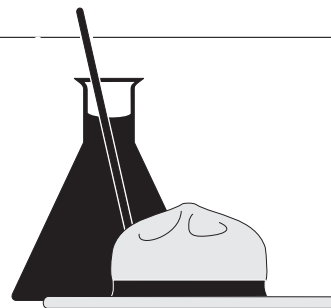




THE RECONSTRUCTION OF KENILWORTH MARSH THE LAST TIDAL MARSH IN WASHINGTON, D.C.

A PARTNERSHIP WITH THE U.S. ARMY CORPS OF ENGINEERS, AND OTHER AGENCIES,
LEADS TO RESTORING A REGIONALLY IMPORTANT WETLAND

By STEPHEN W. SYPHAX AND RICHARD
S. HAMMERSCHLAG

KENILWORTH MARSH IS A 77-acre freshwater tidal marsh and swamp forest located adjacent to the historic Kenilworth Aquatic Gardens along the Anacostia River in Washington, D.C. National Capital Parks—East, a unit of the National Capital Region of the National Park Service, manages the marsh.

This marsh, along with hundreds of other acres of tidal wetlands, had flanked the Anacostia River into the Twentieth Century (figure 1, page 16). However, during the 1920s-40s, the U.S. Army Corps of Engineers dredged and channeled the Anacostia River from the Potomac River up to Bladensburg, Maryland (approximately 9 miles), to improve navigation. The dredge spoil was used to create *upland* within the adjacent wetlands. Much of the newly created land became Anacostia and Kenilworth parks. In 1940, the marshes at Kenilworth were dredged, ostensibly to create a recreational lake (figure 2, page 16). However, the lake developed into a shallow bowl, which at low tide simply became an extensive unvegetated mud flat



Before (top) and after (bottom) reconstruction of mass fill area #1 at Kenilworth Marsh. A tidal gut, or channel, was also installed in the restoration effort and shows in the bottom image of the completed marsh.

(-0.6 to 0.1 feet mean sea level¹) having minimal habitat value (figure 3, page 16). Wild rice (*Zizania aquatica*) and other emergent plants, which once dominated the Anacostia marshes and were major food sources for wildlife, had practically disappeared.

RECOGNIZING POTENTIAL

NPS documents from as early as 1963 recognized the potential of Kenilworth Marsh as an important natural area and wildlife sanctuary. In 1980, the Kenilworth Park and Aquatic Gardens Development Concept Plan promoted the interpretation and study of this natural area (that nearly surrounds the historic gardens). For the area to meet interpretive objectives, improve water quality, and certainly to meet the goal of being a viable wetland habitat, the wetland would have to

Continued on Page 16

¹Mean sea level is the average ocean surface level for all stages of the tide over a recent 19-year period; twice daily tides range above and below mean sea level.

be restored. The site also provided one of the last opportunities to reconstruct a wetland representative of the once extensive Anacostia River tidal marshes.

INVESTIGATIONS BEGIN

Initial NPS investigations focused on water and sediment quality and wildlife feeding as factors that limited wetland plant growth at Kenilworth Marsh. Contaminants such as heavy metals and pesticides are not unusual to such urban watersheds, but are of particular concern at this location, since the Kenilworth Marsh is adjacent to an old sanitary landfill that was capped and reclaimed for recreational land in 1972. The potential of toxins to leach from the landfill established an additional possibility for the lack of wetland vegetation growth in the marsh.

During the early studies, the National Park Service confirmed the presence of toxic substances such as lead, chromium, copper, PCBs, and chlordane in the marsh sediments; however, the levels were not considered to be limiting plant growth. Moreover, the University of the District of Columbia conducted bioassays in which Asian clams (*Corbicula fluminea*) demonstrated successful larval development in laboratory tests after having been exposed to the same sediments. In addition, biologists observed that the few residual benches of emergent wetland vegetation at the marsh were growing well, apparently unaffected by any water or sediment quality problems.

