4 PROPOSED RESTORATION PLAN

Goals and Objectives

Restoration of hydrologic function is the main goal of floodplain restoration. Other goals include values derived from the restored functions (Section 2.3). In this restoration plan, four goals are addressed:

- Improve the water quality of the Illinois River;
- Restore habitats for waterfowl and enhance biodiversity;
- Provide research and educational opportunities; and
- Offer passive recreational amenities with minimum impacts on restored wetland ecosystem.

To attain these goals, a functional wetland must first be restored. The initial step of wetland restoration is restoration of its hydrologic functions. This can be accomplished through reconnecting the HLD to the Illinois River Watershed. The next steps are establishing plant communities and designing the retention ponds. Restoration of diverse habitat configurations and vegetation zones will enhance biodiversity. In this project, preservation of sensitive habitats is also an important element. Preservation not only sustains the existence of endangered and rare species, but also provides unique research opportunities. In addition to the research value of habitat preservation, restoration of the HLD will provide chances for experimentation in techniques of pollution reduction (Sections 3.3 and 3.4). Interpretation centers and interpretive trails will allow people to explore the natural and cultural heritages inherent in the HLD, and thereby gain a better understanding of the value of wetlands (Sections 2.3 and 4.2).

4.1 Restoring Natural Function

4.1.1 Hydrologic Function

Strategies

Reconnect the HLD to the Illinois River

TWI will breach the south end of the levee to return the flood pulses to the HLD and restore the backwater lakes. An inlet pipe will bring in river water through the levee at the northern end of the HLD. The pipe will allow TWI to introduce nitrate-laden Illinois River water into the HLD for denitrification.

Reconnect Coffee Creek Watershed

From the site analysis, there is evidence of where Coffee Creek originally discharged into the HLD (Section 3.1). The Coffee Creek watershed was part of the surface water input; therefore, reconnecting the creek to the HLD is crucial in restoring the hydrologic function of the floodplain. To achieve this objective, the existing buildings and structures on the outwash plain need to be removed and the drainage ditch and levee rerouting Coffee Creek should be blocked on both ends. A new levee for reintroducing Coffee Creek to the HLD must match the historical water channel. Pipes through the levee rejoin the tributaries of Coffee Creek watershed to the HLD.

Recruit Groundwater Sources

The groundwater level (2 feet below the land surface) is considered shallow in the HLD. In addition, the Illinois River has a higher elevation than the average level in the HLD, which causes significant groundwater pressure to flow from the river channel to the floodplain. Besides surface water inflow, the groundwater also contributes to the water input in the HLD (Section 3.1). After a large amount of the groundwater from the Illinois River presses into the HLD, it is likely to recharge the groundwater of Coffee Creek Watershed.

Control the Water Level

According to the site analysis (Section 3.1), the landscape and the land use change significantly altered the status of the natural floodplain on the HLD. It is not feasible to remove the entire levee and completely open the floodplain to the Illinois River. Furthermore, to restore and maintain the floodplain's abiotic environment, vegetation and waterfowl habitat requires seasonal water level variation. Finally, because the water elevation is higher in the Illinois River than the surface elevation of the HLD, reintroducing the Illinois River will inundate the HLD with predominantly steady water levels, retarding the succession of the floodplain ecosystem. Consequently, control of the water level is necessary for the HLD.

The existing pumping station can provide a mechanism to artificially control the water level in the HLD. The pipe through the north end of the levee manages the volume of the water entering the HLD. On the south end of the levee, we propose that the opening is breached in a V-shape with the elevation at the average surface water elevation (440 feet). The V-shaped gate can regulate the amount of the water flowing in and out of the HLD (Figure 4.1.1-1). For example, when water level rises in the HLD or Illinois River, water will flow through a bigger section of the V-shaped gate on the upper portion, thus allowing a larger volume of water flow in and out of the HLD. In contrast, when the water level declines, a lower amount of water can flow through the gate.

