CHAPTER 3 - THE AFFECTED ENVIRONMENT

I. THE PHYSICAL ENVIRONMENT

1. Project Location and Description of the Area

The Kankakee River Basin covers an area about 3.3 million acres (Figure 1) including all or portions of Ford, Grundy, Iroquois, Kankakee, Vermillion, and Will counties in Illinois and Benton, Elkhart, Jasper, Kosciusko, Lake, LaPorte, Marshall, Newton, Porter, Pulaski, St. Joseph, Starke, and White counties in Indiana, and Berrien county in Michigan.

From its source near South Bend, Indiana, the Kankakee River flows for nearly 150 miles through Indiana to its mouth at the Illinois River near Channahon, Illinois. In Indiana it flows southwest through seven artificial channels until it reaches the Illinois-Indiana border. For the next 9.5 miles the river regains its natural character and meanders through a mature floodplain forest on both sides of the river with old meanders functionally intact. It flows across a sandy bottom until it reaches Momence where there is small dam and the river begins to flow over limestone bedrock. From Momence to Aroma Park the river is less meandering and flows over a mixture of substrates alternately sand, cobble and bedrock. At Aroma Park, the Kankakee River is joined by the Iroquois River and turns north again flowing over mixed substrates and bedrock until it reaches the dam at Kankakee. The 12 foot high dam at Kankakee creates a 4.7 mile pool referred to as the "six mile pool". The river flows from Kankakee to Wilmington where an 11 foot dam creates a 2 mile pool. The Kankakee merges with the DesPlaines River near Channahon to form the Illinois River. The Kankakee River's two principle tributaries are the Yellow River and Iroquois River (Bhowmik and Bonini, 1981; Ivens et al., 1981).

Prior to channelization, the river arrived at the state line after traveling 250 miles via 2,000 bends and meanders with a gradient of about 5 inches to the mile. Today, the channel has been deepened and the distance between the two points is 82 miles (Bhowmik and Bonini, 1981; Ivens et al., 1981). Historically, the winding water flowed over sand and gravel until it reached Momence where the substrate changed to limestone bedrock. In 1878, when the U.S. Army Corps of Engineers conducted the first of five studies on the Kankakee River, Major Jared A. Smith referred to this area as the "rock ledge" at Momence. Since that time the term "rock ledge" has lead to a serious misconception that has driven much of the debate over drainage of the "Grand Kankakee Swamp". Many have the impression that the "ledge" is a single obstruction like a dam. It is actually a 4 mile reach of river where the water is flowing over bedrock (see appendix IV for a Chronology of Important Events on the Kankakee River) .

The principal causes for the creation of the Grand Kankakee Marsh were continental glaciation and the Kankakee Torrent. These factors account for why most of the Grand Marsh formed in Indiana, the large expanse of sand dune and swale topography, and why the river past Momence develops a higher energy and much steeper descent: 25 feet over 14 miles from Momence to the confluence of the Iroquois, and then 103 feet over 33.5 miles to its mouth at the Illinois River (Bhowmik and Bonini, 1981; Ivens et al., 1981).

View of the Kankakee River looking east from near the Indiana/Illinois state line.

View of the Kankakee River looking west from near the Illinois/Indiana state line

2. Climate

The climate of the Kankakee Basin is temperate continental, marked by cold winters, warm and humid summers, and the lack of a pronounced dry season. The climate of the northern half of the Basin is influenced by its proximity to Lake Michigan. Lake-effect climatic conditions include warmer autumns, cooler springs, higher humidity, increased winter cloudiness, and greater amounts of snow than areas of comparable latitude (Beatty, 1990). In general, the lake produces a marine effect moderating the continental climate of northern Indiana and Illinois.

Total annual precipitation in the Indiana portion of the basin averages approximately 38 inches/year (Beatty 1990), with nearly 22 inches of this falling between mid-April and mid-October. Of particular note, lake-effect snows that affect the northeast part of the Basin can produce twice the annual snowfall of the southern and western areas of the Basin (Beatty 1990). In a year of average precipitation, it is estimated that 30 inches is lost to evaporation, yielding a water surplus in a normal year (Beatty 1990). This has importance for the availability of water and associated stream flow and recharge of wetlands within the Basin.

