Door Creek Watershed Feasibility Study

Prepared for:

Friends of Lake Kegonsa
Stoughton, Wisconsin

FOLKS

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Friends of Lake Kegonsa

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October 1993

I. Introduction

On March 2, 1993, Friends of Lake Kegonsa (FOLKS) retained Mead & Hunt, Inc., under a Wisconsin Department of Natural Resources (WDNR) lake planning grant to evaluate Door Creek and the adjacent wetlands that form the Door Creek State Fishery Area on the lake's north shore. The need for the study was based on historical data indicating that Door Creek was contributing substantial amounts of nutrients to Lake Kegonsa via upstream erosion and rapid nutrient transport through a channelized reach traversing the wetland.

The study focus was on the potential for restoring wetland water quality functions to benefit the lake, with a goal of presenting recommendations for restoration based on field reviews, a hydrologic analysis, and cost and impact analyses of restoration efforts. This report presents the following:

- Findings of the field review
- Hydrologic analysis
- Watershed analysis
- Best management practices (BMPs) designed to reduce erosion and protect groundwater recharge within the Door Creek watershed

The watershed analysis and BMP development were undertaken as a result of an amended project scope, which was deemed necessary by FOLKS based on a mid-term review of hydrology and wetland functional performance.

II. Results of the Field Review

A. The Door Creek Wetlands

On May 3, 1993, consulting biologists from Mead & Hunt, investigated the Door Creek State Fishery Area wetlands to evaluate the potential to enhance water quality functions. The biologists examined the wetlands by canoe, with foot reconnaissance in accessible areas south of the railroad tracks. Channel cross sections were measured at two locations, and qualitative observations were made concerning vegetation, wildlife, the extent of berming due to channelization, and wetland functional integrity.

The wetlands consist of shallow marsh and wet meadow growing on a substantial peat deposit. Dominant species are lake sedge (*Carex aquatilis*) and narrow-leaved cattail (*Typha angustifolia*) to the south, which give way to tussock sedge (*Carex stricta*) and red osier (*Cornus stolonifera*) on the north as the wetland begins to slope upward and show evidence of groundwater discharge. Wetlands within a quarter mile of the railroad grade contain marsh marigold (*Caltha palustris*), a plant that requires saturation by cool groundwater.

Generally, the vegetation appears to have changed little from that described by Zimmerman,[1] save for the appearance of small patches of giant reed (*Phragmites communis*) distributed through the shallow marsh areas (see Exhibit 1, Door County Wetland Map). This assessment is also supported by comparing 1975 and 1990 aerial photographs from the Dane County Regional Planning Commission. Invasion of some areas by shrubs appears to have halted, or to be proceeding at such a slow rate as to be insignificant over the past 20 years. Within this period, areas immediately south of the railroad tracks reported by Zimmerman to be grazed have been taken out of pasture.

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1 *Wetlands of Dane County*, James H. Zimmerman, Dane County Regional Planning Commission, 1974.

Altogether, the wetland vegetation is in very good condition and—aside from fringe areas impacted by drainage and attempts at hay farming and grazing—has not been damaged or functionally impaired to any great degree by adverse land uses or excessive siltation and eutrophication.[2] This is probably due to the isolation of silt-laden floodwaters by the ditch berm during the early years after ditching. While these sediments certainly contributed to Lake Kegonsa eutrophication, they were prevented from spreading within the marsh by the berms. Subsequent collapse of the berms and subsidence and widening of the channel has now made the marsh interior more accessible to floodwaters than before. Further development and lack of erosion controls in the watershed may now pose a more potent threat to the health of the Door Creek wetlands.

From a drainage standpoint, the ditching of the wetland has had virtually no effect because of the extremely low gradient between the railroad tracks and the mouth and the proximity of Lake Kegonsa, which serves to maintain water levels. It is possible that a shift in the water budget from groundwater to surface water has occurred within the wetland areas due to land clearing in the watershed. This would cause precipitation to be diverted from infiltration to runoff within the watershed, lowering the water table during times of drought and encouraging proliferation of the shrubs, asters, and goldenrods first noted by Zimmerman.

Wildlife use of the wetland is substantial. Several sora rails were seen foraging in the marsh, and the territorial calls of approximately 30 individual soras were heard, as were those of at least two family groups of sandhill cranes. Coots, mallards, Canada geese, great blue herons, marsh wrens, yellow warblers, meadowlarks, and a gallinule and otter were observed. Many signs of beaver, muskrat, and white-tail deer were also found around the channel and backwaters. Collapse of the ditch berms in the southern half has

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2 An increase in nutrient status in a body of water that can cause it to become a wetland. While natural eutrophication is extremely slow, cultural eutrophication (caused by human activities) can very rapidly destroy water quality and ecology.

made most of the shallow marsh adjacent to the channel and backwater ponds accessible to marsh-spawning fish species.

In summary, outstanding features of the Door Creek wetlands are as follows:

- An extensive, relatively diverse vegetation that supports a wide array of vertebrate wildlife.

- A lakeside position that offers aesthetic and recreational resources for the Lake Kegonsa community.

- A streamside position with marsh edges and openings that provide spawning habitat for game and forage fishes.

- Buffering and absorption of agricultural runoff.

- Environmental corridor/greenspace attributes that offer refuge for all wildlife forms and preserve a large segment of the Lake Kegonsa shoreline from development.

B. Potential of Wetlands to Enhance Water Quality

Based on the field review, the potential is low for using the wetlands to enhance water quality for several reasons. While there is a high potential for sediment filtration by the shallow marsh vegetation, environmental and engineering costs are prohibitive. Deliberate shunting of high, sediment-laden flows into the wetland could cause widespread habitat degradation by triggering a long-term shift to a solid cover of nutrient-loving cattails. This would eliminate the forage base for sora rails and other nutlet-feeding shorebirds and severely reduce the structure and species diversity of the vegetation. The functional consequences of this type of development would be a reduction of wildlife, environmental corridor, and aesthetic and recreational values.

From an engineering standpoint, the deep peat and muck deposits of the marsh offer no secure foundation for flow diversion structures or dikes to create backwater. Any structure of significance not located at the mouth or far upstream near the railroad tracks where mineral soils offer potentially secure footholds would eventually be undermined by high flows. In light of the high volume of stormflows, a truly effective structure would have to be built at the mouth of Door Creek and create at least one to two feet of backwater. This would almost certainly cause a massive shift in vegetation, deny recreational access to navigable waters, and require considerable earth moving. Estimated design and construction costs of such a structure range between $150,000 and $200,000.

