

ATLANTIC WHITE CEDAR SPECIES RECOVERY AND WETLAND ENHANCEMENT PROJECT AT HOWARD'S BRANCH, ANNE ARUNDEL COUNTY, MARYLAND

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Abstract—The creation of a new site for Atlantic white cedar [*Chamaecyparis thyoides* (L.) B.S.P.] was the driving force behind a stream stabilization and wetland enhancement project in Anne Arundel County, MD. The Howard's Branch project was designed to create peatland ecosystems in a highly degraded stream valley flood plain by creating a functional seepage wetland supporting a sustainable Atlantic white cedar community. A series of cobble weirs and a network of sand berms were placed over a dry lakebed to simulate the geology and hydrology found in natural Atlantic white cedar sites. In April 2001, construction of the project was completed with the planting of 1,000 Atlantic white cedars propagated from the 10 remaining stands of the species on the western Coastal Plain of Maryland. This paper reviews the procedures developed for the Howard's Branch project, reports on the status of the constructed wetland, and discusses the regulatory hurdles that were encountered.

Keywords: Bog, *Chamaecyparis thyoides*, forested wetlands, seepage wetlands, stream restoration.

INTRODUCTION

Atlantic white cedar [*Chamaecyparis thyoides* (L.) B.S.P.] (AWC) is an evergreen, wetland tree species that inhabits peatlands along the Atlantic and Gulf coasts of the United States. In the past 200 years most of the historic peatlands along the eastern seaboard of the United States have been destroyed. The remaining peatlands and their adjacent uplands harbor an inordinately large number of rare, threatened and endangered plant and animal species (Laderman 1989). Some of these species are found only in cedar swamps (Cryan 1985). AWC may be considered globally threatened as a species or as a community type (McAvoy and Clancy 1993), and has been reduced to < 2 percent of its original acreage (Noss and others 1995).

AWC survives only under a very narrow set of environmental conditions (Laderman 1989, 2003). Rainwater that falls in the sandy uplands in landscapes above AWC wetlands is slowly released over confining soil layers, or at sea level as exfiltrating groundwater seepage. Plants such as Sphagnum mosses and emergent hydrophytes colonize these wet, sandy, mineral soils and over a number of years form an organic peat substrate. Wetland vegetation associated with these areas is typically well adapted to low pH conditions. Peat will also frequently accumulate along the edges of adjacent open water habitats. Associated water impoundments, such as spring-fed ponds, sometimes develop floating mats of peat as water lilies (*Nymphaea odorata* Ait.) and other species create organic material faster than it decomposes. Eventually, species including sedges and Sphagnum mosses colonize

these peat mats and form hummocks that are suitable microhabitats for the establishment of AWC seedlings. Close investigation of sites now containing AWC on organic soils revealed that seepage wetlands are associated with suitable habitat for this species.

In Maryland, AWC occurs on peat that has formed on sandy seepage wetlands along the edges of bogs, ponds, streams, and tidal headwaters of the Chesapeake Bay (Hull and Whigham 1987). The species was once abundant within the predominantly deciduous tidal swamps along the major rivers of the eastern shore of the Chesapeake Bay (Dill and others 1987, Shreve and others 1910). In Anne Arundel County, Maryland, a series of peatland complexes occurs along a narrow band of sandy, acidic soils of the Magothy Geologic Formation (Kirby and Matthews 1973). Where these soils surface at or near sea level along the shores of the Severn and Magothy Rivers, groundwater discharges and peatlands develop. Ten of these peatlands contain the only known remaining wild populations of AWC on the western Coastal Plain of Maryland (WCPMD) and represent the western edge of the range of the species in Maryland. Sheridan and others (1999) found that AWC occurred in nine sites containing a cumulative total of 1,214 living trees > 1.2 m in height remaining on the WCPMD. A 10th site containing < 100 trees was found in 2000 and has subsequently been reduced to less than 20 trees. These inventories indicated declining populations and resulted in investigations of potential sites for AWC conservation, restoration, and recovery opportunities to ensure the continued existence of AWC and other peatland species in Anne Arundel County.