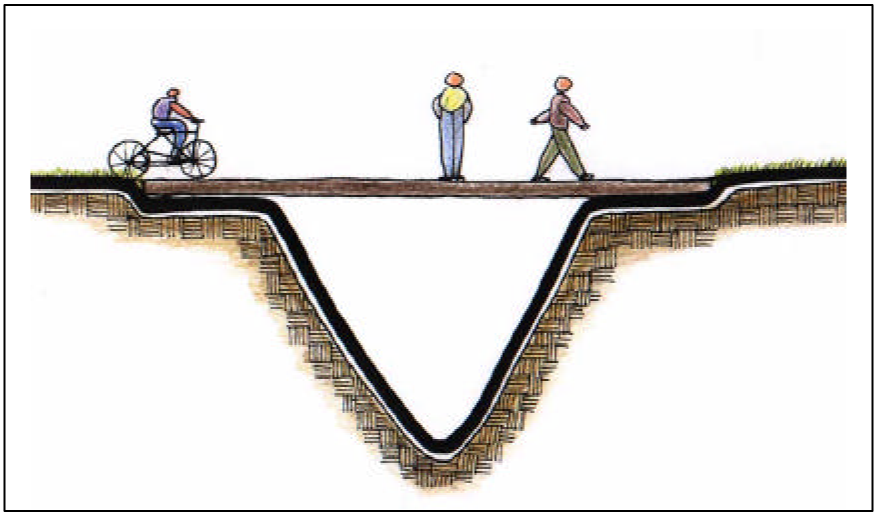

Figure 4.1.1-1 A north-to-south cross section showing a V-shaped opening on the south end of the levee

4.1.2 Water Quality Improvement

Stormwater Treatment

A restored floodplain may play an important role in improving water quality (Sections 2.2, 3.3, and 3.4). Stormwater treatment practices employ the biogeochemical functions of a wetland to remove excessive nitrogen and other nutrients. In addition, they use wetland plants to control sediments through trapping and infiltrating. Stormwater refers to surface flow that carries away surface substrates, especially agricultural and urban pollutants. Contemporary stormwater management establishes a process to clean the polluted water before discharging it to the river.

Stormwater wetlands are constructed systems specifically designed for mediating stormwater quality and controlling stormwater quantity, problems that arise in urban and agricultural lands. The stormwater wetlands provide temporary storage for stormwater in retention ponds or shallow marshes. Microtopography creates growing conditions suitable for diverse wetland vegetation. Thus, the complex of retention ponds, microtopography, and wetland vegetation in the stormwater wetlands can significantly contribute to sediment and nutrient removal.[1]

A well-functioning wetland has the ability to improve water quality; however, the capacity for water purification is limited by the volume of the detention basin, the amount of pollutants in the basin, and the duration that the polluted water is held in the basin. The restored wetlands in the HLD would be neither stormwater wetlands nor natural wetlands. They are stormwater-influenced wetlands since the Illinois River and Coffee Creek watershed are polluted by high concentrations of sediments and nutrients. The quantity of these pollutants will exceed the removal capacity of the historic HLD floodplain wetlands, but a reduction in nutrient load will be accomplished.

Water Purification

Water pollution treatment requires time to proceed through the physical and chemical reactions. Delineating the inlet, outlet, and stormwater flow direction is the core of the stormwater treatment design. One stormwater inlet in the HLD is where Coffee Creek drains into the HLD. Another two inlets are from its tributaries. Surface water from the

Illinois River at the north end of the levee is the other inlet. In order to control water level and the duration of stormwater in the HLD, the existing pumping station serves as the only outlet for stormwater (Figure 4.1.2-1)

Water purification in the HLD comprises a sequence of detention ponds of various depths and varied microtopography to guide water flow and create diverse vegetation zones. Retention areas create more time for pollution removal and reduce water velocity to increase the deposition of sediments. Vegetation communities, such as marshes and wet-meadows, facilitate sediment trapping and nutrient removal.[2]

Three shallow detention ponds are designed in the HLD. A wet pond on the northeast, delineated as 6 feet lower than the average surface water elevation (440 feet), is designed to collect water from Coffee Creek. A pond on the northwest, with a low elevation of 434 feet, is planned for retaining polluted Illinois River water. These detention ponds serve as the first phase of the water purification process. The surrounding deep and shallow marshes, which assist the nutrient removal process and trap sediment, comprise phase two of the process. Finally, the final phase of the process consists of a shallow-open water area collecting the water from phases one and two and gradually releasing it to the Illinois River through the levee breach.[3] It provides a third opportunity to remove sediment and nutrients (Figure 4.1.2-1).

When floods occur, the HLD is designed to extend its storage capacity. An extended detention zone for a normal flood is delineated as 6 feet higher (446 feet) than the average surface water elevation. When the extended detention zone is flooded with inundated water, it becomes a huge detention pond. Instead of three phases, the water purification process will depend on the duration of the polluted water and surrounding vegetation (Figure 4.1.2-2).

