ILLINOIS RIVER BASIN RESTORATION
COMPREHENSIVE PLAN
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT

APPENDIX B

SYSTEM ECOLOGY

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INTRODUCTION

This appendix summarizes several investigations used in the preparation of the Comprehensive Plan for the Illinois River Basin Restoration. Some of the reports summarized below were prepared by contract. The reports are available at the Corps of Engineers, Rock Island District office in Rock Island, Illinois.

I. RESTORATION NEEDS ASSESSMENT

A major focus of the system study was to determine the problems, opportunities, and resource conditions using a Restoration Needs Assessment (RNA) approach. The RNA evaluated the needs for restoration in the entire basin, with a focus on the tributaries and sub-watersheds feeding into the main stem of the Illinois River. It provided a practical and scientific basis for assessing the large study area and identifying potential restoration project types and general locations for the Illinois River and its tributaries. The RNA also defined the critical data gaps hindering the ability to determine habitat needs and focus the study, planning, and construction efforts on the areas of critical need. The RNA provided a comprehensive, basin-wide assessment of historic ecological change, existing conditions, predicted future conditions, and desired future conditions. The information gathered for this effort has been incorporated throughout the Comprehensive Plan. The RNA aspect of the study was designed to:

- evaluate existing data availability;
- compile existing data in a Geographic Information Systems (GIS) application;
- describe physiographic characteristics of the basin;
- evaluate stream channel dynamics;
- evaluate rapid watershed assessment techniques;
- evaluate existing, predicted, and desired future conditions; and
- compile a list of information needs.

The RNA provided information that significantly contributed to the development of the Illinois River Basin Restoration Comprehensive Plan and monitoring program.

Several research investigations were initiated to compile information for preparation of the RNA. Summaries of the following products are included in this appendix:

Illinois River Restoration Needs Assessment GIS
ArcIMS Web Site for Serving Historical Aerial Photographs
Native Ecotype and Historic Change Assessment
Rapid Watershed Assessments

Additional research for the RNA is summarized in Appendix D, *Geomorphology, Sediment Delivery, Sediment Removal and Beneficial Use,* under Section 1, *Summary of Illinois River Basin Landforms and Physiographic Regions*; Section 2, *Stream Dynamics Assessment*; and Section 3, *Sediment Budget*. The RNA and the research investigations listed above were used to prepare the Illinois River Basin Restoration Comprehensive Plan. Much of this information will continue to be used well into the next phases of the Illinois River Basin Restoration project.

II. ILLINOIS RIVER RESTORATION NEEDS ASSESSMENT GIS

Scott A. Tweddale, Corps of Engineers, Construction Engineering Research Laboratory (CERL), Champaign, IL

The Illinois River RNA-GIS application and geospatial database were developed as a tool to support the Illinois River Ecosystem Restoration Feasibility Study - RNA. Its purpose is to assist in the evaluation of historic, existing (primarily), predicted future, and desired future conditions of the Illinois River Watershed by providing an extensive geospatial database and customized GIS analytical capabilities. The study area and extent of the associated geospatial database includes the main stem Illinois River, its tributaries, and watershed in the State of Illinois.

The application is structured to provide access to GIS themes at three different scales: (1) the Illinois River Watershed, (2) the major tributary watersheds [United States Geological Survey (USGS) Hydrologic Unit Code-8 (HUC 8)], and (3) the subwatersheds [USGS Hydrologic Unit Code-12 (HUC12)]. A large number of geospatial data layers in the GIS have been summarized for each HUC-8 and HUC-12 watershed within the Illinois River Watershed. There are 19 HUC-8 and 944 HUC-12 watersheds in the basin. This method of organizing the application and geospatial database supports data browsing, data queried, and summaries at all scales in support of large-scale planning and smaller-scale, site-specific project formulation. The Illinois River RNA-GIS application was created using Environmental Systems Research Institute (ESRI) ArcGIS8.X software and Microsoft's Visual Basic for Applications (VBA), which is included in ArcGIS8.X products.

III. ArcIMS WEB SITE FOR SERVING HISTORICAL AERIAL PHOTOGRAPHS

Dr. Donald E. Luman, Office of the Chief, Illinois State Geological Survey
Champaign, Illinois

The photographic record provided by aerial photographs offers information that may be used for estimating baseline conditions and evaluating changes through time. Aerial photographs can serve as an important resource for geomorphological analyses (e.g., movement of nick points or changes in stream alignment) of physical and cultural landscapes. The first statewide collection of aerial photography of Illinois landscapes was acquired in the late 1930s and early 1940s as part of the U.S. Department of Agriculture, Agricultural Adjustment Administration (USDA-AAA) program. In the 1980s, for safety reasons, the National Archives and Records Administration destroyed the silver nitrate film negatives of this collection. The only remaining records of this photographic collection are the photographic paper prints made from the original film negatives.

Today, there exist more than 27,000 photographic paper prints of this first collection of aerial photographs of Illinois. These photographs represent the earliest and only remaining detailed, historical, aerial photographic record of Illinois' physical and cultural landscapes. The photographs are stored in several university library archives within Illinois and are in nearly pristine condition. However, because of their unique historic value, the photographs are not accessible to the public, planners, or researchers.