The average annual temperature within the Indiana portion of the Basin averages 50^0 F. The main valley of the Kankakee River has the shortest growing season in Indiana (150 days) primarily because of the low-lying terrain and sandy soils covered by organic material. These soils, because they gain and lose heat rapidly, are particularly susceptible to frost (Beatty 1990). Conversely, the northern portion of the Basin has a comparatively long growing season (170 days) because of its proximity to Lake Michigan.

3. Geology

The Kankakee River Basin consists of glacial deposits over paleozoic bedrock (Gross and Berg 1981). The landscape is attributable to events that took place during the latter part of the Wisconsin glaciation from about 24,000 - 10,000 years ago. Most relevant to current fish and wildlife resources are the occurrence of a glacial lake encompassing what is now the Kankakee River floodplain, and windblown sands that formed dunes along the southern margin of the existing Basin. About 14,000 years ago, drainage from the Lake Michigan, Saginaw, and Erie lobes discharged meltwater into the Kankakee Basin. This lake produced a broad flat flood-basin that is approximately 2 miles wide near the city of South Bend, Indiana and spreads to about 8 miles wide at the Indiana-Illinois State line (Beatty 1990). As the glacial lake receded, sand deposited in a belt that ranges from about 20 miles wide in Iroquois County, Illinois, to 30 miles wide in Starke County, Indiana, was exposed to primarily western winds that formed an extensive area of dunes. These lie mostly south of the present day Kankakee River in Newton, Jasper, Starke, and Marshall Counties in Indiana and Kankakee and Iroquois Counties in Illinois (Gross and Berg 1981). These dunes stand from 15 to 50 feet above the surrounding floodplain and are oriented north-south reflecting predominately westerly winds (Beatty 1990).

4. Soils

Soil is formed through the interaction of climate, living organisms, and landscape position with the glacial and bedrock parent material over time (Broderson 1991). Principal soils of interest for the proposed Refuge include: the Maumee-Gilford-Sebewa association on the lacustrine and outwash plains of the main Kankakee River valley that are nearly level, very-poorly drained soils formed under native grasses and mixed water-tolerant hardwoods; Genesee-Eel-Shoals, Tracy-Door-Lydick, and Oshtemo-Fox and Fox-Ockley-Westland associations located on alluvial and outwash deposits, and formed under mixed hardwood trees except on Door (prairie grasses) and Lydick (prairie grasses and trees); the Plainfield-Maumee-Oshtemo association located on *eolian* sands and formed under prairie grasses and black oak (*Quercus velutina*); and, Brookston-Odell-Corwin and Parr-Brookston associations which formed in thin loess over glacial till and Markham-Elliott-Pewamo which formed in clayey glacial till, all of which formed under prairie grasses (Beatty 1990).

Under current land use, soils in the Basin support predominately agricultural ecosystems. At least 3 elements, however, lower the suitability of large areas of soils within the Basin for agriculture. They are erosion, drought, and poor drainage. The most extensive of these is that many soils in the Basin have poor natural drainage and even in artificially-drained areas, wetness, ponding, and flooding can pose moderate-to-severe limitations (Beatty 1990). The continuing difficulties with large-scale agricultural production on one of the world's largest historic wetlands was the driving force behind the establishment of the Kankakee River Basin Commission and the study by SEG Engineers.

5. Water

Groundwater in the Kankakee basin is used primarily for domestic water supply with surface water used for agriculture and recreation. Groundwater in the Basin originates in 3 aquifers: the Valparaiso Outwash Aquifer, the Kankakee Aquifer, and the St. Joseph Aquifer. Surface water in the Basin originates in irrigation ditches near South Bend, Indiana which become the Kankakee River approximately 8 miles southwest.

Water has played the key role in the physical, biological, and socio-economic environments of the Basin. When the Wisconsin glaciation ended approximately 10,000 years ago, meltwater covered the Basin with large lakes and the erosive forces of the Kankakee Torrent contributed to the surficial geology of the Basin. Water continued to be the dominant factor driving the ecosystem until European settlement in the mid-19th century.