In view of the costs and negative impacts of such work, FOLKS is advised to pursue studies that define sediment sources and groundwater recharge areas within the Door Creek watershed. Addressing the problem at its source will be more cost-effective in the long run and offer greater potential for protection of wetland functions and lake water quality.

III. Hydrologic Analysis

A. Introduction

Mead & Hunt engineers also performed hydrologic analyses to determine the rainfall runoff into and out of the wetland at the mouth of Door Creek. Results of the analyses were used to help assess the wetland's potential to improve the quality of the water entering Lake Kegonsa and the feasibility of remedial measures.

B. Methodology and Assumptions

Hydrologic analyses were performed using the U.S. Soil Conservation Service (SCS) TR-20 methodology of determining rainfall runoff for the Door Creek watershed. The TR-20 methodology is contained within the HYDROCAD computer program. The Door Creek watershed was subdivided into six smaller subbasins. (A map of the watershed and corresponding subbasins is presented in Exhibit 3.) Discharge from the subbasins was routed through the downstream channels and combined with other subbasins throughout the watershed.

Watershed discharge hydrographs were calculated for several 24-hour rainfall events ranging from the annual rainfall to a storm having a 25-year recurrence interval. Rainfall amounts were derived from SCS Technical Paper 40 (1961) and are shown in Figure 1. The rainfall was distributed using the SCS Type II 24-hour distribution. The peak durations of the Type II rainfall distribution are such that peak rainfalls corresponding to concentration times for those storms equal to, or less than, 24 hours are contained within that distribution. This was used to accommodate the varying concentration times resulting from the different subbasins within the watershed.

For each subbasin, several hydrologic parameters were derived for use in the runoff calculations:

- Runoff curve number (RCN)[3]
- Hydraulic length[4]
- Average land slope
- Subbasin area

Based on U.S. Geological Survey (U.S.G.S.) 7.5-minute quadrangle topographic maps (quad maps), the subbasins were divided, digitized, and measured. Once the subbasins were determined, the hydraulic length of each subbasin was measured from the quad maps. Average land slope was then determined by lying a grid over each subbasin delineated on the quad maps and determining the land slope within each square of the grid. All of the slopes within each subbasin were then averaged.

3 A dimensionless parameter used in the SCS rainfall runoff method to characterize land cover and soil type for calculating runoff.

4 Hydraulic length refers to the longest distance a particle of water must travel to reach the mouth of a subbasin.

The RCN for each subbasin was selected based on the land cover and hydrologic soil groups within that subbasin. Land cover was determined from the quad maps and digitized onto the basin map. Hydrologic soil groups were determined from the Dane County Soil Survey and were also digitized onto the basin map. Land uses and hydrologic soil groups within the watershed are shown in Exhibits 4 and 6. Weighted averages of the RCNs within each subbasin were then calculated as shown in the tables in Exhibit 7.

Channel cross sections used to route subbasin runoff hydrographs were derived from a combination of the quad maps and field survey. Large overbank flow regions were noted during the field inspection of the watershed and have been accounted for in the analysis.

C. Analysis Results

Discharge hydrographs were calculated throughout the watershed. The areas of concern for this report are the discharge into the wetland area at the mouth of Door Creek and the discharge into Lake Kegonsa. Figure 2 presents discharge hydrographs into the wetland (at the point where the Chicago, Milwaukee, St. Paul, and Pacific Railroad crosses Door Creek) for the storm events analyzed.

Discharge hydrographs were also calculated at the mouth of Door Creek, discharging into Lake Kegonsa. These hydrographs reflect the attenuation of runoff due to the wetland near the mouth of Door Creek. Direct rainfall into the wetlands is also included in these hydrographs. The discharge hydrographs at the mouth of Door Creek are shown in Figure 3.

As illustrated in Figures 2 and 3, the flow at the mouth of Door Creek is less than that upstream of the wetland area. Figure 4 illustrates the amount of runoff attenuation provided by the wetland. The flow is only slightly less at the mouth than at the railroad tracks. However, in addition to the runoff hydrograph at the railroad tracks, there is runoff from the contributing areas between the tracks and the mouth of Door Creek.

From this analysis, it can be concluded that there is a hydrologic benefit provided by the wetland in attenuating the watershed runoff hydrograph. It appears as though a great deal of the wetland area will fill with water during significant rainfall events. It is possible to increase the amount of runoff attenuation through the wetlands by constructing a berm at the mouth of Door Creek and providing controlled outflow into Lake Kegonsa. However, this may not be feasible due to the environmental and social impacts discussed in Section II.B.

IV. Best Management Practices

A. Introduction

The purpose of this section is to document erosion and groundwater recharge areas in the Door Creek watershed and develop Best Management Practices (BMPs) to control erosion and sedimentation and promote groundwater recharge.

For purposes of this report, "erosion" refers to surface soils that become suspended in flowing water (called suspended sediment) due to high water velocities. Sedimentation is the opposite of erosion—it is the settling out of soil from flowing water caused by slowing velocities or stagnant water. "Groundwater recharge" refers to the flow of water through the subsurface into a body of water such as a wetland. Adequate ground water recharge is vital to maintain a wetland's good health (or that of any body of water).

Section II.A. of this report documented the relatively good condition of the wetlands area directly north of Lake Kegonsa on Door Creek. This wetland directly contributes to the water quality on Lake Kegonsa by buffering the nutrients and sediments in Door Creek.

The northern and western portions of the Door Creek watershed are rapidly becoming urbanized, which is causing increased sediment and nutrient loads to the Door Creek wetland and threatening its current good condition.

Ultimately, the wetland may fill in if current sediment flows continue. This section of the report will focus on *preservation* of the current good condition of the wetland.

"Storm water" is defined as precipitation washing off a particular area. Recent studies have found that storm water can be polluted with high concentrations of sediment, heavy metals, oil, grease, and nutrients. In most cases, storm water flows untreated into adjoining lakes, rivers, and streams. Once in the rivers and lakes, the pollutants in storm water can irreparably damage wildlife, fauna, and humans. The effect of excessive suspended sediment in lakes, for example, can affect plants through reduced photosynthesis, destroy fish species, and ultimately cause the lake to fill into a meadow.