The Illinois State Geological Survey initiated a project to digitize these historical aerial photographs. The Survey has scanned more than 7,200 vintage photographs—dating from the 1930s and 1940s—of

Illinois, including photographs from approximately 10 counties having areas that lie within the Illinois River Basin. Photos from an additional four counties have recently been completed. Historical aerial photographs from additional counties within the Illinois River Basin need to be digitized. For each of the counties, an Excel spreadsheet was created that details the relevant information concerning the print collection, including county name, USDA-AAA county prefix code, acquisition date, total number of photographs, scale, number of flight lines, orientation of flight lines, type of county index (photo or line), date of county index, and an area for comments.

The index sheets for the 14 project counties were georeferenced to form the basis of an ArcIMS navigation map for each county. Each scanned county index sheet was geometrically corrected to a standard cartographic map projection using the USGS 1:100,000-scale Digital Raster Graphic (DRG) maps as the georeferencing base. ArcView 3.2 was used to create point data maps that indicate the approximate center point for each aerial photograph. The end product is a vector-based shape file used in ArcIMS as the navigation framework for searching and selecting images for download.

For the county-level and sub-county views, vector-based reference data layers including labeled Illinois counties, municipalities, interstate, U.S. highways, and state highways would be used in conjunction with the historical aerial photography center points. Recent Landsat Thematic Mapper ™ satellite imagery was used as the navigation raster image base, which provides a higher level of surface feature resolution. In addition, all of the vector and raster-based data used for the navigation maps were transformed to Lambert Conformal Conic projection, using the NAD27 datum.

All of the final scanned images for the 14 project counties were formally archived onto the Illinois State Geological Survey's UNIX-based system by county and flight line. This archive was added to the Survey's long-term data storage and back-up routines to ensure permanence for retrieval and access for the project web site.

Although some historical aerial photographs have been digitized and others are being digitized, the digitized images are not available for distribution. An Internet web interface was needed to make the scanned images freely and readily accessible to Federal and State planners and researchers. ESRI's Arc Interactive Map Service software was used for the development of the interactive portion of the Illinois Historical Aerial Photography (ILHAP) web site. This interactive web interface incorporates all of the above information and data layers. These digitized historic aerial photographs are now available at: http://crystal.isgs.uiuc.edu/nsdihome/webdocs/ilhap/

IV. NATIVE ECOTYPE AND HISTORIC CHANGE ASSESSMENT (DRAFT)

Dr. Michael Wiant, Illinois State Museum and Susan Post, Illinois Natural History Survey

Understanding the native ecotypes in the Illinois River Basin is important in establishing restoration endpoints. Restoration to presettlement conditions throughout the Basin is certainly not the goal of this program, but the knowledge helps define the limits, or expectations, for restoration in areas that are selected for restoration.

A. Native Ecotypes by Physiographic Regions. Upland habitats, tributary streams, and main stem floodplains and channels throughout the Illinois River watershed have been altered for a wide variety of reasons using many different methods. Knowledge of the natural potential habitats is important in order to establish a baseline for what could potentially be restored. There is not an expectation that the

Basin will be returned to a pristine condition, but native ecotypes can serve as targets for restoration activities. The first objective was to compile a short, well-illustrated summary of the potential native ecotypes found in the various physiographic regions of the Illinois River Basin, with representative photographs.

Each ecotype was identified, described, and illustrated with photographs for the major natural ecotypes present in the Illinois River Basin. The discussion included the major land cover classes—forest, prairie, marsh, and aquatic habitats—and the different types of those major classes likely to have been found in the Illinois River Basin. Topographic features were mentioned to provide an overview of the broad landscape patterns throughout the Basin. Statewide Government Land Office (GLO) survey records and GIS presettlement land cover maps were referenced for baseline natural community characteristics.

Natural Divisions of Illinois, Principal Natural Features

I. Terrestrial Plant Communities
   A. Forest
      1. Dry upland
      2. Mesic upland
      3. Wet upland
      4. Floodplain
      5. Bottomland
      6. Tamarack swamp
      7. Scrub oak

   B. Prairie
      1. Prairie grove
      2. Prairie
         a. Dry
         b. Mesic
         c. Wet
      3. Sand prairie
         a. Dry
         b. Mesic
         c. Wet
      4. Loess hill prairie

   C. Wetlands
      1. Fen
      2. Marsh
      3. Sedge meadow
      4. Bog

II. Aquatic Habitats
   A. Lakes
   B. Creeks
   C. Rivers
   D. Sloughs
   E. Backwater lakes
   F. Oxbow lakes
   G. Prairie potholes

B. Historic Change Assessment (Timeline). The second objective was to obtain a short summary of the anthropogenic factors that created the highly developed landscape of the modern Illinois River Basin. The pertinent literature and documents describing environmental change in the Illinois River Basin were reviewed, and a concise summary of historical change to native ecotypes and ecosystem function was provided. The analysis began with native cultures' landscape management and continued through European expansion into the Illinois Basin, conversion of upland savannas to crops, upland wetland draining, and levee construction during the 1800s. A second time step to be considered was the early 1900s waterway and urban development, sewage and other pollution discharge to rivers, and further development of the uplands to crops. A third time step began after WWII and emphasized agricultural specialization toward row crops, increased agricultural mechanization, increased use of chemicals, and continued urbanization. A final time step was the post-1970s conservation movement and the success of recent efforts to improve farming practices, control water pollution, and increase conservation practices and habitat restoration. A timeline of major events (legislation, improvements in tools or techniques, cultural factors, etc.) was developed.