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METHODS

Project Site Selection

In the fall of 1997 sites were evaluated for their potential for the establishment of a new AWC population to make up for historic and recent losses. The leading experts in AWC restoration were consulted before and during the undertaking of this project. A 3 acre dry lakebed on a tributary of the Severn River known as Howard's Branch was selected due to factors weighing in its favor to provide a suitable base for creation of a seepage wetland with AWC, including: its general topography, the constant water flow through the site, its proximity to remnant AWC populations (fig. 1), its position in the landscape, the accessibility for equipment and the willingness of landowners to host the project.

Site History

In 1930, a forested stream valley flood plain was flooded to a depth of -4 feet with the construction of an earthen dam across a small stream known as Howard's Branch. The resulting lake was the sole drinking water supply for the community of Sherwood Forest until 1970. In 1980 the dam failed and the lake drained, exposing sediments that had accumulated behind the dam over 50 years. The stream subsequently cut through those sediments, which were then transported downstream to tidal waters, damaging tidal and sub-tidal ecosystems, and resulting in disturbance regime plants such as common reed (*Phragmites australis*) in the tidal wetlands and Eurasian water-milfoil (*Myriophyllum spicatum*) in the adjacent shallow tidal waters.

Physical Conditions

Stream characteristics—Howard's Branch is approximately one mile long from its headwaters to its outflow into Brewer Creek. The stream begins as toe slope seepage from two upper reaches of the ravine system, wherein it converges into one main stream channel just above the project site. The remnants of the dam are located 1,000 feet upstream of a pond at the tidal interface with Brewer Creek, a tributary of the Severn River. The Howard's Branch stream valley floodplain (former impoundment) within the project site is approximately 737 feet long and 120 feet wide. The floodplain ranges in elevation between 10 and 15 feet above sea level. The drainage area to the project site is a total of 231 acres, or 0.4 square miles, and is comprised of a mix of forested open space and low density residential. The base flow of the stream through the project site is about 2 cubic feet per second.

Soils—Surface soils within the project area are generally comprised of mixed alluvial deposits that range from clay to sand (Kirby and Matthews 1973). These soils have been deposited in the former impoundment from various upstream eroding soils. The stream valley flood plain is generally level, with a slope of < 1 percent. The soils are poorly drained and remained wet even in dry periods. The soils surrounding the project area are Monmouth fine sandy loam, with a slope of 15 to 40 percent, which overlays the white sands of the Magothy Formation. Within the Monmouth mapping unit are some deep gullies that have a very sandy or silty surface layer, and the slopes are highly susceptible to erosion when existing vegetation is removed (Kirby and Matthews 1973).