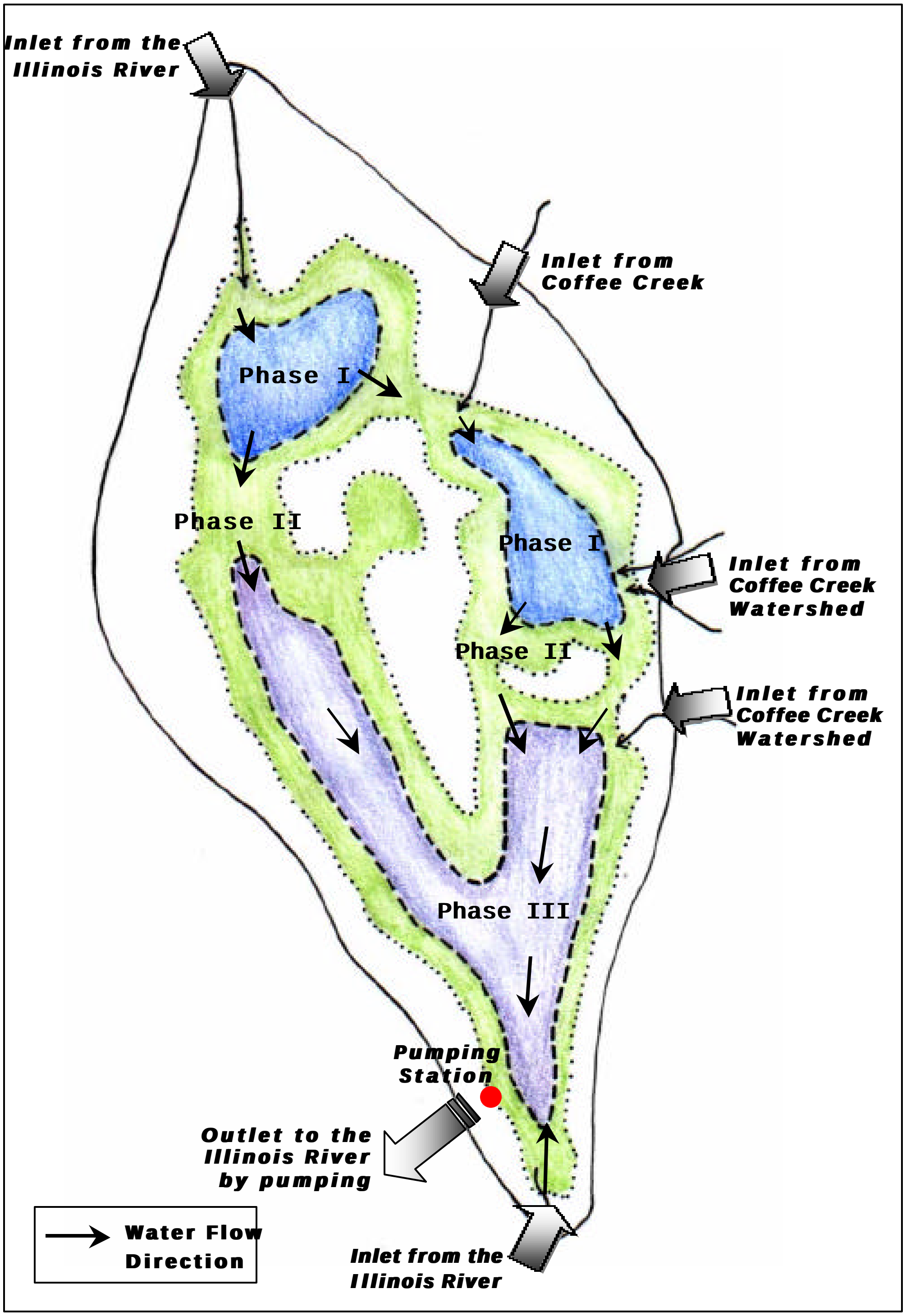

Figure 4.1.2-1 Schematic water purification process at average water level

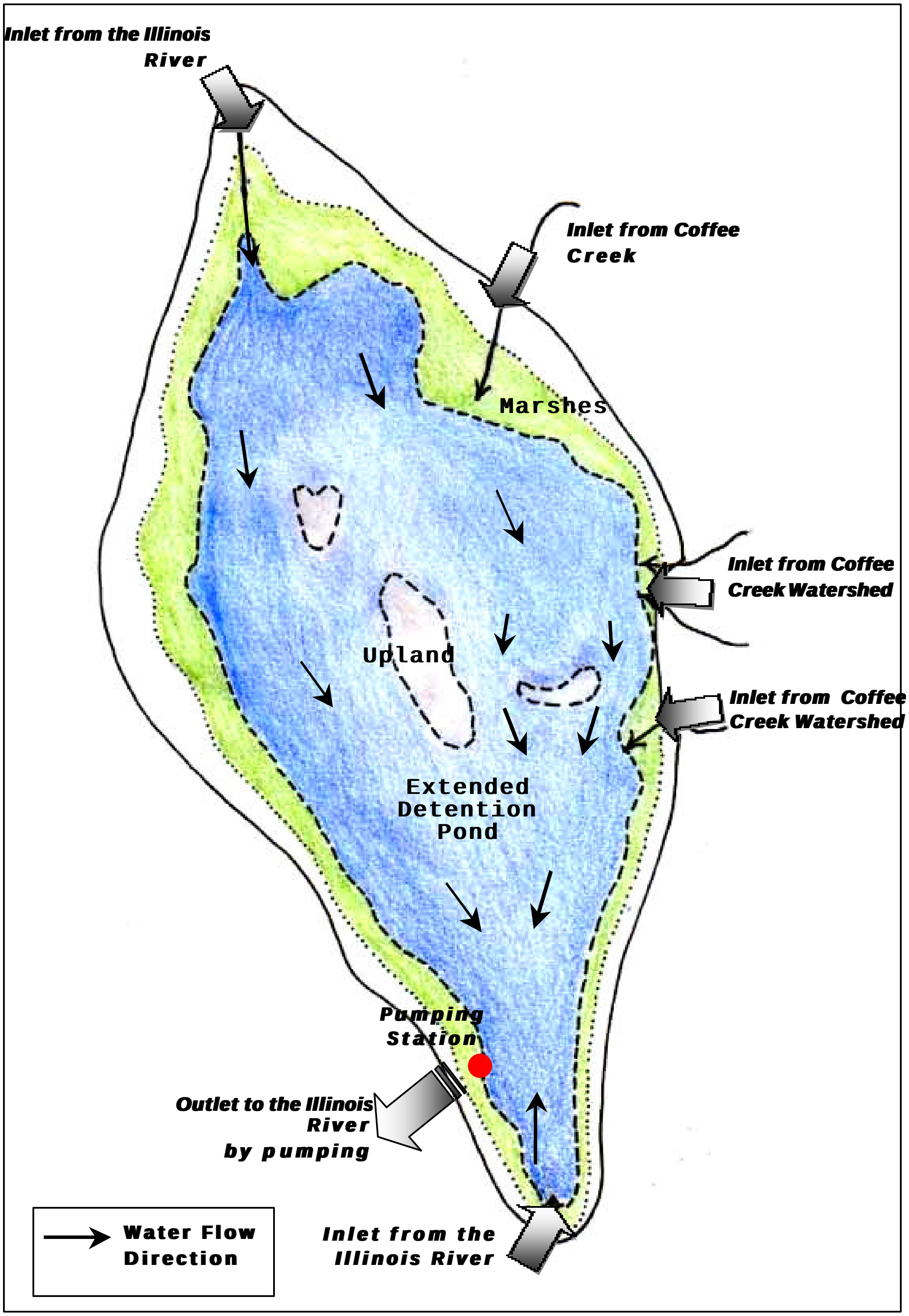

Figure 4.1.2-2 Schematic water purification during flooding seasons.

4.1.3 Habitat Enhancement

Habitat enhancement in the HLD restoration area consists of habitat configuration, vegetation zonation, and endangered species habitat preservation. Habitat configuration is designed to create different niches for various flora and fauna species. Based on the gradient and shape of the topography, 5 main districts are delineated in the HLD restoration area: shallow open water areas, islands, marshes, meadows, and uplands. Vegetation is the key to enhancing wildlife habitat. Wetland vegetation, which adjusts to the water depth resulting from the microtopography and the dynamic water level, is designed into 6 communities: shallow open water communities, deep marshes, shallow marshes, sedge meadows, wet prairies, and upland communities including tallgrass prairies and woodlands. Sensitive habitats for endangered and rare species are fragile and difficult to restore or create. Therefore, to ensure the endangered species habitat is protected, delineation of a preservation area is essential in the habitat enhancement plan (Figure 4.1.3-1).

Habitat Configuration

Diverse Habitat Formation

From the case studies (Section 3.1), we know that diverse wildlife needs a variety of habitat. In addition, plants in an ecosystem supply food and shelter: fundamental needs for wildlife[4]. To increase the diversity of the habitat requires a complex design of microtopography and vegetation communities to create different niches for wildlife species. The habitat configurations in the restoration plan include shallow, open water areas, islands, marshes, meadows, and uplands (Figure 4.1.3-1). Each area provides habitat for various wildlife communities.

