) 12.551% of 11,603				1,456	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A+B+C)				13,059	
D. PERMANENT EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $1,000; ITEMS OVER $10,000 REQUIRE CERTIFICATION)					
TOTAL PERMANENT EQUIPMENT				0	
E. TRAVEL 1. DOMESTIC (INCL. CANADA AND U.S. POSSESSIONS)				2,729	
2. FOREIGN				0	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $					
2. TRAVEL					
3. SUBSISTENCE					
4. OTHER					
TOTAL PARTICIPANT COSTS				0	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				1,200	
2. PUBLICATION COSTS/PAGE CHARGES				2,000	
3. CONSULTANT SERVICES				2,123	
4. COMPUTER (ADPE) SERVICES					
5. SUBCONTRACTS					
6. OTHER (telephone, maintenance agreements)				1,900	
TOTAL OTHER DIRECT COSTS				7,223	
H. TOTAL DIRECT COSTS (A THROUGH G)				23,011	
I. INDIRECT COSTS (SPECIFY) 29.3% of 23,011					
TOTAL INDIRECT COSTS				6,742	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				29,753	
K. RESIDUAL FUNDS (IF FOR FURTHER SUPPORT OF CURRENT PROJECTS GPM 252 AND 253)				0	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				$ 29,753	$

PI/PD TYPED NAME & SIGNATURE*	DATE	FOR NSF USE ONLY		
Richard E. Sparks — Richard E. Sparks		INDIRECT COST RATE VERIFICATION		
INST. REP. TYPED NAME & SIGNATURE*	DATE	Date Checked	Date of Rate Sheet	Initials - DGC Program

Administration
1986 Budget Explanation

Prepared June 1985

Long-Term Ecological Research (LTER)
on the Illinois and Mississippi Rivers

	Man-mos.	Funding requested
A. Senior personnel		
1. R. E. Sparks, PD	4.00	0
2. P. G. Risser	0.20	0
3. R. W. Gorden	0.25	0
(3) Total senior personnel	4.45	0
B. Other personnel		
5. (1) Secretarial	12.00	11,603
(1) Total other	12.00	11,603
Total salaries and wages	16.45	11,603
C. Fringe benefits 12.551% of 11,603		1,456
Total salaries and benefits		13,059

E. Travel - domestic
External Advisory Committee, one 2-day meeting in Champaign, IL

	Airfare	Ground Transp.	Lodging	per Diem	Sub-total per Person
C. E. Cushing	710	0	45	29	784
J. Eckblad	268	30	45	29	372
G. W. Minshall	430	29	45	46	550
D. B. Simons	344	28	45	29	446
R. Wiegert	242	0	45	55	367
Subtotal	1,994	87	250	188	2,519
Overnight travel for Sparks from Havana to other field stations and to Champaign					210
Subtotal					2,729

G.	Other direct costs	
	1. Materials and supplies (stamps, office supplies)	1,200
	2. Publication, page charges	2,000
	3. Consultant services (external advisory committee; 1 extra day by R. Wiegert for help in modeling; 11 man-days @ $193/day	2,123
	6. Other (one-half maintenance and service cost of IBM world processor, 3M copier	700
	Telephone at Havana Laboratory	1,200
	Subtotal	7,223
H.	Total direct costs (A-G)	23,011
I.	Indirect costs 29.3% of 23,011	6,742
J.	Total direct and indirect costs	29,753
K.	Residual funds	0
L.	Amount of this request	29,753

DATA MANAGEMENT

SUMMARY PROPOSAL BUDGET

FOR NSF USE ONLY		
PROPOSAL NO.	DURATION (MONTHS) Proposed	Granted
AWARD NO.		

