# EXECUTIVE SUMMARY

The Wetlands Initiative (TWI) was formed in 1994 with the objective of restoring wetland resources in the Upper Mississippi River Basin and the Great Lakes Region for ecological and economic purposes. The Hennepin Levee District (HLD) acquisition and restoration is part of TWI's *Changing the Course* initiative to acquire 25,000 riparian and floodplain acres in the Illinois River Basin. The HLD is a 2,500-acre levee-impounded floodplain along the Illinois River near the Village of Hennepin. Farmed since the early 1900s, the area has lost much of its original ecological functions. TWI facilitated the purchase of the HLD in 2001 and began the restoration process later that year. Once restored, the Hennepin floodplain may serve as wildlife habitat, improve water quality and provide a place of recreation for Hennepin residents and visitors to the area.

Our group's research focus includes several aspects of the restoration not emphasized by TWI, such as:

- the ecological function and sustainability of the restored floodplain contingent upon the restoration design and the potential impacts of human recreation on the site;
- the creation and implementation of floodplain-based environmental education;
- the ability of the floodplain to removal excess nitrogen from the Illinois River Basin; and
- the economic and political likelihood of using the floodplain to generate nitrogen pollution credits.

The greatest challenge (and ultimately the greatest strength) of this project was to combine the three disciplines of landscape architecture, environmental education and environmental policy. This multidisciplinary approach led us to examine the restoration on several different planes, thereby replacing several single-perspective analyses with one unified, holistic picture of floodplain restoration. Approaching the project in this manner provided us with a better understanding of the impacts of multiple uses of the site, including the inevitable tradeoffs and fortunate parallels. For example, while we discovered that certain uses of the floodplain were incompatible (e.g., the inability to reestablish the original hydrology because the levee

cannot be completely removed for political and engineering reasons), other uses created unique symbioses (e.g., using the levee for the biking trail and floodplain observation). Finally, each project member gained new insights into the other disciplines, instilling the group with a heightened awareness of the difficulties and benefits of working across disciplinary boundaries.

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The geomorphology and hydrology of the Illinois River Basin are determined in part by its glacial past. The basin's ample precipitation and the fertile soil provide desirable lands for agriculture. Levee construction and drainage installation facilitated agricultural production on Illinois River floodplains. These changes, along with the artificial manipulation of the Illinois River water level, significantly altered the hydrology of the HLD floodplain. For example, floodwater no longer enters the floodplain and its soils no longer retain water.

Illinois River floodplains are quality habitat for a diverse assemblage of Illinois flora and fauna and are crucial for natural biogeochemical cycling. The restored HLD floodplain will include habitat for the yellow monkey flower (*Mimulus glabratus*), a state-endangered species, and the canvasback duck (*Aythya valisineria*), a declining species in Illinois. The floodplain may also provide nursery habitat for Illinois River Basin fish, numerous plant species, and migratory birds. The floodplain will feature backwater lacks and wetlands; these are transitional lands between terrestrial and aquatic open-water ecosystems.

While the project focuses on recent and future human use of the HLD, humans have used Illinois River Basin floodplains for thousands of years. Native Americans used the floodplain for food, water and shelter. Later, after Europeans displaced the Native Americans, settlers began to convert the floodplains to agriculture. TWI's recent acquisition of the HLD created controversy in the Hennepin community. Some residents believe that the HLD should remain in agricultural production, while other residents agree with TWI's restoration project. This controversy exposes a conflict in values over the use of the floodplain. Most of the HLD landowners eventually agreed to TWI's purchase of the land because farming in the levee district was not as profitable as investing the money from the sale of the land elsewhere.

The restored floodplain will provide various natural functions valuable to human society including flood control and nutrient cycling. TWI is evaluating means, such as recreation and nutrient credit trading, to capitalize on the valuable functions that the

restoration will create. The HLD restoration also creates opportunities for environmental education. Our project provides a curriculum guide—*Learning in Wetlands*— to assist local school teachers in using the restored floodplain as an example of wetland and floodplain ecosystems. On-site interpretative trails will allow visitors to learn about the natural and cultural heritage of the floodplain.

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Floodplain restoration requires rehabilitation of natural functions of the ecosystem. Restoring the hydrology is of utmost importance for a successful floodplain restoration. To approximate the historic condition of a floodplain, the managers must remove all human disturbance and ensure that the floodplain be self-sufficient without artificial water-level manipulation. However, this level of restoration is not possible and not desirable for the HLD from TWI's point of view. TWI will maintain the legal structure of the Hennepin Levee and Drainage District but breach the levee and manage water levels to achieve its goals. Hydrologic fluctuations in water level will result in the development of hydric soils and wetland vegetation, thereby providing for the structure and function of wetland ecosystems.

Landscape analysis provides an assessment of the opportunities and constraints of different aspects of the restoration (landscape and land use change, landscape spatial analysis, hydrology, soils, vegetation, wildlife, and accessibility). The results of the analysis are aimed at enhancing the opportunities and minimizing the constraints created by this restoration plan.

Historical information about the HLD revealed the presence of two backwater lakes (Hennepin and Hopper), marshes, and prairie before the formation of the levee district. The long-term agricultural practices on the HLD and its region will make it difficult to recover the vegetation and wildlife communities. The HLD soils have the potential to retain water and are appropriate for wetland ecosystem development, but are limited as seedbanks. In addition, several rare plants species occur in Senachwine Seep in the southeast corner of the HLD. Although the presence of these species enhances the natural heritage of the HLD, they also create challenges in developing the restoration plan. The plan must balance the protection of the rare plants while still allowing for restoration of the natural functions of the floodplain ecosystem and accommodating recreational uses.