V. RAPID WATERSHED ASSESSMENTS

A. Watershed Assessment Methods for Illinois Streams

Dr. Chester C. Watson, Don Roseboom, and Michael Robeson, Colorado State University

Channel modification or channelization activities are listed among the top 10 sources for non-point pollution impacts to rivers. Activities such as straightening, widening, deepening, and clearing debris from channels can be considered modification activities. These activities can severely impact major river projects such as navigation and flood control, as well as alter or reduce the diversity of instream and riparian habitats. The streams within the Illinois River Basin have experienced many of these channel modification activities. As such, a watershed assessments program was developed to mitigate these concerns. Stream restoration would reduce sediment input into the Illinois River and restore riparian and instream habitats, helping achieve ecosystem restoration goals for the Illinois River Basin.

The primary objective of the watershed assessment report is to develop and improve procedures that direct the focus for best management practice (BMP) design and implementation. This report presents the watershed systems analysis planning procedure for channel rehabilitation, using two Illinois watersheds, McKee Creek and Sugar Creek, as case studies. Both McKee and Sugar Creeks were initially proposed as potential restoration projects as part of the Illinois River Basin Restoration and Ecosystem Restoration Feasibility Study, though only McKee Creek was selected as one of the initial Critical Restoration Projects.

A key factor for a successful project is to identify the causal problems. Within the watershed system, problems generally fit into two categories—watershed and channel problems. These problems result in a set of impacts that act upon the channel and watershed, and it is these impacts that must be addressed. Watershed problems result from deforestation, intensive agriculture, urbanization, climate change, and stream base level change. Channel problems occur from channelization, dredging, meander cut-off, dams, inter-basin water transfer, navigation, levees, clearing and snagging, gravel mining, and stabilization structures.

The methodologies outlined represent a systematic and organized process for planning and designing regional sediment management projects that can be applied to lessen impacts of erosion on aquatic habitat and reduce the damage to land and infrastructure in the Basin. A comprehensive and systematic approach must be taken to solve stream and watershed problems. Strong emphasis is

placed on evaluating the complete watershed and channel system. While all projects do not include the resource to construct full-system rehabilitation, it is essential to incorporate planning and analysis to identify opportunities, benefits, and potential problems related to piecemeal implementation.

Monitoring and feedback of the performance data for stream rehabilitation features are essential for establishing operations and maintenance requirements, determining performance measures, and providing feedback for future projects. In addition, when habitat restoration is a project goal, biotic sampling is the only true measure of success.

B. Watershed and Pool Assessments

William P. White and Dr. Nani Bhowmik, University of Illinois

Central to the implementation of the Illinois River Basin Restoration Comprehensive Plan is a methodology to rapidly assess individual watersheds and pools to help identify the most immediate restoration needs. This effort focuses on the watershed scale analysis of stream instability, and includes hydrologic analyses of selected watersheds.

The scope of this rapid watershed assessment project will be to perform pool and watershed assessments along the Illinois River and several watersheds of the river in the next 5 years to identify potential restoration project locations that meet the goals of the Illinois River Basin Restoration Study. The following locations have been identified as priorities within the Basin:

Peoria Pool	Tenmile Creek
Partridge Creek	Marseilles Pool
Dresden Pool	Kankakee River main stem
Upper Fox River	Iroquois River (including Sugar Creek)
McKee Creek	Vermilion River

The assessment techniques generally consist of the following:

1. Acquisition and analysis of aerial imagery from fly-overs using GPS for location information
2. In-air and office examination of imagery for channel process identification
3. “Ground-truthing” for verifying identification and general characteristics of potential target sites
4. Hydrologic analysis of selected watershed and pools
5. Sediment transport analysis of selected watersheds and pools
6. Geomorphic assessment of selected watersheds and pools
7. Biological assessment of selected watersheds and pools

After these assessments identify the most critical bed, bank, and erosion sites, more thorough field assessments will be performed. These field assessments will provide more data on site conditions and serve as baseline information to understand and document restoration efforts monitoring. The Illinois State Water Survey will collaborate with the Regional Teams within the Illinois DNR and with other Scientific Survey offices for these efforts. The Illinois Natural History Survey will coordinate the assessments and inventory of the aquatic and riparian biota. The Illinois State Geological Survey will coordinate the assessments and inventory of the basic geological and geomorphological settings.

This initial assessment phase is expected to take 5 years. During the first year, at least one report for a single pool or watershed—identifying possible restoration project locations—will be completed. The remaining reports will be prepared in subsequent years, summarizing the work completed for that specific year.