ORGANIZATION
University of Illinois - Natural History

PRINCIPAL INVESTIGATOR/PROJECT DIRECTOR
K. S. Lubinksi

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title; A.6. show number in brackets)	NSF FUNDED PERSON-MOS. CAL.	ACAD	SUMR	FUNDS REQUESTED BY PROPOSER	FUNDS GRANTED BY NSF (IF DIFFERENT)
1. K. S. Lubinski 2.4 mo	—			$ 0	$
2.					
3.					
4.					
5. ( ) OTHERS (LIST INDIVIDUALLY ON BUDGET EXPLANATION PAGE)					
6. ( ) TOTAL SENIOR PERSONNEL (1-5)					
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. ( ) POST DOCTORAL ASSOCIATES					
2. (1) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.) J. Grubaugh	12.0			20,475	
3. ( ) GRADUATE STUDENTS					
4. ( ) UNDERGRAOUATE STUDENTS					
5. ( ) SECRETARIAL-CLERICAL					
6. ( ) OTHER					
TOTAL SALARIES AND WAGES (A+B)				20,475	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS) 12.551% of 20,475				2,570	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A+B+C)				23,045	
D. PERMANENT EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $1,000; ITEMS OVER $10,000 REQUIRE CERTIFICATION)					
TOTAL PERMANENT EQUIPMENT				0	
E. TRAVEL 1. DOMESTIC (INCL. CANADA AND U.S. POSSESSIONS)				0	
2. FOREIGN				0	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $					
2. TRAVEL					
3. SUBSISTENCE					
4. OTHER					
TOTAL PARTICIPANT COSTS				0	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES					
2. PUBLICATION COSTS/PAGE CHARGES					
3. CONSULTANT SERVICES					
4. COMPUTER (ADPE) SERVICES					
5. SUBCONTRACTS					
6. OTHER					
TOTAL OTHER DIRECT COSTS				0	
H. TOTAL DIRECT COSTS (A THROUGH G)				23,045	
I. INDIRECT COSTS (SPECIFY) 29.3% of 23,045					
TOTAL INDIRECT COSTS				6,752	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				29,797	
K. RESIDUAL FUNDS (IF FOR FURTHER SUPPORT OF CURRENT PROJECTS GPM 252 AND 253)				0	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				$ 29,797	$

PI/PD TYPED NAME & SIGNATURE*	DATE	FOR NSF USE ONLY		
K. S. Lubinski [signature]		INDIRECT COST RATE VERIFICATION		
INST. REP. TYPED NAME & SIGNATURE*	DATE	Date Checked	Date of Rate Sheet	Initials DGC Program

NSF Form 1030 (10-80) *Supersedes All Previous Editions*

*SIGNATURES REQUIRED ONLY FOR REVISED BUDGET (GPM 233)

GEOLOGY

SUMMARY PROPOSAL BUDGET

FOR NSF USE ONLY		
PROPOSAL NO.	DURATION (MONTHS) Proposed	Granted
AWARD NO.		