In 1988, the Metropolitan Washington Council of Governments and the District of Columbia Department of Consumer and Regulatory Affairs joined the National Park Service by targeting special Chesapeake Bay program funds for projects in the Anacostia River watershed. We used the funds to study the potential for tidal marsh restoration at Kenilworth.

In the spring and summer 1991, we tested the hypothesis, supported by preliminary field studies, that limited plant growth in the marsh was caused primarily by a sediment elevation that was too low relative to tidal inundation. Biohabitats, Inc., a contractor, adapted a bioengineering technique that had been used in the Mississippi River Delta in which 20 foot by 20 foot containment cells were constructed us-



Figure 1. Kenilworth area, 1927, before dredging and channelization.



Figure 2. Kenilworth Marsh, 1948, following dredging and filling activities that resulted in a recreational lake.



Figure 3. Kenilworth Marsh, October, 1990, prior to reconstruction. A marsh became a mud flat.

ing materials such as brush bundles (tightly bound pine tree branches) or straw bales. We filled the containment cells to varying elevations with bottom sediments and planted them with 10 emergent wetland species.

Altogether, we constructed some 30 cells, located in two areas of Kenilworth Marsh; elevations ranged from near mean sea level to plus 2 feet. This effort determined the sediment elevation to be near mean high tide for optimal plant growth, and helped us develop a list of native plants with good growth potential. This level was about 2.1 feet above mean sea level during the summer, the same elevation as that of the vestigial benches of wetland vegetation.

The resulting restoration design, possibly involving redistribution of sediments within the marsh, had potential for creating 15 acres of emergent marsh. While we considered the plan workable, funds were not available for its implementation. We also recognized that although bringing in external dredge material, instead of dredging internally, would be feasible for raising elevations, it would likely be too expensive.

RETURN OF THE U.S. ARMY CORPS OF ENGINEERS

We were very excited to learn that the U.S. Army Corps of Engineers intended to dredge the upper Anacostia River for maintenance purposes and quickly recognized the potential to link the marsh reconstruc-

tion project with the dredging project. Although the U.S. Army Corps of Engineers had already identified upland disposal sites in Maryland, staff from the park and the National Capital Region and its Center for Urban Ecology began to explore the feasibility of using dredge material for reconstructing portions of Kenilworth Marsh. If the quality of the Anacostia River sediment was suitable (in levels of contaminants and particle size), we could possibly reconstruct far more than the 15 acres of wetlands detailed in the initial plan. The savings derived from eliminating upland disposal costs would also certainly make the project attractive to the U.S. Army Corps of Engineers. Furthermore, they would be able to demonstrate a beneficial use of dredge material in creating new wildlife habitat in the nation's capital—at a location near their national headquarters!

The Corps accepted the proposal and soon joined the Kenilworth Marsh restoration team. They agreed to perform analyses of the river sediments to be dredged, produce the environmental assessment, and fund the wetland building and planting phases.

THE PLAN

This new larger scale restoration effort required that we modify the methods described in the Biohabitats, Inc., plan. We decided to reconstruct 32 acres of emergent wetland through the establishment of