Shallow open water areas provide habitats for a variety of semi-aquatic fauna and offer spawning beds for fish communities. A central shallow open water area, named after the historical Hennepin and Hopper Lakes, and two smaller ponds on the north, are designed in the HLD. The central island with remnant oak savanna community provides habitat for birds and other animals. Wet meadows, including sedge meadow and wet prairie,

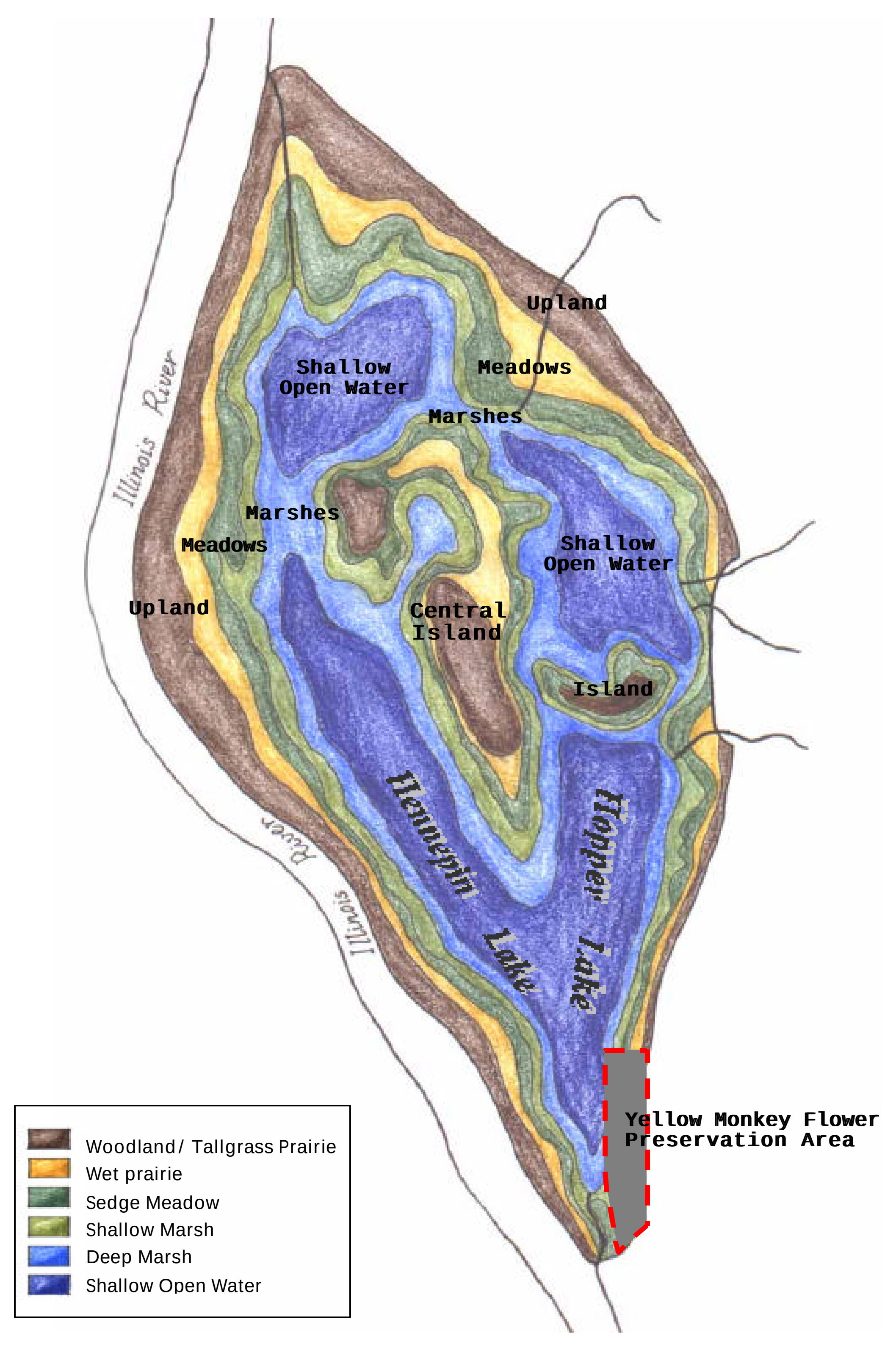

Figure 4.1.3-1 Schematic habitat enhancement plan, which includes habitat configuration, vegetation zonation, and endangered species habitat preservation.