The Grand Marsh posed a formidable challenge to the settlement of the Indiana part of the Basin. As early as 1849, the Indiana General Assembly authorized projects to begin draining the area. By the early part of the 20th century, a system of ditches and levees supported a predominately agricultural landscape. Since that time, it has become essential to many Indiana farmers that the Kankakee River function as an agricultural drainage ditch. In Illinois, where the Kankakee River has not been channelized, the Kankakee exists in a near natural condition especially between the Indiana state line and Momence, Illinois, where the river meanders through natural winding channels, high-quality shrub swamps, and mature floodplain forests. Although the landscape is predominately agricultural, Illinois farmers are not nearly as dependent on the Kankakee River as their principal conduit for agricultural drainage as are many of their Indiana counterparts.

In Illinois, the Kankakee River, based on biological parameters, has among the best water quality of any river in the state. The water in the Kankakee has been variously classified as "excellent among Illinois streams", and a "Class B Stream (Highly Valued Aquatic Resource)", and included on a list of outstanding Illinois aquatic ecosystems (Kwak 1993). In Indiana, based on the Index of Biotic Integrity (IBI), 76% of stream miles surveyed fully or partially support aquatic life use, while 24% are not supportive. Low IBI values were primarily attributable to lack of habitat, and to a limited extent, low dissolved oxygen (IDEM, 1995).

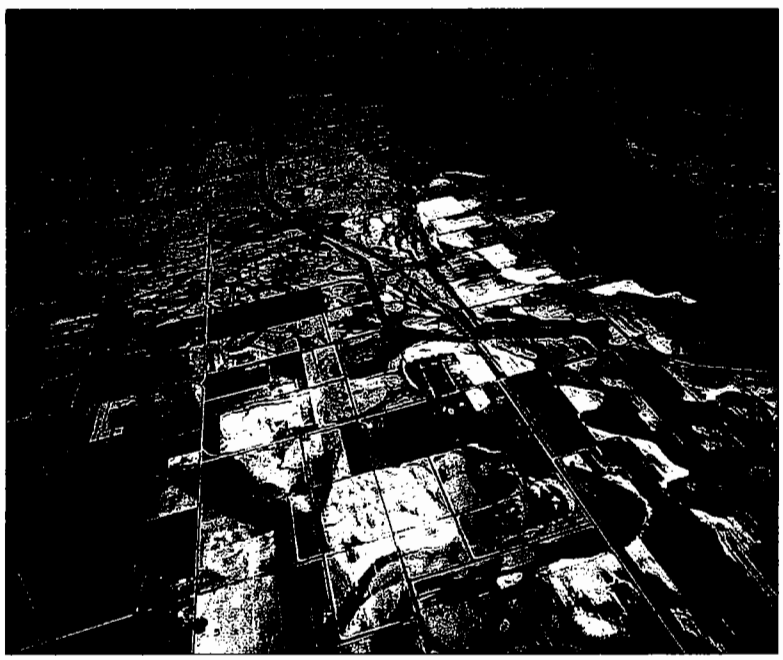
6. Sedimentation

The deposition of sediment in the Kankakee River has long been an issue with its users. Concern exists that materials carried downstream from the channelized portions of the river settle out when they reach the natural river in Illinois, causing flooding and limiting the overall recreational and ecological value of the river. Recent studies on sedimentation by the U.S. Geological Survey on the meandering portions between the state line and the Momence Wetlands and Six-Mile pool above the Kankakee dam found substantial amounts had accumulated in recent years. From 1980 to 1994, 133,600 cubic yards of sediment had accumulated along the Momence Wetlands. Between 1978 to 1980, 115,700 cubic yards had accumulated in Six-Mile pool and from 1980 to 1994, sediment in the pool grew by another 182,900 cubic yards.

7. Flooding

Currently the Kankakee River overflows its banks an average of every two years. These flooding events combine large volumes of water with unusually low peaks and extremely long durations. This is principally due to the large expanse of flat land that holds the water for extended periods of time. Data beginning in 1926 show that annual flood peaks are increasing due to intensified agricultural practices, diking and pumping, and urban growth (Kankakee River Basin Commission, 1989).