With the discovery that storm water can be polluted and was flowing untreated into lakes and rivers, municipalities and industries had to develop methods to reduce the amount of storm water pollution. These methods are broadly classified as BMPs, which are defined as processes, activities, or physical structures used to reduce the amount of pollution entering surface waters.

This report focuses on two storm water concerns that are critical to preserve the current good condition of the Door Creek wetlands:

- *Erosion Control BMPs*
- *Groundwater Recharge BMPs*

BMPs can be subdivided into:

- *Regional BMPs*—These BMPs control pollution from a large regional area. An example of a regional BMP is the dam structure built at the mouth of Door Creek discussed in the watershed analysis portion of this report. The structure is considered a regional BMP, because it acts to reduce sedimentation from the entire Door Creek watershed.

- *Source BMPs*—These act to control pollution at its source by focusing on managing materials and building structures to reduce pollution leaving each individual site. An example of a source BMP could be storing toxic materials inside, so that they are not exposed to storm water, or placing a silt fence to capture the sediment in the water.

As described earlier, using regional BMPs in this watershed has a high cost and significant negative environmental impacts. This section thus focuses on source BMPs to control pollution entering the wetland.

B. Inventory Existing Watershed Conditions

The first step in developing BMPs is to inventory conditions within a watershed, targeting areas and activities currently contributing to erosion, sedimentation, and groundwater recharge.

A Mead & Hunt engineer visited the Door Creek watershed on September 23, 1993, to document watershed conditions. The watershed land use is primarily agricultural, interspersed with some wooded and low-density residential areas. The topography consists of fairly steep, rolling hills in the upper watershed and flat meadows and wetlands in the lower watershed.

The natural topography of this watershed causes erosion in the steep upper watershed—due to the high velocity of the storm water—and sedimentation in the lower watershed near the wetland, as the storm water velocity decreases and the suspended sediment settles out. As shown in Exhibit 9, active sedimentation was observed in the lower, flat areas, seen both in agricultural areas and in the murky brown color of Door Creek.

1. Identification of Erosion/Sedimentation Areas

Based on the site visit, the following four areas and activities were identified as potential contributors to the sediment flow into Door Creek. Photographs of examples of these areas and activities are shown in Exhibit 10.

a. **Gravel Pits**—This watershed has a number of abandoned or active gravel pits, which have typically cleared an entire face of a large, steep hill. The high-velocity storm water erodes loose soil from these areas and contributes to the sediment flow into Door Creek.

b. **Residential Construction**—As noted above, the northern and western portions of this watershed are undergoing rapid urbanization, consisting primarily of developing and constructing residential subdivisions. During construction, large areas are cleared of vegetation and exposed to storm water for a long period. Erosion occurs in these cleared areas and contributes to the sediment flow in Door Creek.

c. **Agricultural**—The major land use of this watershed is agricultural. During the fall and spring, these agricultural areas are left cleared of vegetation and exposed to storm water. Agricultural erosion is a major source of sediment in Door Creek, due to the large number of these areas and their proximity to Door Creek and its tributaries.

d. **Industrial**—The industrial land use in this watershed is minimal. However, industrial activities on the extreme northwestern portion of the watershed contribute to sediment flow in Door Creek primarily through erosion occurring along the exposed gravel, stone, and soil piles.

2. Identification of Groundwater Recharge Areas

Groundwater recharge areas in Door Creek directly contribute to the good condition of the wetland by ensuring an adequate flow of water into the wetland even during drought conditions. Without adequate groundwater recharge, the wetland could dry up during prolonged drought conditions, causing the loss of wildlife and plant species and the water quality and flood flow reduction benefits of the wetland (see Section III., *Hydrologic Analysis*).

The ground water recharge areas of Door Creek can be identified as those where soil conditions allow percolation of water into the ground, which, in turn, flows into the wetland. Door Creek watershed soil types are shown in the Hydrologic Soil Group Map in Exhibit 4. Soil types are broken into three groups, which were determined by the SCS to distinguish the varying percolation capacities of different soils. SCS hydrologic soil group "B" has the greatest groundwater recharge capability (see Exhibit 5 for description of soil groups). As Exhibit 4 shows, this soil type prevails throughout the watershed. However, since ground water moves very slowly, the contributing recharge areas to the wetland are in the middle and lower watershed areas. (Sub-areas 3, 4, 5, and 6).

C. Development of Best Management Practices

1. Erosion Control

The BMPs to control erosion may be divided into practices that affect agricultural, industrial, and construction/gravel pit storm water runoff.

a. **Agricultural**—The following BMPs to control erosion from agricultural practices have been developed by the SCS. These BMPs are in the best interest of the farmers, because they reduce the amount of soil lost from an area:

- *Terracing*—Terracing consists of constructing a channel or earth embankment across the slope of a field to capture the storm water runoff. The channels carry the sediment-rich runoff to a central vegetated outlet, where the sediment settles out prior to leaving the field. Exhibit 11 provides detailed sketches of terraces developed by the SCS.

- *Filter Stripping*—Filter stripping consists of placing a vegetative strip of grass or other vegetation downslope of a field to slow the storm water before it leaves the property. Filter strips may also be used to remove storm water pollutants resulting from barnyard practices (manure, feed lots, etc.)

- *Crop Residue*—Crop residue refers to leaving a residue of a crop on a field surface after the fall harvest to slow storm water until the planting season begins in the spring. In late fall, the residue is usually plowed under and the earth exposed until the onset of the next summer's growing season.

- *Critical Area Planting*—Critical area planting refers to planting grass or other fast-growing vegetation during off-growing months on critical erosive areas of a farmer's field.

- *Strip Cropping*—Strip cropping refers to planting row crops perpendicular to the slope of a field. The storm water is slowed by the rows, depositing soil before leaving the field.

These are several of the most popular BMPs to control erosion from agricultural areas that have been developed by the SCS. Detailed specifications concerning the appropriate use of these and other agricultural erosion control BMPs are available from the SCS[5].

b. Construction/Gravel Pits—In its manual *Wisconsin Construction Site Handbook*[6], the WDNR has developed many BMPs to control erosion from construction sites. These BMPs also apply to gravel pit operations in this watershed. Several construction site BMPs commonly used include:

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5 SCS Engineering Field Manual, SCS–U.S. Department of Agriculture, July 1984.