provide habitat for many species. Also included are uplands, which are areas situated at the higher elevation that is rarely flooded, providing habitat for wildlife adapted to a drier environment.[5]

Soil Considerations

Soil types and their characteristics are explained in section 3.1.4. Areas with 7107 soils are designed for standing water and semi-permanent water areas. The position and form of the islands are derived from the location and the shape of the 7302 soils. Another small island on the east of the HLD is created under this consideration (Figure 4.1.3-1). The location of the 8304 soils coincides with the inlet of Coffee Creek. 1480 soils, influenced by seepage, are designed as marshes or wet meadows. 93 E and 93 G are soils with steep slopes and are suitable for upland settings.

Vegetation Zonation

Creating Vegetation Zonation

The most appropriate way to create diverse wetlands habitats is to create microtopography by designing a gradient of slope rather than straightforward edges of conventional ponds.[6] Once the gradients of slope and hydrologic function have been set up, various wetland types from shallow open water, deep marsh, shallow marsh, sedge meadow, wet prairie, to tallgrass prairie and woodland will provide a wide range of habitat for wildlife (Figure 4.1.3-1).

Shallow open water communities generally have standing water with the depths less than 6.6 feet (2m). Submerged and floating aquatic vegetation characterize this wetland type (Section 2.1.2). In the HLD, shallow open water area is delineated from the lowest point at 434 feet in the northeast basin to 437 feet in most of this zone (the average surface water elevation of the Illinois River is at 440 feet). Deep marsh communities have standing water depths between 6 inches and 3 or more feet during most of the growing season. Herbaceous emergent, floating, and submergent vegetation occur in this community (Section 2.1.2). Deep marshes in the HLD range from 437 feet to 439 feet 4 inches. Shallow marsh communities have soils that are saturated or inundated by standing water up to 6 inches deep throughout most of the growing season. Herbaceous, emergent vegetation characterizes this community (Section 2.1.2). They are designed at an elevation from 439 feet 4 inches to 442 feet in the HLD. Sedge meadows range from an elevation of 442 feet to 444 feet. Wet prairies are open herbaceous plant communities dominated by native grasses and forbs. Their distribution in the HLD is from an elevation of 444 feet to 446 feet. Areas above the elevation of 446 feet are designated for upland communities that comprise tallgrass prairies and woodlands[7]. Since the HLD is in the tallgrass prairie bioregion (Section 2.1.2), the restoration of native communities is essential in the restoration plan.

Water Level Manipulations

A model illustrating the influence of water level changes from high, average, to low water level and the alteration of the corresponding vegetation zonation is shown in figure 4.1.3-2. When the water level rises in the flooding season, assuming the elevation of the surface water increases from 440 feet to 444 feet, the plant communities will shift the subemergents and aquatic plants upwards and eliminate other vegetation type such as sedge meadow and wet prairie. On the other hand, when the water draws down from the elevation of 440 feet to 436 feet, shallow open water and deep marshes will disappear.

Animal population and species richness will also be altered according to the water level. For example, bird populations, bird species richness, and the number of muskrats decrease both at the high water level, when the cattails are dense; and at the low water level, when the cattails are sparse.[8] Shifts in the hydrologic dynamics of the water levels occur frequently from season to season and year to year. This model demonstrates how the hydrology significantly influences the vegetation composition.

Planting considerations

“To plant or not to plant” is a question arising in planting design of a restoration plan. Mitsch et al. concluded that “a hydrologically open created wetland can develop, through self-design, a diverse assemblage of species even where no propagules existed before.”[9] They also implied that flood pulses in a riparian system and pumping river water in and out of the levee district might mix the seeds or propagules in the river. Some reports claim that early introduction of a diversity of wetland plants may facilitate an increase in biodiversity