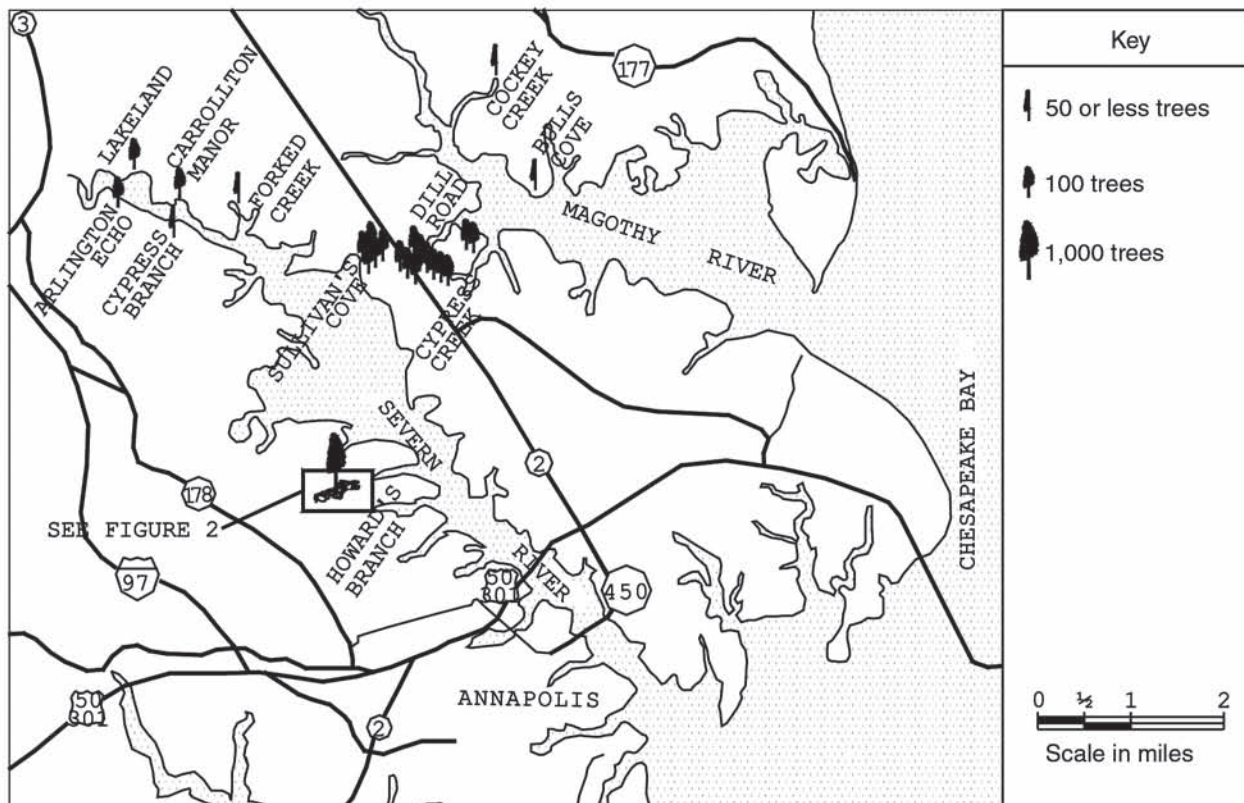


Figure 1—Locations of all known Atlantic white cedar populations west of the Chesapeake Bay.

Preproject Environmental Conditions

Wetlands—The project area was dominated by nontidal wetlands surrounded by steep slopes. The site was predominantly characterized as an open wet meadow dominated by rice cut-grass (*Leersia oryzoides*), Asiatic tearthumb/mile-a-minute vine (*Polygonum perfoliatum* L.), joe-pye weed (*Eupatorium dubium* Willd.), boneset (*Eupatorium perfoliatum* L.), and goldenrod (*Solidago* sp.). A small amount of sphagnum (*Sphagnum* sp.) was present.

Woody species included smooth alder (*Alnus serrulata* Ait. Willd), which formed a mature stand consisting of about 20 large individuals standing 30 feet apart at the upper end of the project site. Sweet gum (*Liquidambar styraciflua* L.) formed a small stand of perhaps 50 individuals up to 4 inches diameter at breast height (DBH) on the north side of the site at the confluence of a forested ravine. Eleven mature red maples (*Acer rubrum* L.) up to 11 inches DBH were mapped at the uppermost end of the flood plain and also formed a small stand of trees up to 4 inches DBH at the lower end of the project site. The site was generally wetter near the upper end and drier near the downstream end in the vicinity of the remaining portion of the earthen dam.

Uplands—The watershed contains a low density residential community on the south side and a 100 year old forest under a conservation easement on the north side. The drainage area consists primarily of steep slopes that grade up to 120 feet in elevation. About 80 percent of the uplands are currently forested with a mixed hardwood canopy, including oak (*Quercus* sp.) and American beech (*Fagus grandifolia* Ehrh.), with a minor Virginia pine (*Pinus virginiana*) softwood component and a mountain laurel (*Kalmia latifolia* L.) understory.

Planning and Permits

The project was designed to simulate the geology and hydrology found in the remaining native AWC sites. A fill operation was designed and permitted, resulting in the establishment of a seepage wetland that supports a viable population of AWC.

Flow rates for various storm events at Howard's Branch were determined using calculations derived from the Soil Conservation Service "Urban Hydrology for Small Watersheds" Technical Release (TR) 55 (U.S. Department of Agriculture 1986). The Anne Arundel County soil survey maps (Kirby and Matthews 1973) were also consulted to develop the calculations. Current land use results in a runoff curve number (RCN) of 70, while the ultimate development based on existing zoning results in a RCN of 77. The time of concentration—the time for rainwater runoff to travel from the hydraulically most distant point of the watershed to a point of interest within the watershed—for both existing conditions and ultimate build-out based on current zoning was calculated to equal 1.15 hours. A conservative approach from the Seelye (1960) design manual and Harr (1990) was used to determine the capability for the capillary potential of sand to wick water toward the surface. This information was used to design the project features.