6 Wisconsin Construction Site BMP Handbook, Wisconsin Department of Natural Resources, Publication WR-222-89, June 1990.

- *Filter Fences/Hay Bales*—Filter fences are 2- to 3-foot-high pieces of fabric anchored into the ground by stakes. The fabric allows water to flow through while capturing the sediment. Bales of hay function similarly. Exhibit 12 shows a typical filter fence, and Exhibit 13 shows a typical hay bale. Filter fences and hay bales can be placed downslope of construction areas to filter runoff. They must be periodically inspected and maintained throughout the construction project.

  During Mead & Hunt's September 23, 1993, inspection of the watershed, many construction sites were observed that either did not have silt fences or hay bales, or had improperly installed ones.

- *Sediment Traps*—Sediment traps consist of small temporary gravel dams constructed across storm water outlet channels. Exhibit 14 shows a typical sediment trap.

- *Retention Basins*—For larger or steeply sloped construction projects, silt fences and sediment traps are not appropriate. In these cases, a small retention basin can be constructed to control erosion. Retention basins slow the storm water, allowing the sediment to settle out before leaving the project.

c. **Industrial sites**—The contribution of industrial sites to erosion in this area arises primarily through large exposed soil, gravel, and small stone piles. The BMP recommended for industries with exposed piles of materials is to cover them with a tarpaulin or store them under a roof so that they are not exposed to storm water.

2. Groundwater Recharge

BMPs to ensure adequate recharge into the wetland involve restricting zoning so that land use is compatible with ground water recharge in critical areas. An example of incompatibility between zoning and ground water recharge would be an "industrial/commercial," area—with highly impervious areas—in a critical ground water recharge area.

Sub-areas 3, 4, 5, and 6 in Exhibit 4 are critical to groundwater recharge. These sub-areas lie in the townships of Cottage Grove, Pleasant Springs, Blooming Grove, and Dunn. Zoning for the majority of this watershed in these townships has not been determined. The zoning that does exist is primarily residential and agricultural. The BMP to ensure adequate recharge is to zone the land adjacent to the creek "environmental corridor/greenspace" within these sub-areas. Such zoning would also increase recreational use of Door Creek through increased public access.

D. Summary

This report has summarized watershed conditions in terms of contributing erosion, sedimentation, and groundwater recharge areas in the Door Creek wetland.

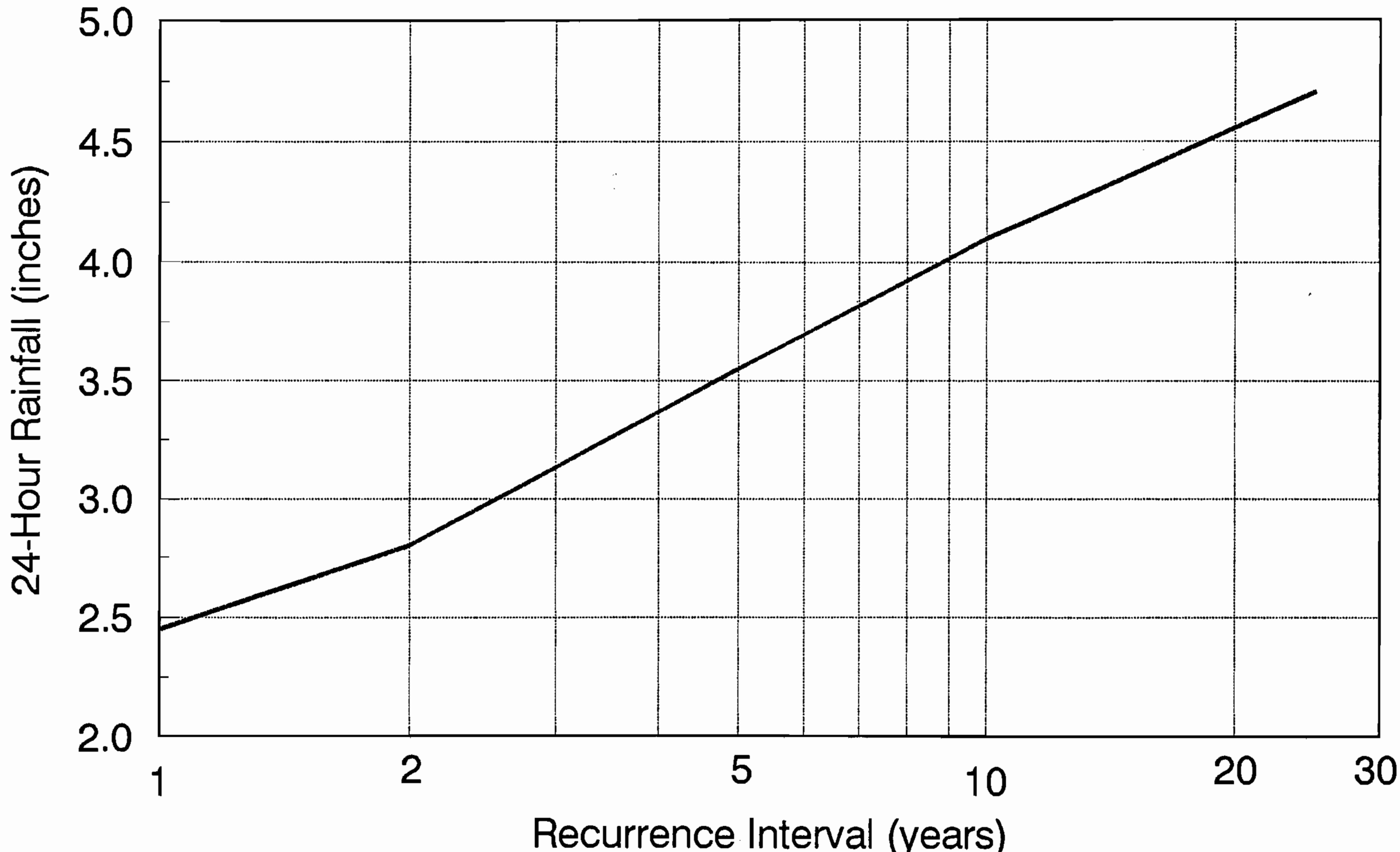
BMPs have been developed to control erosion from four activities in the watershed that contribute to the sediment flow into the wetland. These activities and BMPs are:

- *Agricultural*—Terracing, filter stripping, crop residue, critical area planting, and strip cropping.
- *Construction/Gravel Pits*—Filter fences, hay bales, sediment traps, and retention basins.
- *Industrial Sites*—Covering exposed materials with a tarpaulin or storing them under a roof.