th Marsh,
ior to marsh
t low tide, the
n unvegetated

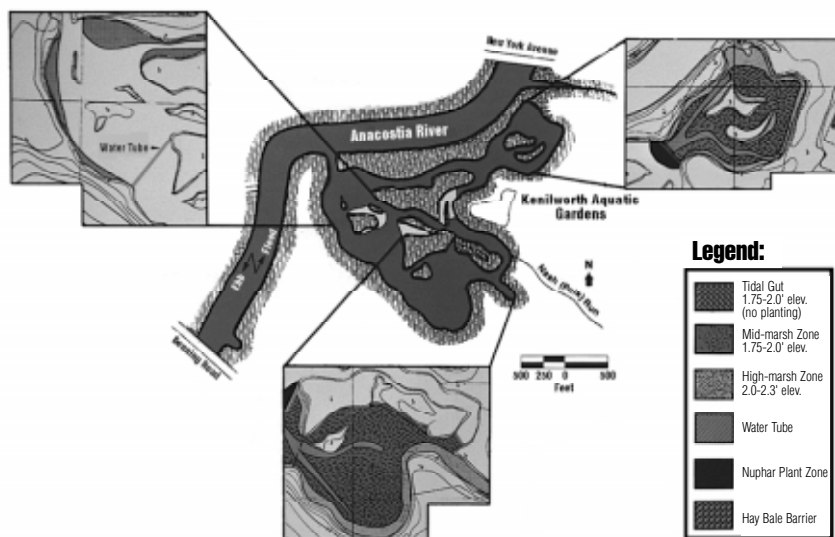


Figure 4. Kenilworth Marsh Restoration Plan.

Figure 5. The reconstructed marsh—Sept. 1993. Note greening of mass fill areas #1 and #2 where the newly established marsh can be seen.

two mass fill areas (#1 and #2), 10 and 15 acres respectively, and smaller fringe areas (#3) totaling some 7 acres (figure 4).

Our plan was to temporarily separate mass fill areas #1 and #2 from the tidal marsh (and river) using large water tube devices. Once positioned, the water tubes were pumped full with marsh water. When full, the tubes proved effective at damming fill placement areas and containing sediments released during the filling operations. Similarly, we established fringe marsh areas using the straw bale containment perimeter approach. Straw bales were also installed to protect the few remnant emergent wetland areas that were adjacent to the mass fill sites. We had learned from the demonstration phase that building the brush bundles was too labor-intensive, and the energy regime of the marsh did not require them.

In October 1992, we installed a floating boom with an attached sediment curtain at the marsh inlet-outlet, and the hydraulic dredge barge Blue Ridge (owned and operated by Cottrell Engineering Corporation) began removing sediment from the upper Anacostia riverbed. Through a system of 12-inch diameter pipes, the dredge material was pumped to selected areas of the Kenilworth Marsh. Areas of coarse sandy material in the river, which had been identified during preliminary sampling, were dredged first and used as a foundation for the water tubes.

Once the water tubes were stable, we filled the selected restoration areas to the approximate target elevations. The intent was for roughly two-thirds of reconstructed marsh to be mid-marsh (with elevations approximately 2.1-2.4 feet above mean sea level). We placed additional material around the perimeter of mass fill #1 and #2 such that the elevations would be slightly (several inches) higher to create a high-marsh zone (elevations about 2.5-2.8 feet above mean sea level). A D-4 track bulldozer graded the perimeter edge fill areas, and we surveyed the sites to record initial sediment placement elevations.

We determined that further dewatering (draining) and consolidating would result in the target elevations of about 2.5 feet above mean sea level for high-marsh and 2.1 feet for mid-marsh. A low-marsh zone, planted with spatterdock (*Nuphar advena*), was planned to provide the transition and stabilization between the mass fill areas and the adjacent unfilled areas of Kenilworth Marsh. These elevations reflect the mean high tide levels during the summer, which average some 6 inches higher than winter, due to solar gravitation. We knew the elevations would change from subsidence during dewatering and from displacement and compaction of unconsolidated sediments. We used calculations based on sediment characteristics performed by the Army Corps of Engineers to achieve the final target elevations.

The mass fill areas were allowed to dewater, settle, and consolidate from January 1993, to the time planting began in May 1993. We achieved dewatering by constructing adjustable outlet weirs on one side of each of the two main water tubes.

PLANTING BEGINS

On May 17, 1993, work crews from Ecological Restoration and Management, Inc. (a subcontractor to the Army Corps) began planting mass fill #1 with 16 native and local species (table 1, page 18).