Plans were designed to physically alter the lakebed and incised stream channel in relationship to existing hydrologic

characteristics. The project was designed to capture and redirect base flows to maximize irrigation of the berms while redirecting and reducing the energy associated with large storm flows allowing excess water to pass harmlessly through the site. The plans were submitted to the regulatory authorities, and the U.S. Army Corps of Engineers and Maryland Department of the Environment issued permits for temporary impacts to 125,389 square feet (2.88 acres) of existing nontidal wetlands and 737 linear feet of stream channel.

Construction

A series of seven cobble weirs were constructed across the main stream channel about 100 feet apart in 1 foot lifts as grade controls. Each weir flooded the soils above it, including the incised eroding stream channel, resulting in water retention, creation of sheet flow, and reduction in velocities of storm water passing through the project site. The weir structures were reinforced with the placement of sandstone boulders at the toe of each weir. The subsequent colonization of the weirs by vegetation was intended to further improve their stability.

A network of berms, comprised of sand, gravel, and wood chips about 3 feet thick and 40 feet wide, was combined with the cobble weirs to form a new surface topography that would control surface and subsurface hydrology (fig. 2). Hydrology for the sand berms was provided by lateral seepage of water from the moats and capillary action, resulting in increased and stabilized soil moisture levels. The berms were designed to serve as temporary haul roads by placing a single 12 foot wide strip of poly-woven geotextile in the design locations of the future berms.

The sand berms were placed about ten feet from the toes of the adjacent steep slopes flanking the northern and southern sides of the project site. The resulting depressions between the tops of the berms and the adjacent side slopes serve to capture surface water and ground water seepage from the side slopes, which formed long pools (moats) that surrounded most of the site (fig. 3). The water surface elevation in the moats was designed to be up to 3 feet higher than the water surface elevation in the channel. Water captured in the moats would then move laterally and irrigate the sand berms. As water slowly filters through the sand berms to lower elevations, sandy seepage slopes are created similar to those found in other AWC sites. The sand berms were placed to meet the edge of water impoundments created by the weirs in the stream channel.

Six thousand tons of white, bank-run silica sand and gravel were used to form the berms and 1,000 tons of sandstone (ferracrete) boulders were used as grade controls for the weirs and the lower stream channel. One hundred cubic yards of Virginia pine and red maple wood chips were trucked into the site. One hundred four cubic foot bales of Canadian peat were placed on the site and exposed to rain a month before planting of the trees. One thousand tons of processed white silica sand (white play sand) was placed on the surface of the berms to preclude the establishment of red maple and sweet gum, undesirable plant species that require nutrients not available in pure sand.