BMPs have also been developed to promote groundwater recharge in critical areas of the watershed. The BMP is to zone areas that contribute the majority of the groundwater to the wetland as "greenspace" or "environmental corridor" of the developing townships within the watershed. The creation of these zones also increases the recreational use of the wetland and Door Creek.

FIGURE 1

Rainfall Amounts
Door Creek



	1	2	5	10	25
Rainfall (inches) —	2.5	2.8	3.6	4.1	4.7

FIGURE 2

Hydrographs at RR Tracks

Door Creek

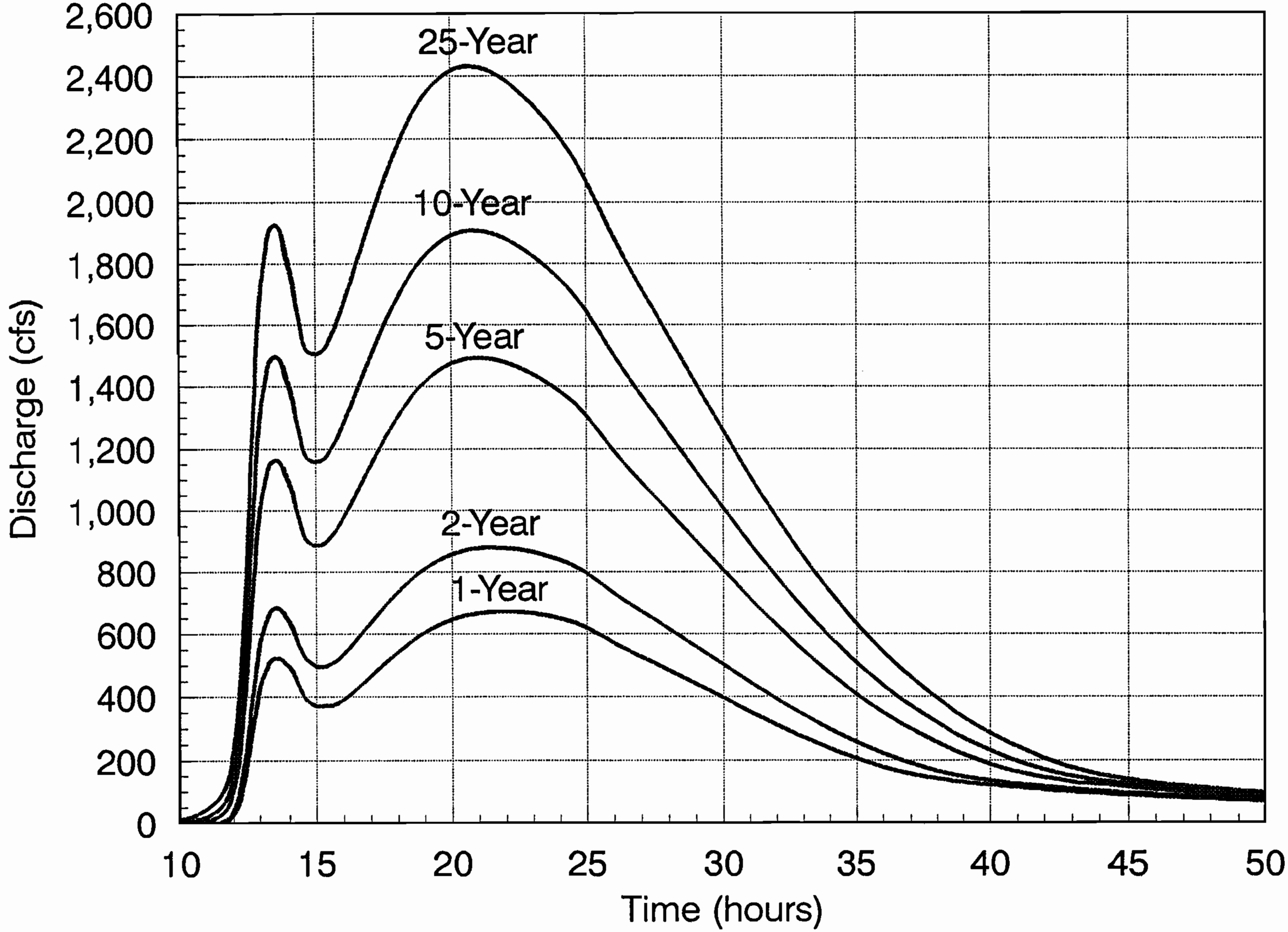


FIGURE 3

Hydrograph at Lake Kegonsa

Door Creek

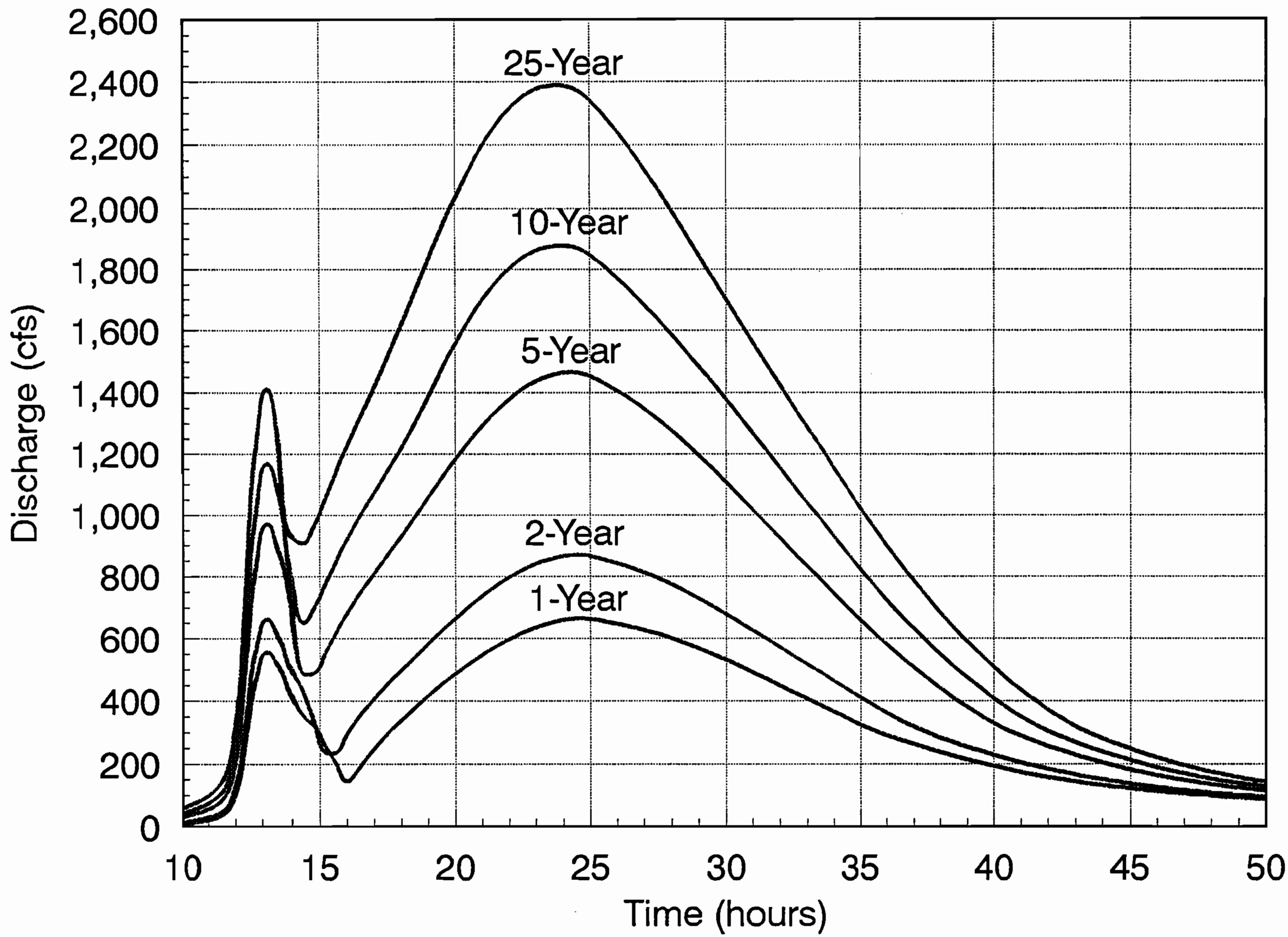