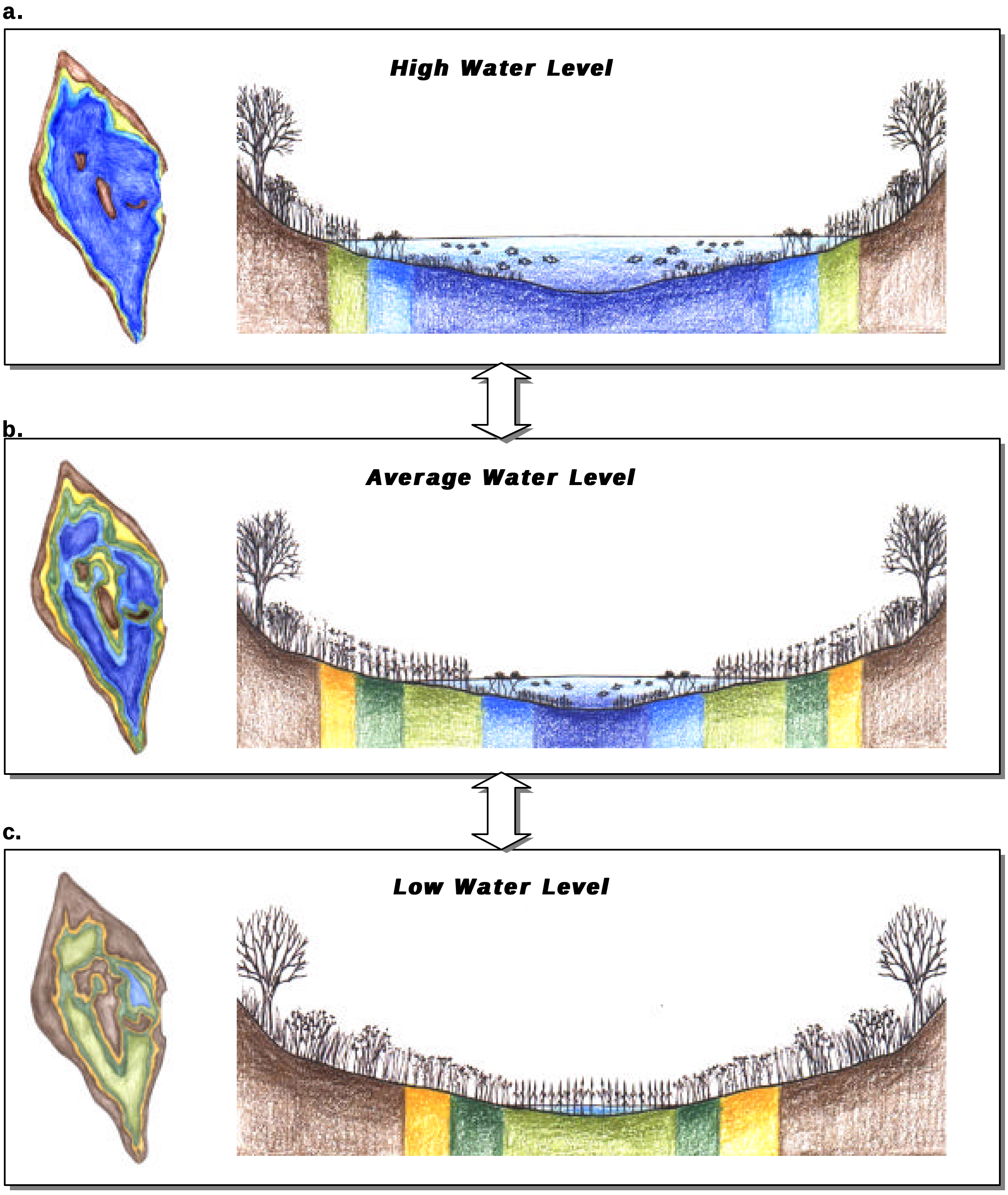

Figure 4.1.3-2 Schematic of the dynamics between water level and vegetation zone varies among (a) the high water level (444 feet), (b) the average water level (440 feet), and (c) the low water level (436 feet). The plan view is shown on the left and the cross section is presented on the right.

in an ecosystem and prevent invasive plants from expanding.[10] Various wetland vegetation communities, however, have different degrees of regeneration. Submergents such as pondweeds, bladderwort, and duckweeds in most of the restored wetlands recover their compositions rapidly. Similar rehabilitation condition occurs in the emergent communities such as cattails and bulrushes. Sedge meadow and wet prairies, on the other hand, have limited abilities to reestablish their communities without revegetation actions. They may be out-competed by invasive species, e.g., reed canary grass and cattails, before they can develop.[11] Reintroducing seeds for upland vegetation such as tallgrass prairie may not be necessary. Therefore, integrating multiple planting design strategies is a crucial concept in the HLD restoration plan.

There is a potential onsite seed sources from the remnants of the upland forest and the Senchachwine Seep, in addition to the seeds brought by the Illinois River from the adjacent natural wetlands. However, invasive species in the HLD may hinder the development of other wetland plant communities. The proposed vegetation plan recommends:

1. remove invasive plants by hand or mechanical tools to prevent the elimination of designed vegetation communities;
2. introduce sedge meadow and wet prairies propagules to assist their reestablishment (Table 4.1.3-1); and
3. flood the HLD, by reconnecting the Illinois River, to encourage seed distribution and natural succession through self-design.