ORGANIZATION: University of Illinois - Natural History

PRINCIPAL INVESTIGATOR/PROJECT DIRECTOR: D. L. Gross

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title; A.6. show number in brackets)	NSF FUNDED PERSON-MOS. CAL.	ACAD	SUMR	FUNDS REQUESTED BY PROPOSER	FUNDS GRANTED BY NSF (IF DIFFERENT)
1. D. L. Gross, PI 2.0 mo				$ 0	$
2. R. A. Cahill, Co-PI 4.0 mo				0	
3. W. M. Wendland, Co-PI 0.5 mo				0	
4.					
5. ( ) OTHERS (LIST INDIVIDUALLY ON BUDGET EXPLANATION PAGE)					
6. (3) TOTAL SENIOR PERSONNEL (1-5)				0	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. ( ) POST DOCTORAL ASSOCIATES					
2. ( ) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)					
3. (2) GRADUATE STUDENTS M. Grubb, A. Autrey				17,428	
4. ( ) UNDERGRADUATE STUDENTS					
5. ( ) SECRETARIAL-CLERICAL					
6. ( ) OTHER					
TOTAL SALARIES AND WAGES (A+B)				17,428	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS) .32% of 17,428				56	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A+B+C)				17,484	
D. PERMANENT EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $1,000; ITEMS OVER $10,000 REQUIRE CERTIFICATION)					
TOTAL PERMANENT EQUIPMENT				0	
E. TRAVEL 1. DOMESTIC (INCL. CANADA AND U.S. POSSESSIONS)				2,000	
2. FOREIGN				0	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $					
2. TRAVEL					
3. SUBSISTENCE					
4. OTHER					
TOTAL PARTICIPANT COSTS				0	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				1,831	
2. PUBLICATION COSTS/PAGE CHARGES				0	
3. CONSULTANT SERVICES				0	
4. COMPUTER (ADPE) SERVICES				0	
5. SUBCONTRACTS Western Illinois University				14,361	
6. OTHER Reactor costs C-14 costs, boat dock fees				800	
TOTAL OTHER DIRECT COSTS				17,262	
H. TOTAL DIRECT COSTS (A THROUGH G)				36,746	
I. INDIRECT COSTS (SPECIFY) Tuition 21.5% of 17,428 = 3,747; 45% of 22,115 (36,746-14,631) = 9,952					
TOTAL INDIRECT COSTS				13,699	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				50,445	
K. RESIDUAL FUNDS (IF FOR FURTHER SUPPORT OF CURRENT PROJECTS GPM 252 AND 253)				0	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				$ 50,445	$

PI/PD TYPED NAME & SIGNATURE*	DATE	FOR NSF USE ONLY		
David L. Gross [signature]		INDIRECT COST RATE VERIFICATION		
INST. REP. TYPED NAME & SIGNATURE*	DATE	Date Checked	Date of Rate Sheet	Initials - DGC Program

NSF Form 1030 (10-80) *Supersedes All Previous Editions*

*SIGNATURES REQUIRED ONLY FOR REVISED BUDGET (GPM 233)

Component 1. Geology
1986 Budget Explanation

Prepared June 1985

Long-Term Ecological Research (LTER)
on the Illinois and Mississippi Rivers

	Man-mos.	Funding requested
A. Senior personnel		
1. D. L. Gross, PI	2.00	0
2. R. A. Cahill, Co-PI	4.00	0
3. W. M. Wendland, Co-PI	0.50	0
(3) Total senior personnel	6.50	0
B. Other personnel		
3. (2) Graduate students		
M. Grubb, Ph.D. candidate (9.00 @ 50% time; 2.50 @ 100% time; $1,388/month	7.0	9,712
A. Autrey, M.S. candidate (12.0 @ 50% time; $1,286/ month full time)	6.0	7,716
(1) Total other	13.00	17,428
Total salaries and wages	13.00	17,428
C. Fringe benefits 0.32% of 17,428		56
Total salaries and benefits		17,484
E. Travel - domestic		
Field work on the Illinois and Mississippi rivers; presentation of papers at two domestic meetings		2,000
G. Other direct costs		
1. Materials and supplies		1,831
5. Western Illinois University subcontract		14,631
6. Reactor, C-14, docking fees for diesel-powered workboat		800
Subtotal		17,262

H.	Total direct costs (A-G)	36,746
	Exclusion of subcontract (14,631)	
	Modified total direct costs	22,115
I.	Indirect costs	
	21.5% of 17,428 (tuition)	3,747
	45.0% of 22,115	9,952
	Subtotal	13,699
J.	Total direct and indirect costs	50,445
K.	Residual funds	0
L.	Amount of this request	50,445

HYDROLOGY

SUMMARY PROPOSAL BUDGET

FOR NSF USE ONLY		
PROPOSAL NO.	DURATION (MONTHS)	
	Proposed	Granted
AWARD NO.		