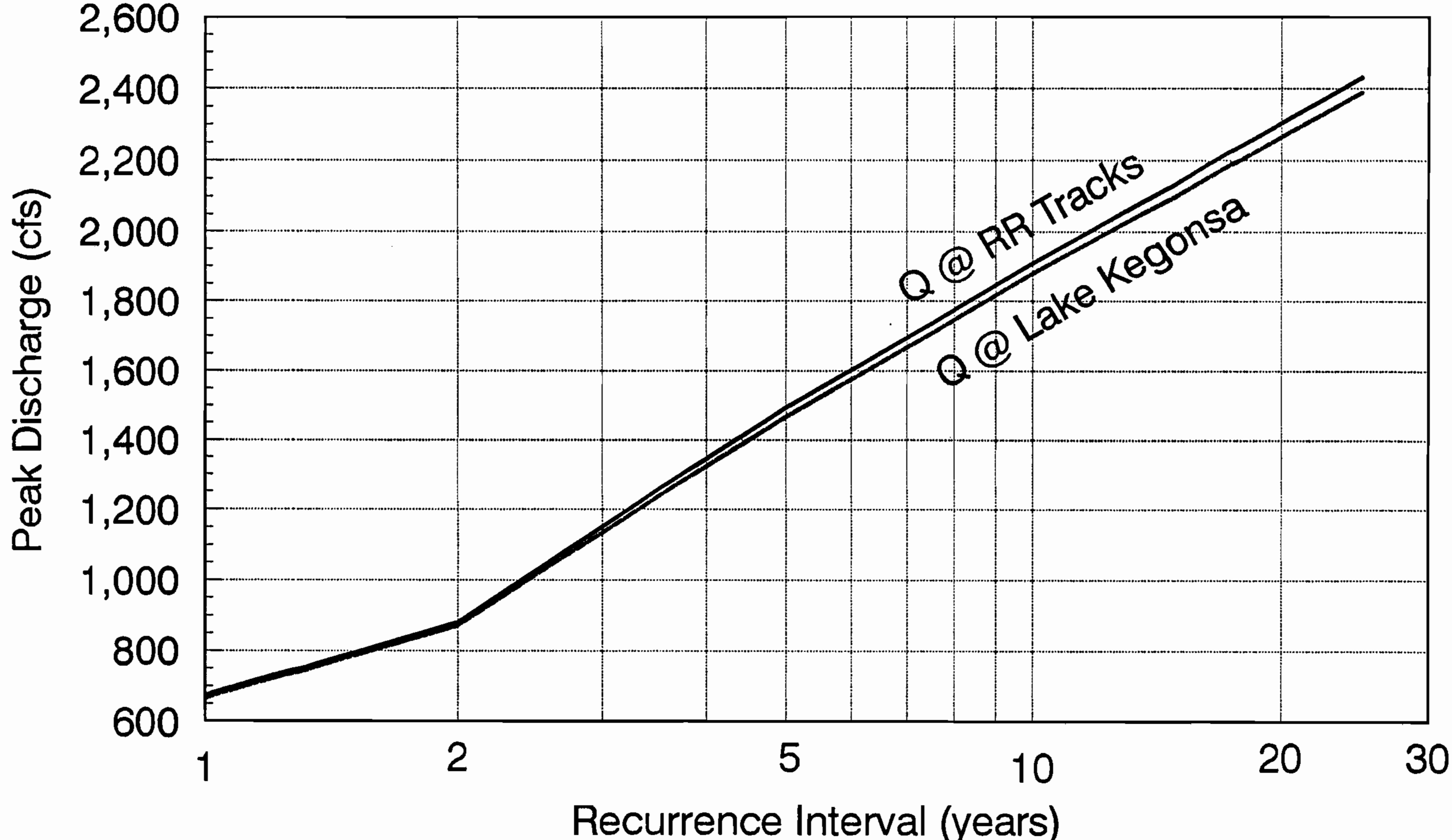


FIGURE 4

Peak Discharge

Door Creek



	1	2	5	10	25
Q @ RR Tracks	672	879	1,492	1,908	2,430
Q @ Lake Kegonsa	666	870	1,467	1,878	2,389

DOOR CREEK MARSH

Yahara River Valley Region

Priority Group II

Wetland Description

Door Creek Marsh rests on one of the major peat deposits of the Yahara River system. The vegetation consists mainly of shallow marsh, with stands of cattail. At the north end of the peat deposit the surface is drier, with sedge meadow and shrubs. Still farther north, the ditched water course of Door Creek is lined with sedge meadow and disturbance vegetation.