The frequent flooding in the Basin is the result of several factors, including 1) the loss of river capacity due to channelization, 2) increased runoff to the river and its major tributaries due to agricultural drainage and urban/rural development, 3) loss of wetlands to retain and slowly release flood waters, 4) erosion of topsoil due to inadequate land treatment practices, and 5) bank erosion along the river and its tributaries as a result of increased peak flows. Not only does the Kankakee River and its tributaries receive increasing amounts of runoff, increased deposition and build-up of sediments within the river and its tributaries are reducing the capacity to retain these waters within the river banks. Further, due to the flatness of the Basin, floodwaters have the potential to affect large acreages.



Modern-day flooding and sedimentation not only cause monetary damages to local property, they also destroy natural resources and degrade and/or restrict many recreational uses of the river.

Flooding along the Kankakee's main channel in Indiana impacts 106,150 acres, of which 86,060 are cropland. A 1976 study placed the extent of annual damage at $1,420,000, which in 1997 dollars is $4,250,000. With respect to tributaries, that same study found that flooded land amounted to 91,000 acres and produced damages estimated at $1,234,700, or $3,690,000 in 1997 dollars. Another study in Illinois found that flooding along the Illinois portion of the river produced similar damages. It was estimated that over 10 percent of the land within the Basin floods and annual damages along the Kankakee, Iroquois, and Sugar Creek could be as high as $1,240,000 (1997 dollars). Recent estimates of flood damages within the Basin indicate annual damages in excess of $14 million.

8. Archeological Resources

Numerous archeological sites are known to exist in the Kankakee River Basin. The following data indicate the known archeological sites within each of the counties that comprise most of the Basin: Iroquois - 204 sites, Kankakee - 486 sites, Will - 1,682 sites, Porter - 515 sites, St. Joseph - 342 sites, Lake - 443 sites, LaPorte - 247 sites, Starke - 113 sites, Newton - 180 sites, Jasper - 66 sites, and Marshal - 363 sites. The river and its tributaries offered native peoples excellent transportation and sites rich in essential resources.

II. THE BIOLOGICAL ENVIRONMENT

The Keystone Center, 1991, defines biological diversity as the variety of life and its processes including the variety of living organisms, the genetic differences among them, and the communities and ecosystems in which they occur. Biological diversity can be considered at a minimum of 4 levels: *genetic level, species level, ecosystem level, and landscape level.* In order to manage the biological resources of the Basin, it is necessary to work at the species, ecosystem, and landscape levels.

Because the Basin exists at the edge of the prairie biome, numerous species occur at the edge of their ranges there. The area remains important for those organisms inhabiting prairie-wetland and the transition zone between prairie and oak-hickory forest. Considerations of genetic diversity may be particularly important for these species, but for practical reasons, planning to actively conserve genetic diversity will constitute a minor component of Refuge development.

To limit the complexity of the discussion, we consider the various levels of biological diversity independently here. However, the levels of biological diversity are inextricably interrelated on the ground. Species are how we typically measure biological diversity and they historically represent the principal focus of wildlife managers.

1. Species Level Biological Diversity

A. Plant Species

The protection of plants by means of the proposed Refuge will focus on three categories of plants: 1) Federally listed (endangered, threatened, and candidate) plants or plants necessary to the viability of populations of Federally listed species; 2) those that biologists within the Indiana DNR Division of Nature Preserves (DNP) and Illinois DNR consider particularly vulnerable; and, 3) plants that would best be protected by the proposed Refuge's landscape approach.

B. Threatened and Endangered Species

Restoration of the wetland-prairie/oak savanna landscape would also benefit other historically important and ecologically significant species. Federally endangered, threatened, and candidate species within focus areas in the Basin include Mitchell's satyr butterfly and Indiana bat. The entire Basin holds more than 200 state-listed species including the western sand darter (*Etheostoma clarum),* northern leopard frog (*Rana pipiens),* eastern massasauga *(Sistrurus catenatus catenatus)*, Franklin's ground squirrel (*Spermophilus franklinii)*, and Kankakee mallow (*Iliamnaa remota)*. One important outcome of the proposed Refuge would be to avert possible Federal listing of some of the numerous Illinois and Indiana state-listed species occurring in the Basin. While not a primary goal of the Refuge, the recent successful reintroduction of the northern river otter (*Lutra canadensis)* by the Indiana DNR in a neighboring watershed suggests opportunities for the reintroduction of other extirpated species into a landscape of protected areas. Examples could include prairie chicken and bison (*Bison bison)*. The latter would reintroduce a large herbivore and an important component of the prairie/savanna ecosystem.