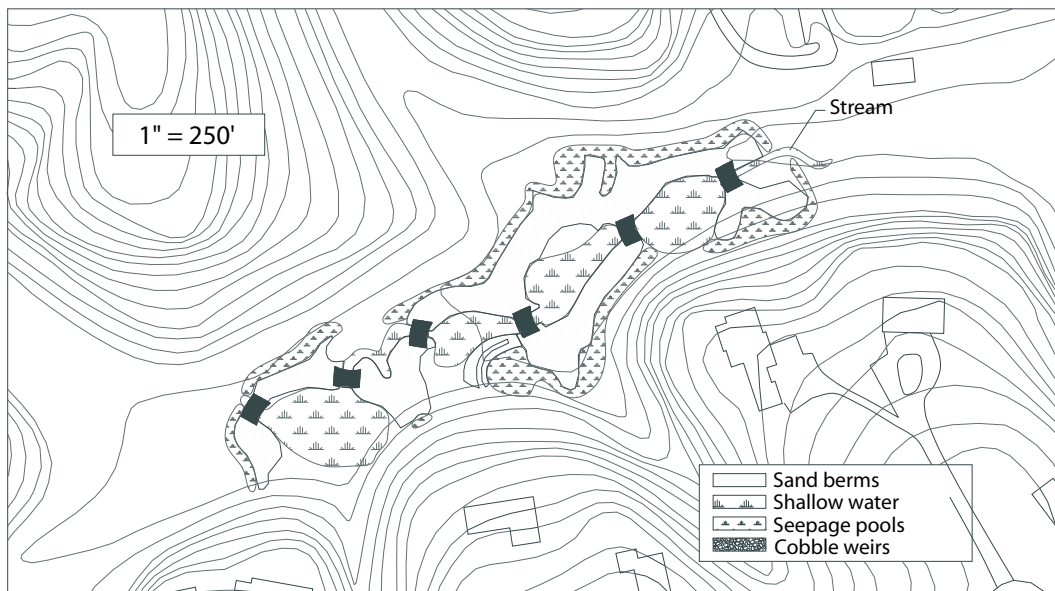


Figure 2—Howard's Branch as-built drawing.

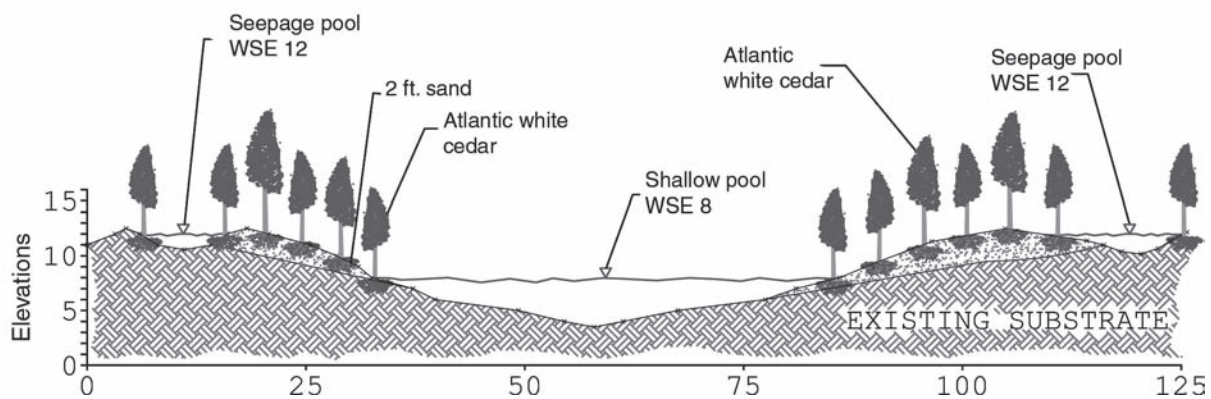


Figure 3—Howard's Branch typical cross section drawing.

The last 50 feet of the lower end of the stream channel needed to match up with the level of the undisturbed channel on the adjacent downstream property. The stream was incised 5 feet below the adjacent flood plain with eroding vertical banks. The channel was filled with bank-run gravel. Geo-textile was then placed over the gravel, and native sandstone boulders weighing up to 2 tons were used to line the channel to create a stable configuration for the new, steeper gradient.

Construction access into the project site was achieved by shaping a wedge of bank-run gravel to form a ramp into the project site over a storm drain pipe system. The drain pipe and three drop structures were filled with gravel, which would treat storm water from a 10 acre drainage area that had previously discharged as untreated storm water into the site. This technique allowed some storm water to filter into the site as ground water. Upon departure from the site, the access ramp was reshaped to form a pedestrian pathway.

Vegetation

Two schoolyard wetlands were constructed specifically to propagate indigenous AWC stock for this project. Seed and cuttings were collected from all ten of the remaining wild populations west of the Chesapeake Bay. The seed and cuttings were used to propagate trees in the schoolyard wetlands and the Anne Arundel County greenhouse. Meadowview Biological Research Station in Woodford, VA also generated seedlings from the Arlington Echo native population as part of another study. The schoolyard wetlands were then used as grow out areas for the potted cedars.

Following construction in April, 2001, one thousand Anne Arundel County-native AWC were planted as containerized saplings up to 48 inches in height on the sand berms by volunteers including school children, community members, politicians, and representatives of universities, research organizations, regulatory agencies and civic associations. Some plant species associated with AWC were subsequently introduced to the site from local native sources.