The land in the Door Creek region is entirely agricultural, except for a few small groups of houses. The upper valley has been ditched and farmed extensively, and little of the original vegetation remains. The large ditch which has taken over the function of Door Creek has been extended southward through the center of the peat deposit to Lake Kegonsa. This major ditch carries runoff, silt, and nutrients from the farm land, making filtering action by the marsh nearly impossible. An early study (Lackey and Sawyer, 1945) of nutrient loading of the Crawfish, Yahara, and Rock Rivers included Door Creek. Even at that time, the nutrient input of Door Creek was found to be very high.

Threats and Management

The major threat to the Door Creek Marsh itself is from continued attempts to convert it to conventional agricultural use. Since this has not been successful on any of the deep peat deposits, the further destruction of this natural area does not appear worthwhile. A possible agricultural use is muck farming, but this would destroy the wildlife value of the marsh as well as adding more nutrients to the Yahara River. It should be possible to experiment with closing or partially closing ditches, so as to slow and spread the water flow through the marsh. This may help to preserve it, but there is no substitute for rehabilitation of the upper creek valley. The greatest need for such rehabilitation, however, is the restoration of the quality of the Yahara River.

DOOR CREEK MARSH

MAP KEY

Deep marsh.

Shallow marsh.

Sedge meadow.

Dried out sedge meadow with abundant asters, goldenrod, etc.

Shrubs.

Wetland disturbance vegetation, especially reed canary grass, giant ragweed, and nettle.

Upland old field.

Trees.

Orchard or planted trees.

Pastured.

Cultivated.

Developed.

Fill.

Ditch.

Power line.

DOOR CREEK MARSH

MAP EXPLANATION

NOTE: This area was not examined thoroughly enough in the field for detailed mapping. Differentiation between sedge and shallow marsh areas needs further investigation. Some of the area east of the central ditch was not field checked.

1) See Lower Mud Lake for continuation.

2) Area not examined in field.

3) Small disturbed sedge-reed canary grass (Phalaris arundinacea) area.

4) No information obtained in field.

5) Grazed and sometimes cultivated, disturbance vegetation.

6) Old meanders which hold water in spring, surrounded by reed canary grass.

7) Houses built in floodplain.

8) Grazed sedge meadow.

9) Shrubs heavily invading sedge meadow.

10) Probable shrub area, not examined in field.

11) Shrubs, almost all red-osier dogwood (Cornus stolonifera), invading sedge meadow.

12) Along channel, the vegetation is predominantly red-osier dogwood, elderberry (Sambucus canadensis), black willow (Salix nigra), box elder (Acer negundo), and sandbar willow (Salix interior).

13) Shallow marsh, Carex lacustris dominant, scattering and stands of broad-leaf cattail (Typha latifolia), narrow-leaf cattail (Typha angustifolia), Carex aquatilis, soft-stem bulrush (Scirpus validus), and bluejoint grass (Calamagrostis canadensis).

14) Vegetation in natural opening predominantly narrow-leaf cattail. Some round stemmed bulrush (Scirpus sp.), Carex comosa, Carex aquatilis, Carex stricta, rice cutgrass (Leersia oryzoides), jewelweed (Impatiens biflora), water hemlock (Cicuta bulbifera), and marsh dock (Rumex orbiculatus) were seen.

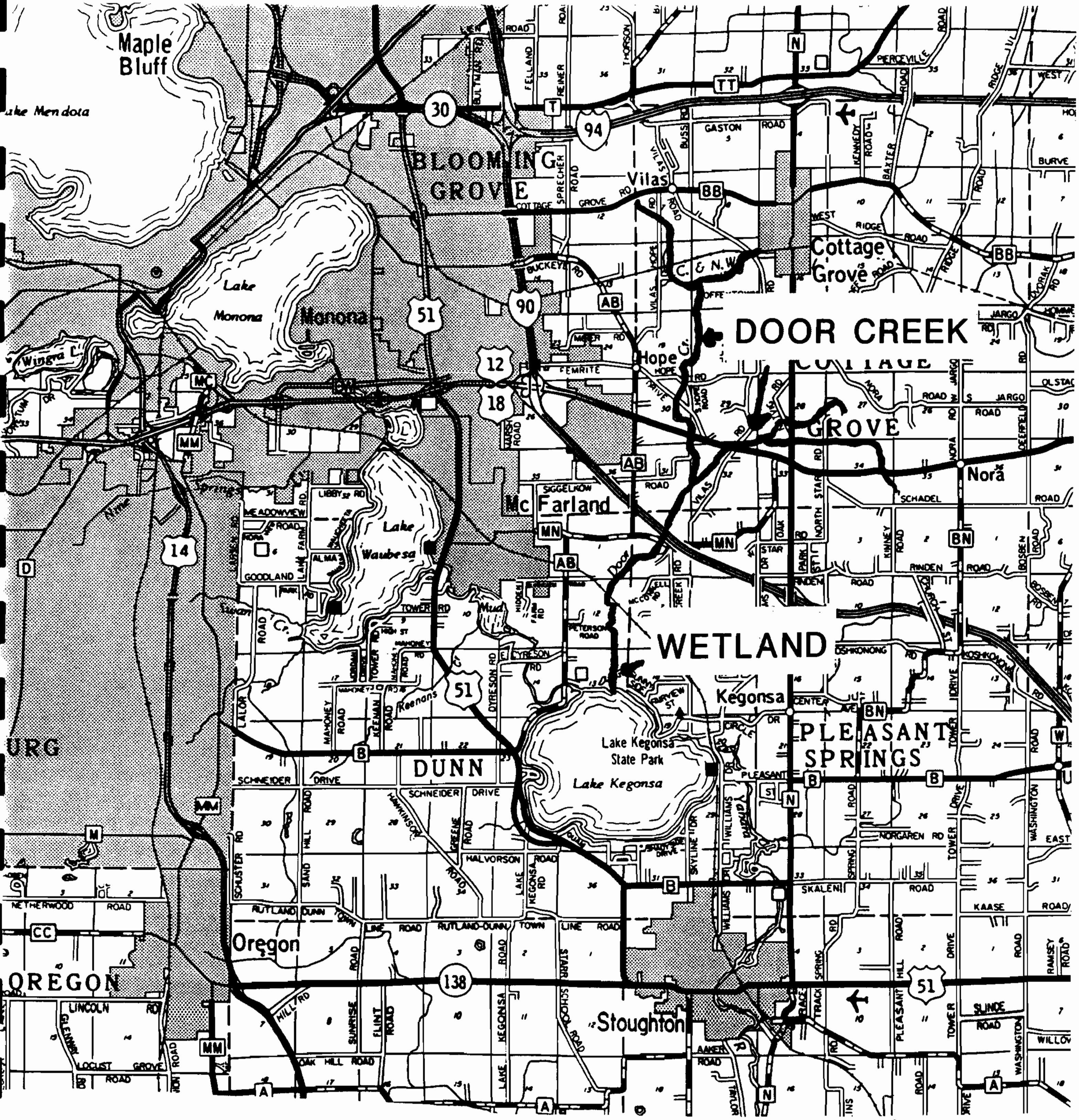
15) Disturbance vegetation, not examined.