C. Invertebrate Species

The Kankakee River in Illinois supports a diverse mussel fauna (20 species) including 10 species that are listed under the Illinois, Indiana, or Federal Endangered Species Acts. The Federally endangered Higgin's eye (*Lampsilis higginsi)* and the state endangered rainbow (*Villosa iris)*, snuffbox (*Epioblasma triquetra),* and spectaclecase (*Cumberlandia monodonta)* do not have recent live records and may be extirpated from the drainage (Kwak 1993).

State-listed species extant in the "Kankakee River Resource Rich Area" in Illinois, which corresponds closely with Refuge focus areas include: slippershell (Alasmidonta viridis) (state threatened (ST)), spike (Elliptio dilatata) (ST), sheepnose (Plethobascus cyphyus) (state endangered (SE)), purple wartyback (Cyclonaias tuberculata) (ST), black sandshell (Ligumia recta) (ST), salamander mussel (Simpsonaias ambigua) (SE), and ellipse (Venustaconcha ellipsiformis) (Special Concern) (Francis Harty, Illinois Dept. of Natural Resources, 9 March 1997, facsimile communication; Illinois Natural History Survey Mollusk Collection Database 1999).

The Federally endangered Hine's emerald dragonfly does not likely occur in the Basin, but the area has not yet been adequately surveyed and suitable habitat for this species may exist (Tim Cashatt, Illinois State Museum, 29 July 1997, telephone conversation).

D. Fish Species

Fishing on the Kankakee River is a major recreational activity in northwestern Indiana and northeastern Illinois. The Kankakee River in Illinois is a premiere smallmouth bass stream and holds past state records for several recreational species. Ninety-nine species of fish in 19 families have been collected in the Kankakee River (Kwak 1993). In addition, the Illinois DNR lists 6 species in the Kankakee River Resource Rich Area as either state endangered or state threatened. They are: western sand darter, northern brook lamprey (*Ichthyomyzon fossor*), river redhorse (*Moxostoma carinatum*), pallid shiner (*Notropis amnis, Hybopsis amnis*), ironcolor shiner (*Notropis chalybaeus*), and weed shiner (*Notropis texanus*). The varied fish fauna of the Kankakee River has long been valued as a food and recreational resource by the people of the Basin.

E. Amphibians and Reptile Species

Herpetofauna are increasingly the concern of conservation biologists (Blaustein, Wake, and Sousa 1994). Nearly 15 years ago, Minton 1982, perceived declines of some species in Indiana including the cricket frog (*Acris crepitans*), the northern leopard frog, and the striped chorus frog (*Pseudacris triseriata triseriata*). Although we do not completely understand the apparent decline of certain amphibian populations, habitat loss and fragmentation may play an important role. Wetland protection and linking isolated wetlands into a landscape complex in the Basin could be important for the long-term survival of some amphibian species.

F. Bird Species

The restoration of wetland complexes containing large, interconnected habitat patches would provide habitat for a variety of area-sensitive (birds that have minimum area requirements) wetland-dependent

birds including the least bittern, American bittern, black tern, sedge wren, and prothonotary warbler which currently breed in the Basin. Numerous other wetland or successional habitat-dependent species including several on the list of Migratory Non-game Birds of Management Concern in the United States (1995 List) occur in the Basin (Office of Migratory Bird Mgt. 1995).