Once the hydrologic function has been restored, the aquatic plants, marshes, and upland species will return to wetlands spontaneously. Meadows, however, need revegetation in most cases. Ultimately, the designed vegetation zonation can be established. Water level manipulation to create the water depth suitable for each vegetation type will be used as needed. Further activities include monitoring the development of plant communities, replanting, and controlling invasive species. Thus, the viability of the designed vegetation zonation can be sustained, and the goal of enhancing the wildlife habitats can be attained.

Table 4.4.2-1 Recommended species for sedge meadow and wet prairie revegetation[12]

Vegetation Zonation	Plants often recolonizing without planting	Plants can be mechanically seeded	Plants are hand-seeded	Plants are transplanted as seedlings or plugs	Invasive plants to be avoided
Sedge Meadow	*Fox sedge (Carex vulpinoidea)* *Rice cutgrass (Leersia oryzoides)* *Torrey's rush (Juncus torreyi)* *Beggar's ticks (Bidens spp.)* *Curly dock (Rumex crispus)*	*Cordgrass (Spartina pectinata)* *Boneset (Eupatorium perfoliatum)* *Joe pye weed (Eupatorium maculatum)* *Woundwort (Stachys palustris)* *Monkey flower (Mimulus ringens)* *Blue vervain (Verbena hastata)* *Asters (Aster falcatus)*	*Bluejoint (Calamagrostis canadensis)* *Swamp milkweed (Asclepias incarnata)* *Skullcaps (Scutellaria spp.)* *Bugleweeds (Lycopus americanus)* *Yellow loosestrifes (Lysimachia punctata)*	*Woolly sedge (Carex lanuginosa)* *Tussock sedge (Carex stricta)* *Fringed gentian (Gentianopsis crinita)* *Bottle gentian (Gentiana andrewsii)* *Western fringed prairie orchid (Platanthera praeclara)* *White ladyslipper (Cypripedium candidum)*	*Canadian thistle (Cirsium arvense)* *Sawtooth sunflower (Helianthus grosseserratus)*
Wet prairie	*Fleabane (Erigeron philadelphicus)*	*Big bluestem (Andropogon gerardii)* *Switchgrass (Panicum virgatum)* *Coreopsis (Coreopsis spp.)* *Tick clover (Desmodium canadense)* *Gray coneflower (Ratibida pinnata)* *Cup plant (Silphium perfoliatum)* *Compass plant (Silphium Laciniatum)*	*Prairie phlox (Phlox pilosa)* *Culver's root (Leptandra Virginica)* *Golden Alexander (Zizia aurea)* *Blazing star (Liatris lancifolia)* *Mountain mint (Pycnanthemum virginianum)* *Canada anemone (Anempne canadensis)*	*Prairie gentian (Gentiana puberulenta)* *Yellow star grass (Hypoxis hirsuta)* *Michigan lily (Lilium michiganense)* *Wood lily (Lilium philadelphicum)* *Heavy sedge (Carex gravida)*	*Quackgrass (Agropyron repens)* *Switchgrass (Panicum virgatum)*

Endangered Species Preservation

Finally, we emphasize the importance of protecting the endangered species and preserving its habitat in order to ensure the viability and sustainability of these species (Section 3.1). The Senchachwine Seep should be delineated as a preservation area and any possible impacts should be avoided or minimized in this area.

---

[1] Schueler, T. R. 1992. p5-12., and Marble, A. D. 1992. p31-33.
[2] Eggers, S. D. and D. M. Reed. 1987., and Marble, A. D. 1992. p47-49.
[3] Hammer, D. A. 1997. p187-188.
[4] Ibid. p183, 248.
[5] Ibid. p248., and Eggers, S. D. and D. M. Reed. 1987.
[6] Sempek, J. E. and C. W. Johnson. 1987., and Kentula, M. E. et al. 1993. p131.
[7] Eggers, S. D. and D. M. Reed. 1987.
[8] Weller, M. W. 1981. p64.
[9] Mitsch et al. 1998.
[10] Mitsch, W. J. and J. G. Gosselink. 2000. p677., and .Streever, B. and J. Zedler. 2000.
[11] Galatowitsch, S. M. and A. G. van der Valk. 1994. p130-132.
[12] Adapted from Galatowitsch, S. M. and A. G. van der Valk. 1994. p135.

This page intentionally left blank.