ORGANIZATION: University of Illinois - Natural History

PRINCIPAL INVESTIGATOR/PROJECT DIRECTOR: N. G. Bhowmik

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title; A.6. show number in brackets)	NSF FUNDED PERSON-MOS. CAL.	ACAD	SUMR	FUNDS REQUESTED BY PROPOSER	FUNDS GRANTED BY NSF (IF DIFFERENT)
1. J. R. Adams ~~5 mo~~				$ 0	$
2. N. G. Bhowmik ~~2 mo~~				0	
3. M. Demissie	3.5			8,788	
4.					
5. ( ) OTHERS (LIST INDIVIDUALLY ON BUDGET EXPLANATION PAGE)					
6. (3) TOTAL SENIOR PERSONNEL (1-5)	3.5			8,788	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. ( ) POST DOCTORAL ASSOCIATES					
2. (1) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	12.0			* 17,000	
3. (1) GRADUATE STUDENTS				9,600	
4. ( ) UNDERGRADUATE STUDENTS					
5. ( ) SECRETARIAL-CLERICAL					
6. ( ) OTHER					
TOTAL SALARIES AND WAGES (A+B)				35,388	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS) 12.551% of 25,788; 0.32% of 9,600				3,268	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A+B+C)				38,656	
D. PERMANENT EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $1,000; ITEMS OVER $10,000 REQUIRE CERTIFICATION)					
TOTAL PERMANENT EQUIPMENT				0	
E. TRAVEL 1. DOMESTIC (INCL. CANADA AND U.S. POSSESSIONS) *OAE = 3,722/TR = 1,778				5,500	
2. FOREIGN				0	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $					
2. TRAVEL					
3. SUBSISTENCE					
4. OTHER					
TOTAL PARTICIPANT COSTS				0	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				500	
2. PUBLICATION COSTS/PAGE CHARGES				1,000	
3. CONSULTANT SERVICES					
4. COMPUTER (ADPE) SERVICES				1,500	
5. SUBCONTRACTS					
6. OTHER				3,300	
TOTAL OTHER DIRECT COSTS				6,300	
H. TOTAL DIRECT COSTS (A THROUGH G)				50,456	
I. INDIRECT COSTS (SPECIFY) 45.0% of 26,100 (27,600-1500) = 11,745; *29.3% of 22,856 = 6,697; 21.5% of 9,600 - 2,064					
TOTAL INDIRECT COSTS				20,506	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				70,962	
K. RESIDUAL FUNDS (IF FOR FURTHER SUPPORT OF CURRENT PROJECTS GPM 252 AND 253)				0	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				$ 70,962	$

PI/PD TYPED NAME & SIGNATURE*	DATE	FOR NSF USE ONLY		
N. G. Bhowmik (signed) NGBhowmik		INDIRECT COST RATE VERIFICATION		
INST. REP TYPED NAME & SIGNATURE*	DATE	Date Checked	Date of Rate Sheet	Initials - DGC / Program

NSF Form 1030 (10-80) *Supersedes All Previous Editions*

*SIGNATURES REQUIRED ONLY FOR REVISED BUDGET (GPM 233)

Component 2. Hydrology
1986 Budget Explanation

Prepared June 1985

Long-Term Ecological Research (LTER)
on the Illinois and Mississippi Rivers

	Man-mos.	Funding requested
A. Senior personnel		
1. J. R. Adams	5.00	0
2. N. G. Bhowmik	2.00	0
3. M. Demissie	3.50	8,788
(3) Total senior personnel	10.50	8,788
B. Other personnel		
2. (1) Technician, F. Dillon	12.00	17,000
3. (1) Graduate student @1600/mo	6.00	9,600
(2) Total other	18.00	26,600
Total salaries and wages	13.00	35,388
C. Fringe benefits		
12.551% of 25,788		3,237
0.32% of 9,600		31
Subtotal		3,268
Total salaries and benefits		38,656
E. Travel - domestic		
Vehicle expense for field data collection		3,722
Meetings		1,778
Subtotal		5,500
G. Other direct costs		
1. Materials and supplies		500
2. Publication costs, page charges		1,000
4. Computer services		1,500
6. Sediment sample analysis		3,000
Telecommunications		300
Subtotal		6,300