The 1995 List contains 122 species and documents habitat loss as the primary threat to 80% of those species (Office of Migratory Bird Mgt. 1995). Grassland species of management concern on the 1995 List that would benefit from prairie/savanna restoration and protection in the Kankakee Basin include: grasshopper sparrow, bobolink, Henslow's sparrow, field sparrow, eastern meadowlark, dickcissel, and upland sandpiper. The proposed Refuge's contribution to large scale prairie restoration in the Basin will provide necessary habitat particularly for area-sensitive non-game grassland birds. Herkert 1994 identified the following grassland species breeding in northeastern and east-central Illinois as area sensitive: grasshopper sparrow, Henslow's sparrow, bobolink, savannah sparrow, and eastern meadowlark.

The wetlands of the Kankakee remain a significant breeding area for waterfowl despite habitat loss and fragmentation. Dubowy and Hartman, 1995 studied waterfowl nesting in the Basin and found mallards, blue-winged teal, and wood ducks exhibited a nesting density of 0.8 pairs/wetland acre in natural and restored wetlands within the Basin. In addition, tens of thousands of migratory waterfowl depend on the wetlands of the Kankakee River Basin. Waterfowl hunting remains an important recreational activity in the area with a tradition going back to the days of the Grand Marsh.

The Basin currently supports up to 100% of the eastern population of greater sandhill cranes (*Grus canadensis tabida*) during migration. Sandhill cranes now use primarily 1 site, the Jasper-Pulaski Fish and Wildlife Area, to stage during migration. The realization of the proposed Refuge would provide additional protected habitat for this species. One objective of the Refuge is to spread out the population of birds to avoid potential loss to disease, catastrophic weather, or other stochastic events.

G. Mammal Species

The mammals of principal concern within the Basin are those historically associated with grassland ecosystems and, therefore, several occur at the edge of their ranges. Illinois has no mammals on the state list. The Federally endangered Indiana bat (*Myotis sodalis)*, and the following Indiana-listed species occur within the Basin: American badger (*Taxidea taxus*), bobcat (*Lynx rufus*), Franklin's ground squirrel (*Spermophilus franklinii*), northern river otter (*Lutra canadensis*), plains pocket gopher (*Geomys bursarius*), and western harvest mouse (*Reithrodontomys megalotis*).

2. Ecosystem Level Biological Diversity

Ecosystems are defined as the interacting parts of the physical and biological worlds (Ricklefs 1990). There are three ecosystems of primary importance with respect to the Kankakee River Basin: wetlands, savannas, and prairies. Historically, ecosystem level protection has occurred through regulatory programs such as Section 404 of the Clean Water Act, and by protecting habitat for refuges, state-protected areas, and preserves.

In the Kankakee River Basin, several examples of each ecosystem are protected in existing managed areas. Wetlands are an important component of most of the managed areas in the Basin. More than 1,000 acres of wet prairie and sedge meadows are protected at the Iroquois County State Conservation Area and the Beaver Lake State Nature Preserve and over 2,000 acres of high-to-fair quality oak savanna are protected among several state-owned areas in Indiana and Illinois. In addition, TNC's Fair Oaks Farm restoration project could result in restoration of approximately 7,200 acres of grasslands (TNC 1997). While state agencies and private organizations have made significant strides in ecosystem protection, for the most part, protected areas remain isolated, and ecosystems are unrelated to one another in the landscape.

A. Wetland Ecosystems

Wetlands have declined at an alarming rate. The State of Illinois has lost more than 85% of its pre-settlement wetlands and the State of Indiana has lost about 87% (Dahl 1990). Of the approximately 5.6 million acres of pre-settlement wetlands in Indiana, approximately 15% were found in the Grand Kankakee Marsh. Abundant, diverse, and functioning wetlands provide a broad range of benefits to society. The value of wetlands have been accepted by multi-disciplinary forums (National Wetlands Policy Forum 1988). Wetland ecologists classify these values into 3 categories: population, ecosystem, and global values. Population values consist of habitat for a wide variety of species and related recreation values. For example, about 35% of all endangered animal species require wetlands during their life cycles (National Wetlands Policy Forum 1988). Ecosystem values include: flood water storage, water quality, and sediment control. Global values may include maintenance of the biogeochemical cycles of nitrogen, carbon, and methane (which may be important in preservation of the ozone layer).