In a variation on techniques used by Haas and Kuser (1999) that resulted in the best growth of AWC in a sterile sand site with appropriate hydrology, we used peat, wood chips and Osmocote® as soil amendments during planting. Subsequently, the cedars were fertilized with half strength Miracid® three times in 2001 and twice in 2002. One handful of Holly tone® was also applied to the base of each tree in August of 2002.

Regeneration of AWC is hindered by browsing of white-tailed deer (*Odocoileus virginiana*) and other herbivores, a problem that is widely recognized throughout the range of AWC (Hinesley and others 2003, Kuser and Zimmermann 1995, Laderman 1989, Little and Somes 1965). Herbivore exclusion cages were constructed of 12 gauge, 4-inch grid, galvanized wire fencing, secured into the ground with a single piece of 6 foot long No. 6 rebar woven through the fencing and driven 2 feet deep into the soil, resulting in a 48 inch high cage. Cages were placed around approximately 80 percent (800) of the planted AWC saplings.

Groundwater monitoring wells were installed at various locations across the project site prior to construction. Twelve 36-inch lengths of PVC pipe were installed to depths of about 24 inches. Photographic documentation of the project features and some of the organisms as well as groundwater to surface depth data was collected once every 2 weeks during the growing season prior to construction and each year following construction of the project.

Grab samples of water leaving the site were collected once each year and sent to Phase Separation Sciences laboratory in Baltimore, MD for analysis of pH, dissolved oxygen, nitrogen, nitrate, ammonia, phosphorus and turbidity concentrations. A field run topographic survey of the entire project site was also conducted each year. Soil profiles from borings near the groundwater monitoring wells were described using the Munsell soils charts.

RESULTS

General Description

We converted an eroding wetland dominated by non-native and invasive plant species to a stable seepage wetland complex supporting a number of threatened plant species. Construction of the project resulted in temporary impacts to 89,810 square feet (2.06 acres) of regulated, existing nontidal wetlands and 737 linear feet of stream channel. Wetland enhancement was achieved on 47,266 square feet of emergent wetlands in shallow flooded areas and 42,264 square feet of forested wetlands on the sand berms. An additional 280 square feet of stream channel was stabilized at the outfall. The area that was left undisturbed was 35,079 square feet.

Topography

The new topography formed by capping the flood plain with sand berms and cobble weirs remains stable in its designed position. Erosion of the stream banks was prevented, as was the subsequent loading of sediments into the downstream tidal water ecosystem of the Chesapeake Bay.

Hydrology and Hydrogeology

The constructed berms and weirs slow and retain base flow surface waters while allowing a non-erosive course for surface waters generated by storm events. Vegetation growing on the weirs has restricted the channel width over the weirs and created water depths of approximately 6 inches, which is adequate for passage of local fish species. Surface water flows are directed into a broad, flat, and gentle meandering pattern. Water captured in the moats and retention of water above the weirs serves both to raise and to stabilize the groundwater table and irrigate the berms.

Groundwater has been maintained within 12 inches of the surface of the sand berms at all monitoring well locations for 3 years with the exception of two wells in 2002 following a 3-year drought. The irrigation moats (seepage pools) flanking the berms remained full with the exception of the highest pool, which was dry for a week in 2002 during a drought. The sand berms are wet to the surface through capillarity and the lateral seepage of water from the irrigation moats through the sand. Most of the former lake bottom is now perennially submerged under 1 to 18 inches of water.

The base flow of the stream is now slowed and distributed to maximize the irrigation of the sand berms, while energies associated with storm flows are adequately dissipated by the project features to allow the water to pass harmlessly through the site. The project will also reduce the peak flows associated with storm events and will slowly release the storm water as base flow to the stream.

Vegetation

One hundred seventy-seven vascular plant species were identified in the site by William S. Sipple in 2003 (appendix 1). Using Reed (1988) to determine the wetland indicator status, 34 percent of the identified species are obligate wetland plants and 72 percent are facultative or wetter. AWC is now the dominant tree on the project site. The average DBH was 1 inch in 2003, and the canopy diameter averaged 34.6 inches. The planted cedars have grown from an average of 2 feet in height to a range of between 6 and 12 feet tall. More than 50 percent of the trees produced seed in 2003. Thousands of AWC seedlings resulting from natural recruitment range up to 16 inches in height. *Utricularia sp.* and American bur-reed (*Sparganium americanum* Nutt.) are dominant in the flooded areas. The herbaceous layer is dominated by yellow-eyed grass (*Xyris torta* Sm.) and the groundcover is dominated by American cranberry (*Vaccinium macrocarpon* Ait.) and *Sphagnum sp.* Algal mats are present on the surface of the wet sand.