H.	Total direct costs (A-G)	50,456
	Exclusion of computer services (1,500) Modified total direct costs	48,956
I.	Indirect costs	
	21.5% of 9,600 (tuition)	2,064
	Technician salary and fringe benefits (17,000 + 2,134) plus vehicle operation (3,722); 29.3% of 22,856	6,697
	45.0% of 26,100 (48,956 MTDC - 22,856)	11,745
	Subtotal	20,506
J.	Total direct and indirect costs	70,962
K.	Residual funds	0
L.	Amount of this request	70,962

ECOSYSTEM STRUCTURE

SUMMARY PROPOSAL BUDGET

FOR NSF USE ONLY		
PROPOSAL NO.	DURATION (MONTHS) Proposed	Granted
AWARD NO.		

ORGANIZATION
University of Illinois - Natural History

PRINCIPAL INVESTIGATOR/PROJECT DIRECTOR
K. S. Lubinski

A. SENIOR PERSONNEL: PI/PD, Co PI's, Faculty and Other Senior Associates (List each separately with title; A.6. show number in brackets)	NSF FUNDED PERSON-MOS. CAL.	ACAD	SUMR	FUNDS REQUESTED BY PROPOSER	FUNDS GRANTED BY NSF (IF DIFFERENT)
1. K. S. Lubinski 6 mo				$ 0	$
2. R. W. Gorden 1 mo				0	
3. R. E. Sparks 0.4 mo				0	
4.					
5. ( ) OTHERS (LIST INDIVIDUALLY ON BUDGET EXPLANATION PAGE)					
6. (3) TOTAL SENIOR PERSONNEL (1-5)				0	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. ( ) POST DOCTORAL ASSOCIATES					
2. (2) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	22			18,519	
3. ( ) GRADUATE STUDENTS					
4. ( ) UNDERGRADUATE STUDENTS					
5. ( ) SECRETARIAL-CLERICAL					
6. ( ) OTHER					
TOTAL SALARIES AND WAGES (A+B)				18,519	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS) 12.551% of 18,519				2,324	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A+B+C)				20,843	
D. PERMANENT EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $1,000; ITEMS OVER $10,000 REQUIRE CERTIFICATION)					
TOTAL PERMANENT EQUIPMENT				0	
E. TRAVEL 1. DOMESTIC (INCL. CANADA AND U.S. POSSESSIONS)				1,500	
2. FOREIGN				0	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $					
2. TRAVEL					
3. SUBSISTENCE					
4. OTHER					
TOTAL PARTICIPANT COSTS				0	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				810	
2. PUBLICATION COSTS/PAGE CHARGES					
3. CONSULTANT SERVICES					
4. COMPUTER (ADPE) SERVICES					
5. SUBCONTRACTS					
6. OTHER				2,500	
TOTAL OTHER DIRECT COSTS				3,310	
H. TOTAL DIRECT COSTS (A THROUGH G)				25,653	
I. INDIRECT COSTS (SPECIFY) 29.3% of 25,653					
TOTAL INDIRECT COSTS				7,516	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				33,169	
K. RESIDUAL FUNDS (IF FOR FURTHER SUPPORT OF CURRENT PROJECTS GPM 252 AND 253)				0	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				$ 33,169	$

PI/PD TYPED NAME & SIGNATURE*	DATE	FOR NSF USE ONLY		
K. S. Lubinski		INDIRECT COST RATE VERIFICATION		
INST. REP. TYPED NAME & SIGNATURE*	DATE	Date Checked	Date of Rate Sheet	Initials - DGC Program

NSF Form 1030 (10-80) *Supersedes All Previous Editions*

*SIGNATURES REQUIRED ONLY FOR REVISED BUDGET (GPM 233)