Wetlands are among the most productive areas on earth. These diverse systems provide the biological interface between the aquatic and terrestrial communities, which multiply their function and contribute to their dynamics. Within wetlands, invertebrates, insects, gastropods, and other organisms living among the vegetation provide an important food source for fish and mammals. Waterbirds and other wildlife rely on wetlands for subsistence, nest sites, and cover, while others utilize fish and invertebrates which inhabit the vegetation. Where natural processes are still occurring, zonation and succession in response to environmental conditions are among the important community processes. Water level fluctuations and the resultant plant and animal response is often the most significant driving force in most wetland communities.

Another ecologically important aquatic habitat found along the Kankakee River are side channels, which are defined as all departures from the main channel in which there is current during normal river stage. These areas are characterized by low current, soft bottom, and reduced turbidity, and provide important food sources of zooplankton, phytoplankton, and benthic organisms for fish, waterfowl, and migratory birds. Side channels often have a greater production and diversity of benthic organisms, phytoplankton, and aquatic macrophytes than the main channel due to their structural diversity that ranges from fast flowing chutes with high banks, to sluggish streams moving through marshy areas.

Water quality, quantity, velocity, timing, frequency, and duration are the primary determinants of a rivers floodplain structure and function. When a river floods under natural conditions, it alters its shape by scouring new channels and inundating riverside lands, depositing sediments, and building new banks and beaches. These functions, called reset mechanisms, are as important to a healthy river system as a fire is to a prairie.

During the annual spring flood, fish and other aquatic life are transported to inundated floodplain nursery and spawning habitats. As the water naturally recedes, it forces the spring's production into the web of larger fish, fish eating birds, and alike. It also allows the transfer and incorporation of organic materials, such as leaves and decaying branches found in the floodplain, into the river's base food webs.

The summer's dry cycle seasonally exposes mudflats where sediments dry and compact, organic material breaks down, and moist soil vegetation (annuals) begin to grow. The annual fall flood makes the summer's bounty available to migrant and resident wildlife and fish. It also provides fish and other aquatic life access to wintering areas that have adequate food supplies and relatively slow currents.

The construction of levees and channels has altered the natural structure and function of the river-floodplain relationship. The seasonal hydrologic pulsing that normally provides the vehicle for transfer between the floodplain and the river has been modified. Vast floodplain areas have been virtually excluded from the river system through levee and channel construction.

Historically important, the Kankakee River Basin remains significant in terms of existing wetland resources. Areas of protected wetlands in Illinois and Indiana include: the Momence Wetlands Nature Preserve and the Momence Wetlands Land and Water Reserve, Kankakee River State Park, and the Des Plaines Wildlife Conservation Area in Illinois; and, LaSalle, Kankakee, and Kingsbury, Jasper-Pulaski, and Willow Slough Fish and Wildlife Areas, and Potato Creek State Park in Indiana. The 500,000 to 1,000,000 acre wetland area that once existed in the Basin obviously affords the opportunity for landscape scale wetland restoration. The IDNR has funded a remote sensing study of the wetland restoration potential in the Basin similar to that conducted for the Indiana Gap Analysis project in the Eel River watershed (Yang et al. 1996). Wetland restoration efforts are currently underway in the Basin, most notably the Indiana Partners for Wildlife Habitat Restoration Project and the Indiana Grand Kankakee Marsh Restoration Project of the North American Waterfowl Management Plan.

B. Savanna Ecosystems

Savanna is defined as a variety of related plant communities found around the world consisting of open-grown trees, found scattered or in small groves, with a primarily grassy understory. Botanists typically use tree density to distinguish between prairie, oak savanna, and forest. In Indiana and Illinois, tree canopy cover from 10% to 80% can define oak savanna ecosystems. Natural processes important in the formation of Midwest oak savanna include: fire, climate, topography, soil, and large herbivores (Nuzzo 1986). In addition, savanna is typically a transitional community between forest and grassland where it occurs in the United States.

Midwest oak savannas are among the world's most threatened communities (Anderson, et al. 1993). Although what remains in the Kankakee Basin is among the most concentrated occurrence of northern black oak savanna in the nation, loss to development continues to be a serious threat. In addition to loss,

many remaining savannas are severely degraded primarily because of the absence of fire critical to the maintenance of this system. Prompt management and protection efforts are required to conserve what remains.