Even before planting, the fill areas were being colonized by several *volunteer* plant species (table 2, page 19), particularly mass fill #1. Many of these species were 6 inches tall and had carpeted the area by the time planting began. These plants, however, did not colonize depressions, or low spots in the mass fill areas that contained a residual inch or two of pond water as rapidly as the higher, drier areas. We did not expect the magnitude of volunteer plant growth to be so high, but welcomed it overall. The volunteer vegetation also *absorbed* some of the feeding pressure from Canada geese and ducks.

We performed planting by creating patches of plant species on 2-foot centers; the number of plants in a flat (about 40) controlled the patch size. Placement of plant species was often arbitrary, although we directed high-marsh species to the higher elevation areas.

Continued on Page 18

Following planting, an 8-inch hydraulic dredge barge with a 10-foot wide cutter head, known as a Versi-Dredge Model 308, re-created tidal channels in the two mass fill areas. The channels had been staked previously and were not planted. The new channels were cut approximately 3 feet deep and 10 feet wide and their locations approximated those of the original tidal channels. The sediment cut out of the channel was used to raise the remaining low areas (bottom photograph, front page).

MASS FILL #1

Mass fill #1 averaged 2.5 feet above mean sea level in elevation and was the first area to be planted. Volunteer plants colonized this fill area more quickly than mass fill #2, presumably because we planted it earlier and it was higher in elevation. Subsequently, mass fill #1 contained more undesirable plants, as well (species on table 2 marked with an asterisk).

Rice cutgrass (*Leersia oryzoides*) dominated mass fill #1 with dense growth. Because of its potential to out-compete other wetland plants, purple loosestrife (*Lythrum salicaria*) was a particular concern. Of similar regard were a few small clumps of the aggressive phragmites (*Phragmites australis*). Between the fall 1993 and winter 1994, we made attempts to manually eradicate both species, and we will continue to suppress these two potential pests.

A primary observation on the revegetation process was that depressions, or low spots containing a residual inch or two of water, did not green up like the other portions of this area. Apparently, the seeds of potential volunteer species were not nearly as likely to germinate in the puddles as opposed to the drier areas. Perhaps oxygen availability is a controlling factor.

MASS FILL #2

We began planting mass fill #2 in early June. Although later in the season, volunteer plants had not invaded to the same degree as they had at mass fill #1. Mass fill #2 supported a diversity of mid-marsh species. Presumably, this is due to the elevational differences, averaging approximately 2.1 feet mean sea level in mass fill #2—some 4 inches lower than mass fill #1.

TABLE 1. Species Planted in the Kenilworth Marsh Reconstruction

Scientific Name	Common Name	Quantity
High Marsh		
<i>Cephalanthus occidentalis</i>	buttonbush	2,148
<i>Hibiscus mosheutos</i>	marsh hibiscus	2,148
<i>Leersia oryzoides</i>	rice cutgrass	14,362
<i>Saururus cernuus</i>	lizard tail	14,362
Mid-Marsh		
<i>Alisma plantago-aquatic</i>	water plantain	5,122
<i>Carex stricta</i>	tussock sedge	5,122
<i>Iris versicolor</i>	blue flag	5,122
<i>Peltandra virginica</i>	arrow arum	64,815
<i>Polygonum sp.</i>	smartweeds	14,362
<i>Pontedaria cordata</i>	pickerelweed	4,840
<i>Sagittaria latifolia</i>	duck potato	64,815
<i>Scirpus americanus</i>	common three-square	14,362
<i>Scirpus validus</i>	soft stem bulrush	64,815
<i>Sparganium americanum</i>	lesser bur-reed	5,122
<i>Sparganium eurycarpum</i>	giant bur-reed	5,122
Low-Marsh		
<i>Nuphar advena</i>	spatterdock	4,840

The volunteer plants appeared only at the higher areas near the perimeters where water did not pond significantly. Volunteer plants seemed to become more prevalent when standing water was reduced. A noticeable green up occurred when the water tube was removed and tidal channels were cut. Additionally, volunteer plant growth occurred during June and July when growing conditions were optimal.