Component 3. Ecosystem Structure
1986 Budget Explanation

Prepared June 1985

Long-Term Ecological Research (LTER)
on the Illinois and Mississippi Rivers

	Man-mos.	Funding requested
A. Senior personnel		
1. K. S. Lubinski	6.00	0
2. R. W. Gorden	1.00	0
3. R. E. Sparks	0.40	0
(3) Total senior personnel	7.40	0
B. Other personnel		
2. (2) Technician	22.00	18,519
(2) Total other	22.00	18,519
Total salaries and wages	29.40	18,519
C. Fringe benefits 12.551% of 18,519		2,324
Total salaries and benefits		20,843
E. Travel - domestic		1,500
G. Other direct costs		
1. Materials and supplies		810
6. Other - contractual services, field station operation and maintenance, electricity, telecommunications, equipment repair and replacement		2,500
Subtotal		3,310
H. Total direct costs (A-G)		25,653
I. Indirect costs 29.3% of 25,653		7,516
J. Total direct and indirect costs		33,169
K. Residual funds		0
L. Amount of this request		33,169

F-23

ECOSYSTEM FUNCTION

SUMMARY PROPOSAL BUDGET

FOR NSF USE ONLY		
PROPOSAL NO.	DURATION (MONTHS) Proposed	Granted
AWARD NO.		

ORGANIZATION: University of Illinois - Natural History

PRINCIPAL INVESTIGATOR/PROJECT DIRECTOR: R. E. Sparks

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title; A.6. show number in brackets)	NSF FUNDED PERSON-MOS. CAL.	ACAD	SUMR	FUNDS REQUESTED BY PROPOSER	FUNDS GRANTED BY NSF (IF DIFFERENT)
1. R. E. Sparks 3.0 mo				$ 0	$
2. P. G. Risser 0.5 mo				0	
3. R. W. Gorden 0.5 mo				0	
4. R. V. Anderson			3.0	7,875	
5. ( ) OTHERS (LIST INDIVIDUALLY ON BUDGET EXPLANATION PAGE)					
6. (4) TOTAL SENIOR PERSONNEL (1-5)			3.0	7,875	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. ( ) POST DOCTORAL ASSOCIATES					
2. ( ) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)					
3. ( ) GRADUATE STUDENTS					
4. ( ) UNDERGRADUATE STUDENTS					
5. ( ) SECRETARIAL-CLERICAL					
6. (2) OTHER technicians				27,571	
TOTAL SALARIES AND WAGES (A+B)				35,446	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS) 12.551% of 35,446				4,449	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A+B+C)				39,895	
D. PERMANENT EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $1,000; ITEMS OVER $10,000 REQUIRE CERTIFICATION)					
TOTAL PERMANENT EQUIPMENT				0	
E. TRAVEL 1. DOMESTIC (INCL. CANADA AND U.S. POSSESSIONS)				1,500	
2. FOREIGN				0	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $					
2. TRAVEL					
3. SUBSISTENCE					
4. OTHER					
TOTAL PARTICIPANT COSTS				0	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				2,137	
2. PUBLICATION COSTS/PAGE CHARGES				240	
3. CONSULTANT SERVICES					
4. COMPUTER (ADPE) SERVICES					
5. SUBCONTRACTS					
6. OTHER water sample analyses, service agreements, boats				14,586	
TOTAL OTHER DIRECT COSTS				16,963	
H. TOTAL DIRECT COSTS (A THROUGH G)				58,358	
I. INDIRECT COSTS (SPECIFY) 29.3% of 58,358					
TOTAL INDIRECT COSTS				17,099	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				75,457	
K. RESIDUAL FUNDS (IF FOR FURTHER SUPPORT OF CURRENT PROJECTS GPM 252 AND 253)				0	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				$75,457	$

PI/PD TYPED NAME & SIGNATURE*	DATE	FOR NSF USE ONLY		
Richard E. Sparks *Richard E. Sparks*		INDIRECT COST RATE VERIFICATION		
INST. REP. TYPED NAME & SIGNATURE*	DATE	Date Checked	Date of Rate Sheet	Initials - DGC Program