Soil Characteristics

Soil characteristics have varied only slightly since the completion of the project although some wetness characteristics and redoximorphic features are evident in the created sand berms. Hydric soils require long periods of time for the development of wetness characteristics (Environmental Laboratory 1987).

Water Quality

Grab samples were collected just below the project site each year and sent for lab analysis. The pH of the water collected just below the project site has decreased from 6.54 in 2001

to 5.60 in 2003. This may in part be due to the release of organic acids provided by decomposing vegetation. Pre- and post-construction nitrogen levels were not detectable at a concentration greater than or equal to the practical quantitative limit. The post construction level of phosphorus was 0.10 ppm.

Fauna

Deer browse has not yet been a problem, and only a few trees have been damaged each year by deer scraping. In addition, over the 3 year period since construction, approximately 10 trees have been damaged or destroyed by beaver (*Castor canadensis*). Bullfrogs (*Rana catesbiana*), pickerel frogs (*Rana palustris*), green frogs (*Rana clamitans*), wood frogs (*Rana sylvatica*), American toads (*Bufo americanus*), spring peepers (*Pseudacris crucifer*), gray treefrogs (*Hyla sp.*) and spotted salamanders (*Ambystoma maculatum*) use the site for reproduction. Bluegills (*Lepomis macrochirus*) and pumpkinseeds (*Lepomis gibbosus*) have invaded the main channel from downstream, but have not made it into the moats.

DISCUSSION

We have observed considerable losses of dozens of peatland species in the Atlantic Coastal Plain. These peatland ecosystems need active management, preservation and restoration. Damaged ecosystems, e.g., Howard's Branch, provide sites that "could be restored in such a way as to enhance the chances of survival for one or more rare, endangered, or threatened species" (Cairns 1986). Given the recent scientific documentation of the immense benefits provided by peatland ecosystems to tidal estuaries (Hinesley and Wicker 1999), restoration or establishment of new peatlands in created environments to make up for historic losses takes on a fresh urgency.

Peatlands, including AWC swamps, become degraded when development and/or agriculture occurs within their drainage areas (Ehrenfeld and Schneider 1990, Laidig and Zampella 1999). Without immediate efforts to appropriate habitat, manage storm water, and restore populations of peatland species, they will continue to disappear along with significant genetic variation within a number of species throughout their range. For instance, Benedict (in press) predicts the extinction of the fourth largest remaining AWC stand on the WCPMD in 2015.

The resultant substrate for AWC at this site was most similar to the "extremely barren sand locations" at the lakeside site of Haas and Kuser (1999). It differed from other projects that attempted to restore AWC on former and/or degraded peatlands (Hinesley and Wicker 1999, Smith 1999). It is anticipated that the coarse growing medium, coupled with the creation of suitable habitat with relation to shade tolerance (Belcher and others 2003), planting survival (Brown and Atkinson 1999, McCoy and others 2003), natural regeneration (Eagle 1999, Zimmermann and others 1999) and competition with hardwoods (Eagle 1999) will produce the correct habitat for colonization by early successional species such as AWC. Accordingly, a peatland should develop as the AWC stand and its associated species produce organic material more rapidly than it decomposes. The novel approach of

creating seepage wetlands at Howard's Branch could be used in other geographic areas to enhance the sustainability of other rare species dependent on this geomorphic setting.