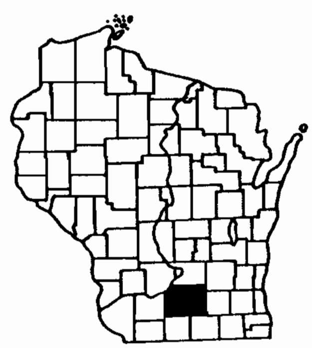
16) Probably can be cultivated only in dry years.

17) Lake Kegonsa State Park. This park does not include or protect any of the marsh.

Exhibit 2

Vicinity Map





NORTH

SCALE 0 1 2 MILES

MAP PREPARED AND PRINTED BY
LAND REGULATION & RECORDS DEPT.
SURVEYOR'S OFFICE, ROOM 116
CITY-COUNTY BLDG. MADISON, WI 53709

Compiled from U. S. G. S. Quadrangles
Based on Aerial Photographs

Exhibit 6

Land Use Map

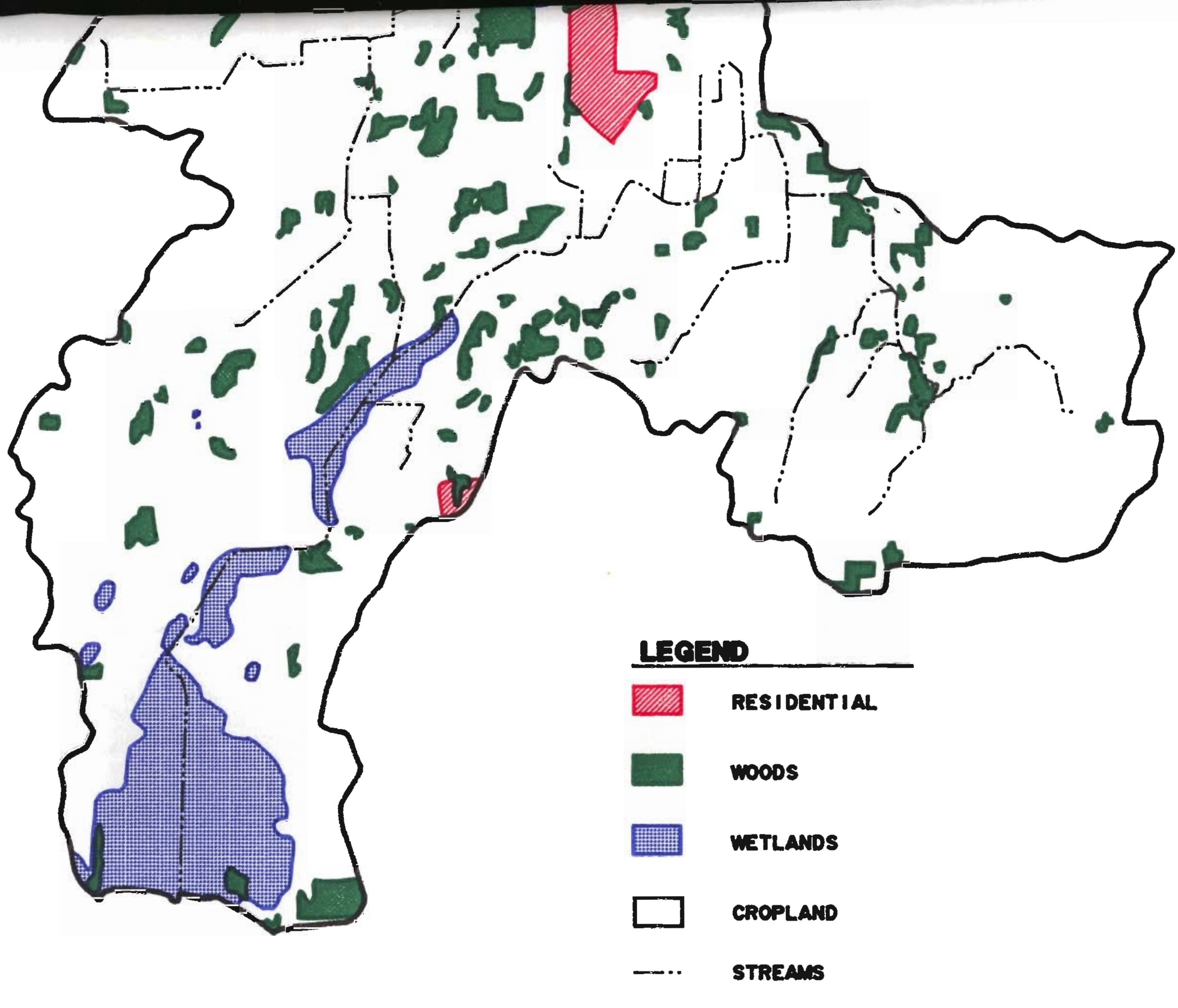


EXHIBIT 6	MEAD & HUNT Consulting Engineers 6501 Watts Road Suite 101 Madison, Wisconsin 53719-1361 (608) 273-6380 / FAX (608) 273-6391	DESIGNED EAV DRAWN JRG SURVEYED - CHECKED APPROVED	JOB NO. F132-93A DATE MARCH, 1993	DOOR CREEK WATERSHED LAND USE MAP