FRINGE AREAS

We planted fringe areas as we had the others, except that we used only mid-marsh species. The plan was to create fringe elevations that matched those of mass fill #2. However, after the dredge material was in place, the final elevations of the fringe areas were lower than those in both mass fill #1 and #2. As a

result, the fringe areas supported volunteer plant growth only minimally. Similarly, planted species did not establish themselves nearly as vigorously in the fringe areas as they did in mass fill #2.

SUMMARY

Overall, Kenilworth Marsh revegetated extensively and vigorously. During the first year, at least 90% of mass fill areas #1 and #2 was

covered with dense plant growth averaging several feet in height (bottom photograph, front page and figure 5, page 17). This may be attributable to several factors: the surrounding berms and islands protected the vegetation from fetch, volunteer plants established themselves prevalently, the newly deposited sediments provided dissolved oxygen and nutrients, sediment levels were near and just above the high tide elevation, wildlife feeding was limited, we planted native species, and we timed planting to coincide with optimal growing conditions.

FOLLOW-UP MONITORING

As a prototype, the Kenilworth Marsh restoration project pioneered methods that may be useful in restoring other freshwater tidal wetlands

(including others within the Anacostia watershed such as Kingman Lake). The project also raised numerous questions concerning the quality and impacts of the wetlands being produced. Consequently, the agencies involved in restoring the marsh (National Park Service, U.S. Army Corps of Engineers, Metropolitan Washington Council of Governments, District of Columbia Department of Consumer and Regulatory Affairs, Environmental Protection Agency, U.S. Fish and Wildlife Service, the University of the District of Columbia, and the Interstate Commission on the Potomac River Basin) felt strongly that the project be monitored for several years to determine its degree of success. Together, we formed the Kenilworth Marsh monitoring committee for the purpose of

TABLE 2. Volunteer Plants

Scientific Name	Common Name
<i>Acer rubrum</i>	red maple
<i>Bidens sp.</i>	beggar-ticks
<i>Carex sp.</i>	sedges
<i>Eleocharis sp.</i>	spike rush *
<i>Leersia oryzoides</i>	rice cutgrass
<i>Lythrum salicaria</i>	purple loosestrife*
<i>Phragmites australis</i>	phragmites*
<i>Polygonum sp.</i>	smartweeds
<i>Populus deltoides</i>	cottonwood
<i>Sagittaria latifolia</i>	duck potato
<i>Salix sp.</i>	willow
<i>Typha angustifolia</i>	narrow-leaved cattail
<i>Typha latifolia</i>	broad-leaved cattail
<i>Zizania aquatica</i>	wild rice
*Potential pest species	

identifying, promoting, sponsoring, and conducting monitoring studies to document the results of the project.

The studies have examined the project from its first year, 1993, and will continue for many years to come. They will assess levels of toxicants, such as chlordane, in sediments, pore water, and the biotic food chain of the marsh. They will also monitor the effectiveness of wetland vegetation re-establishment; the productivity of wildlife habitat and habitat use (including grazing) by wildlife; the stability of sediment and development of soil, and hydrologic patterns; and water quality. Finally, they will inventory plankton, aquatic macro-invertebrates, mammals, birds, and fish. We have assembled a report for 1993 consisting of several data sets and anticipate writing annual reports and preparing a synoptic report after five years. 

Stephen W. Syphax is the Resource Management Specialist for National Capital Parks-East. His address is 1900 Anacostia Drive, S.E., Washington, D.C. 20020, and he can be reached by telephone at (202) 690-5185.

Richard S. Hammerschlag is the Chief of the Center for Urban Ecology, National Biological Survey. His address is 4598 MacArthur Blvd., N.W., Washington, D.C. 20007, and he can be reached by telephone at (202) 432-1443.