The southeastern Kankakee County/northeastern Iroquois County area in Illinois has the potential for large-scale management for oak savanna. Recent work by Banks et al. preliminarily confirms the existence of significant remnant savanna in the Indiana portion of the Basin. Landscape level management of sand savannas in this region is a priority for the Indiana DNR and the Indiana Field Office of TNC. The Midwest Oak Ecosystem Recovery Plan (Leach and Ross 1995) lists as goal 2: "establish a networked system of reserves that captures the full array of oak ecosystem species, communities, and processes, and that conserves viable populations of all plants and animals known to inhabit them." Other listed goals include the establishment of buffer areas and the development of stewardship and education networks.

C. Prairie Ecosystems

Prairie is a general term for several types of grass-dominated ecosystems. In Indiana, tall-grass prairie historically covered approximately 13% of the state and yet in the late 1960's, Lindsey found only 1 remnant large enough to allow him to consider prairie a landscape type (Lindsey, Schmesz and Nichols 1969). In 1978, the Illinois Natural Areas Inventory identified only 2,352 acres of high quality prairie scattered over 253 areas, with a full 73% occurring along railroads and in cemeteries (White 1981). Many small remnants exist in the study area, but will require intensive management to preserve their diversity. Even under careful stewardship, small, isolated "islands" exhibit the twin problems of the loss of some conservative species and the domination of opportunistic species (Noss and Harris 1986).

Betz, 1978, divides the prairies of Indiana into 3 major types: sand prairies and black oak savannas; black silt-loam prairies; and, dry gravel-hill prairies. Approximately 50% of the Indiana prairies were sand prairies and black oak savanna. White and Madany, 1981, classified prairie communities of Illinois into 6 subclasses: Prairie subclass, Sand Prairie subclass, Gravel Prairie subclass, Dolomite Prairie subclass, Hill Prairie subclass, and the Shrub Prairie subclass. The railroad prairie remnants identified by Bacone and Harty in the Kankakee Sand Area (contained mostly in Kankakee and Iroquois counties) consisted of predominately sand prairie and 1 gravel prairie site (Bacone and Harty 1981). Because particularly the black silt-loam prairie soils are agriculturally valuable, little of the eastern tall grass prairie remains anywhere.

Until 1997, when TNC completed the purchase of approximately 7,200 acres of the 19,760 acre Prudential farm, little opportunity existed to restore a large, functional prairie ecosystem. Prairie restoration and management has typically been conducted on a much smaller scale. TNC's property, along with Indiana DNR and Illinois DNR properties, provide the core around which additional prairie restoration and complementary management of other ecosystems can occur. These core areas provide the possibility for the restoration and management of prairie as part of a biologically diverse landscape.

3. Landscape Level Biological Diversity

Landscape is defined as a number of interacting stands or ecosystems repeated in similar form over a kilometer wide area (Forman and Godron 1986). For convenience, we can think of it as a regional view of biological diversity. Until recently, there has been very little work, particularly in the Midwest, to protect biological diversity at the landscape scale. In order for the proposed Refuge to exist as part of a functioning landscape, the Service will have to: 1) protect and restore ecosystems historically occurring in the landscape across a significant portion of the Basin, 2) arrange protected areas so that the arrangement of ecosystems mimics the natural organization, e.g., between the Kankakee River and riparian forest adjacent to wet prairie surrounding oak savanna, 3) work cooperatively with a broad array of partners to manage public and privately owned land in order to mimic natural processes, e.g., fire, flooding, succession, and providing connectivity to the matrix in which the refuge would occur.

Management at the landscape level goes well beyond the scope or authority of any one agency. To be successful, it will take a true partnership among government, conservation organizations, and the citizens of the Basin. A partnership to manage a landscape represents decades of cooperative effort, but may be the only way to both protect biodiversity and sustain economic development in the region.

III. THE SOCIOECONOMIC ENVIRONMENT

The socioeconomic environment of the Kankakee River Basin is discussed in detail in the appended *Economic Impact Assessment Of The Proposed Grand Kankakee Marsh National Wildlife Refuge* prepared by the Department Of Agricultural Economics At Purdue University.