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The levee blocked the natural hydrology between the HLD and the Illinois River. Hydrologic function can be restored through reconnecting the HLD to the Illinois River and Coffee Creek watershed, recruiting of groundwater sources, and controlling the water level. Water quality may be improved through stormwater treatment and the water purification process. In order to increase biodiversity, the plan will create diverse habitat configurations and vegetation zones on the restored floodplain. Once restored, it will provide recreational and educational opportunities to the Village of Hennepin and visitors to the region.

Visitors can obtain information and encounter the site directly through indoor interpretive materials in an interpretive center and outdoor interpretive materials along the trails. Three interpretive trails are provided in the restored floodplain:

- *Wetland Ecosystems Interpretive Trail*. This interpretive trail will address how wetland ecosystems function, why wetland habitat is important, and what vegetation zones exist in the area.
- *Hennepin Levee District History Interpretive Trail*. This interpretive trail will address how the landscape and land use changed over time on the Hennepin floodplain and the motivation behind the restoration project.
- *Archaeology and Ethnobiology Interpretive Trail.* This interpretive trail will address what Native American life might have been like on the Hennepin floodplain including descriptions of the plants and animals they used in daily life.

Circulation is crucial for planning recreational uses. The circulation plan provides access for people to enjoy outdoor activities at the floodplain, while minimizing the potential impacts on the floodplain ecosystems. Only passive recreational uses are designed (e.g., hiking, biking, canoeing, and wildlife observation). Some activities, such as canoeing, are restricted during certain seasons to avoid disturbing wildlife, and the hiking trails may close during the spring because of flooding. Access to the HLD is available from the Illinois River, highways, and the Village of Hennepin. However, these access points need to be developed before visitors can use them. The real challenge of this restoration comes in balancing the various uses of the restored HLD floodplain, as some uses may be incompatible with one another.

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One result of human activity in the basin is the disruption of nutrient cycling. The potential impacts of excess nitrogen and especially nitrate are of significant concern, both in Illinois and the Mississippi River Basin. The average nitrate concentration in the Illinois River rose from 0.8 mg/l in the 1880's to 5.0 mg/l by the 1980's. Nitrate loading to the Illinois River Basin comes from agriculture (~50%), municipal and industrial activity (~20%), and atmospheric deposition and soil depletion (~30%). Excessive nitrate levels are implicated in methemoglobinemia (blue-baby syndrome) and Gulf of Mexico Hypoxia. Hypoxic conditions on the Louisiana Coastal Shelf threaten the benthic (ocean bottom) fisheries (i.e., shrimp, lobsters, and mussels).

The sources of nitrate include both point sources (sources with discrete origins of effluent discharge) and nonpoint sources (sources with diffuse origins of effluent discharge). Current US EPA regulations limit the concentration of nitrate in drinking water to 10 mg/L or less. The US EPA is authorized to regulate point source effluent discharge by the Clean Water Act (CWA). In contrast, the CWA contains no provisions for the control of nonpoint source pollution. Rather, individual states must develop Total Maximum Daily Limits of nutrients for impaired waterways. The threat of hypoxia in the Gulf of Mexico prompted the Federal Government to study the effects of hypoxia and create recommendations for reducing the nitrate loading. To date, no legislation has been passed to limit nitrate loading for control of hypoxia.

TWI wants to use the restored HLD to demonstrate floodplain restoration as a solution to the nitrogen effluent problem. Bacterial denitrification will allow the restored HLD floodplain to function as a nitrogen removal system. Our estimates suggest that the restored floodplain can remove roughly 500 tons of nitrate effluent through denitrification. Additionally, the conversion of the HLD to a floodplain will entail the removal of 2500 acres of farmland, reducing the nitrogen loading to the Illinois River by another 20 tons.

TWI envisions turning the HLD into an economically self-sustainable nitrogen farm, which would generate nitrogen-trading credits and sell them in a watershed-based trading market. Through the use of Federal and State monies to help fund the restoration process, TWI's annualized restoration costs equal $280,000, or $560 per ton of nitrate removed. In contrast, the annualized costs of removing nitrate at a wastewater treatment facility equal $36,000 per ton. This cost differential suggests that if a nitrate credit trading market existed in Illinois, trades between municipal wastewater treatment facilities and the HLD would

result in significant cost savings for the treatment facilities and a significant revenue stream for TWI.

A functioning nitrogen-credit market in Illinois is necessary before HLD can become a viable nitrogen farm. Establishing a trading market requires a 'cap' on a pollutant, for example a TMDL, or the political will to solve a large-scale problem like Gulf of Mexico hypoxia. States and regions, like the Chesapeake Bay region, are using watershed-based trading as a tool to solve hypoxia problems in other major estuaries.

The Illinois NPDES permit system is not flexible enough to allow for watershed-based trading. In order for trading to occur in Illinois, the state must pass legislation to allow for in-stream treatment of pollutants. Considering that the state finds designating court-mandated TMDLs to be a challenge, a major change in the state permitting system would require significant political pressure. A strong coalition of states formed to address the Gulf of Mexico hypoxia issue could provide the impetus for change in Illinois.

TWI required financial support from Federal and Illinois sources to acquire the HLD and begin the restoration. These funding sources may not always be available. Therefore, for TWI to continue to restore Illinois River floodplain, it will need to secure other sources of revenue. Watershed-based trading is a potential source of revenue for floodplain restoration. Using a restored floodplain for nitrogen removal requires less investment than upgrading municipal treatment facilities. However, Illinois law does not allow for off-site treatment of point source effluent.

This project explores several potential uses of the floodplain, including recreation, habitat creation, education, and watershed-based trading. Humans are an integral part of the restoration plan. Balancing these uses without disrupting the ecology of the floodplain is a major concern. The challenge for the advocate of floodplain restoration comes from finding funding sources and balancing the needs of humans with the ecology of the floodplains.