NSF Form 1030 (10-80) *Supersedes All Previous Editions*

*SIGNATURES REQUIRED ONLY FOR REVISED BUDGET (GPM 233)

Component 4. Ecosystem Function
1986 Budget Explanation

Prepared June 1985

Long-Term Ecological Research (LTER)
on the Illinois and Mississippi Rivers

	Man-mos.	Funding requested
A. Senior personnel		
1. R. E. Sparks	3.00	0
2. P. G. Risser	0.50	0
3. R. W. Gorden	0.50	0
4. R. V. Anderson	3.00	7,875
(4) Total senior personnel	7.00	7,875
B. Other personnel		
6. (2) Technicians		
K. D. Blodgett @ 2037.50	10.59	21,571
D. Day @ 1,000.00	6.00	6,000
(2) Total other	16.59	27,571
Total salaries and wages	23.59	35,446
C. Fringe benefits 12.551% of 35,446		4,449
Total salaries and benefits		39,895
E. Travel - domestic		1,500
G. Other direct costs		
1. Materials and supplies		2,137
2. Publications, page charges		240
6. Other		
Analysis of 309 water samples by INHS Water Chemistry Lab @ $39 ea.		12,051
Half of maintenance and service agreements for IBM word processor, Mettler balance, 3M copier		1,210
Maintenance and service on boats and field equipment		1,325
Subtotal		16,963

ECOSYSTEM FUNCTION

SUMMARY PROPOSAL BUDGET

FOR NSF USE ONLY		
PROPOSAL NO.	DURATION (MONTHS) Proposed	Granted
AWARD NO.		

ORGANIZATION
University of Illinois - Natural History

PRINCIPAL INVESTIGATOR/PROJECT DIRECTOR
R. E. Sparks

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title; A.6. show number in brackets)	NSF FUNDED PERSON-MOS. CAL.	ACAD	SUMR	FUNDS REQUESTED BY PROPOSER	FUNDS GRANTED BY NSF (IF DIFFERENT)
1. R. E. Sparks 3.0 mo				$ 0	$
2. P. G. Risser 0.5 mo				0	
3. R. W. Gorden 0.5 mo				0	
4. R. V. Anderson			3.0	7,875	
5. ( ) OTHERS (LIST INDIVIDUALLY ON BUDGET EXPLANATION PAGE)					
6. (4) TOTAL SENIOR PERSONNEL (1-5)			3.0	7,875	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. ( ) POST DOCTORAL ASSOCIATES					
2. ( ) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)					
3. ( ) GRADUATE STUDENTS					
4. ( ) UNDERGRADUATE STUDENTS					
5. ( ) SECRETARIAL-CLERICAL					
6. (2) OTHER technicians				27,571	
TOTAL SALARIES AND WAGES (A+B)				35,446	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS) 12.551% of 35,446				4,449	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A+B+C)				39,895	
D. PERMANENT EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $1,000; ITEMS OVER $10,000 REQUIRE CERTIFICATION)					
TOTAL PERMANENT EQUIPMENT				0	
E. TRAVEL 1. DOMESTIC (INCL. CANADA AND U.S. POSSESSIONS)				1,500	
2. FOREIGN				0	
F. PARTICIPANT SUPPORT COSTS 1. STIPENDS $ 2. TRAVEL 3. SUBSISTENCE 4. OTHER					
TOTAL PARTICIPANT COSTS				0	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				2,137	
2. PUBLICATION COSTS/PAGE CHARGES				240	
3. CONSULTANT SERVICES					
4. COMPUTER (ADPE) SERVICES					
5. SUBCONTRACTS					
6. OTHER water sample analyses, service agreements, boats				14,586	
TOTAL OTHER DIRECT COSTS				16,963	
H. TOTAL DIRECT COSTS (A THROUGH G)				58,358	
I. INDIRECT COSTS (SPECIFY) 29.3% of 58,358					
TOTAL INDIRECT COSTS				17,099	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				75,457	
K. RESIDUAL FUNDS (IF FOR FURTHER SUPPORT OF CURRENT PROJECTS GPM 252 AND 253)				0	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				$75,457	$