Aspects of the Howard's Branch project were contested by some individuals within the regulatory community. Key regulators stated that the site in its pre-project condition represented a stable, appropriately vegetated wetland, and further stated that the site represented the premium reference model for wetlands on the WCPMD. However, the authors documented erosion of the banks of the stream channel breaking away in series and falling into the channel at a rate of 1 cubic yard per week throughout the pre-construction monitoring period. The exposed sediments in the former impoundment allowed the colonization of invasive disturbance regime vegetation, mostly Asiatic tearthumb and rice cutgrass. Both are common species in disturbed wetland soils, and the tearthumb is a non-native weed. The few tree species on the site were locally abundant, including red maple and sweet gum. Some of the red maple, sweet gum, and alder died or showed stress from inundation, but alders in general have benefited from the project and increased in number and area covered. The subsequent erosion and deposition downstream also dictated occupation by the invasive species common reed at the tidal interface and Eurasian water-milfoil in the adjacent shallow tidal water. Downstream reaches are more stable now, and the AWC complex, which includes other rare plants, is a higher quality wetland than the system that was in the site.

There was also a dispute as to whether the depth of sand placed to form the berms, and the amount of capillary movement of water through the sand, would result in wetlands or uplands. The depth to groundwater is an important aspect of creating appropriate habitat for AWC (Atkinson 2001, Harrison and others 2003, Mylecraine and others 2003). A conservative approach from the Seelye (1960) design manual and Harr (1990) was used to determine the capability for the capillary potential of sand to wick water toward the surface. However, the primary hydrology source for the berms was not only groundwater rising from below, but also water moving laterally and downward from the higher elevation moats. Constant seepage through the sand berms creates similar irrigation to highly organic sites mentioned by Atkinson (2001), where the organic content modulated water table fluctuations. The sand berms on the Howard's Branch site are wet enough to support algae growth on the surface and recruitment of obligate wetland plants is occurring. We not only believe that the sand berms will meet the definition of wetlands (Environmental Laboratory 1987), but that they will function as high quality wetlands for the long term.

Finally, fisheries biologists opposed the issuance of the permits, despite the fact that electro-shocking showed that there were no fish in Howard's Branch before the project was undertaken. They argued that the weirs would produce fish blockages and, therefore, the project would not benefit any fisheries resource. However, rains shortly after the project was completed raised the water level in the stream, and sunfish moved through the weirs and invaded the site. The fish have not invaded the moats, where they could reduce amphibian populations.

Although AWC wetlands are a globally threatened ecosystem with < 2 percent of its historic acreage remaining and not a single intact AWC ecosystem remains in the State, it is listed by the Maryland Department of Natural Resources' Heritage Program as an S-3 (State watch list) species and given no protection. State ranking is determined by the number of occurrences of any given species within the State. Historical evidence of former abundance exists, including excavated stumps and logs, local lore, site names and numerous personal communications, that indicates that the AWC forest dominated a large part of the landscape of the Cypress Creek watershed 100 years ago. Dissection of that population occurred with the construction of a highway. The ensuing development adjacent to the highway caused the species to retreat to three small isolated locations. These remnants are now erroneously considered as three occurrences by the Maryland Department of Natural Resources' heritage program. This splitting of sites does not accurately represent the current rarity or the former importance of the AWC ecosystem type.

A significant obstacle to ecological restoration can be the lack of ecological understanding by policymakers. Regulatory arguments against this project reflected limited knowledge of restoration ecology or habitat requirements for these organisms. For example, the reference sites used were highly degraded and represented refugia, not optimal habitat. The pre-restoration analysis in this project served to remind restoration ecologists and regulators of the importance of appropriately evaluating reference systems as models. There is a need to transfer technology such as that which was developed in this project to illustrate the value of restored wetlands and to distinguish between high quality and low quality wetlands.

CONCLUSIONS

The successful establishment of viable, reproducing populations of several rare wetland species at Howard's Branch is an example of what can be accomplished given the will to act now while opportunities still exist. This 3 acre project at Howard's Branch, from concept to construction, was achieved at a cost of less than \$350,000.

This project has demonstrated the feasibility of restoring and enhancing rare ecosystems using damaged sites; e.g., former impoundments, abandoned sand mines, stormwater management facilities and degraded wetlands, to create seepage wetlands in the absence of existing peatlands; of establishing a viable, reproducing population of AWC and associated species (a rare plant community) in a created seepage wetland; of designing criteria for establishment of functional AWC wetlands within the historic range; and of "Uniting Forces For Action" by actively engaging the public and promoting interest, awareness, education and stewardship. Similar projects should be undertaken wherever possible.

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