PI/PD TYPED NAME & SIGNATURE*	DATE	FOR NSF USE ONLY		
Richard E. Sparks *Richard E. Sparks*		INDIRECT COST RATE VERIFICATION		
INST. REP. TYPED NAME & SIGNATURE*	DATE	Date Checked	Date of Rate Sheet	Initials - DGC Program

NSF Form 1030 (10-80) *Supersedes All Previous Editions*

*SIGNATURES REQUIRED ONLY FOR REVISED BUDGET (GPM 233)

Component 4. Ecosystem Function
1986 Budget Explanation

Prepared June 1985

Long-Term Ecological Research (LTER)
on the Illinois and Mississippi Rivers

	Man-mos.	Funding requested
A. Senior personnel		
1. R. E. Sparks	3.00	0
2. P. G. Risser	0.50	0
3. R. W. Gorden	0.50	0
4. R. V. Anderson	3.00	7,875
(4) Total senior personnel	7.00	7,875
B. Other personnel		
6. (2) Technicians		
K. D. Blodgett @ 2037.50	10.59	21,571
D. Day @ 1,000.00	6.00	6,000
(2) Total other	16.59	27,571
Total salaries and wages	23.59	35,446
C. Fringe benefits 12.551% of 35,446		4,449
Total salaries and benefits		39,895
E. Travel - domestic		1,500
G. Other direct costs		
1. Materials and supplies		2,137
2. Publications, page charges		240
6. Other		
Analysis of 309 water samples by INHS Water Chemistry Lab @ $39 ea.		12,051
Half of maintenance and service agreements for IBM word processor, Mettler balance, 3M copier		1,210
Maintenance and service on boats and field equipment		1,325
Subtotal		16,963

H.	Total direct costs (A-G)	58,358
I.	Indirect costs 29.3% of 58,358	17,099
J.	Total direct and indirect costs	75,457
K.	Residual funds	0
L.	Amount of this request	75,457

APPENDIX G

Use of the Increment of $40,000 at the Large River LTER Site in 1986

Justification

We plan to pay two of our senior people summer salaries so that they can devote more time to the LTER project. Dr. Mike Demissie will extend the hydraulic model to additional channel border areas and will investigate ways of modeling complex secondary flow patterns induced by the main flow, winds, and large boats. We believe that these flows move detritus from inshore aquatic plant beds to offshore beds of invertebrate consumers. Dr. Richard Anderson will refine the biological model and link it more directly to the hydraulic model.

Ann Autrey will continue to operate the carbon analyzer which was partially paid for with LTER funds and will assist with measurement of carbon isotope ratios in plants, sediments, and invertebrates.

Doug Blodgett will assume some of the field duties now carried out by Jack Grubaugh, so that Jack can devote more time to managing the entry and analysis of data on nutrients, organic matter, and invertebrate populations at the field stations.

Budget

	Man-mo.	On campus	Off campus
Personnel Salaries			
R. Anderson	2.000		5,250
D. Blodgett	1.732		3,528
M. Demissie	3.500	8,788	
A. Autrey (MS student)	6.000	7,716	
Subtotals	13.232	16,504	8,778
Fringe benefits			
12.551% of 8,778			1,102
12.551% of 8,788		1,103	
0.32% of 7,716		25	
Subtotal		1,128	1,102
Total direct costs		17,632	9,880
Indirect costs			
21.5% of 7,716 (tuition)		1,659	
45.0% of 17,632 (in campus)		7,934	
29.3% of 9,880 (off campus)			2,895
Direct and indirect costs		27,225	12,775
Total costs		40,000	