

# **Ecological Restoration & Protection Status Report 2003 - 2006**



**December 31, 2006**

**Delaware Department of Natural Resources  
and Environmental Control**

# Ecological Restoration and Protection

## Executive Summary

Ecological restoration is a very important mission for the Department of Natural Resources and Environmental Control. To strengthen the Department's abilities to implement environmentally beneficial on-the-ground projects, Secretary John A. Hughes assembled an Ecological Restoration and Protection Team in September, 2003. The goal of the Ecological Restoration and Protection Team is to work together to ensure that the maximum level of environmental results are being derived to establish and improve wildlife habitat, enhance water quality, provide stream-bank protection and reduce erosion. Restoration efforts involve a variety of initiatives including stream restoration, invasive species control, establishment or reestablishment of early successional (native warm season grasses) and secondary successional (trees/shrubs) habitats, wetland restoration, *Phragmites* control, shoreline stabilization and riparian corridor planting. The Team is also involved with monitoring and assessing the effectiveness of these restoration efforts and devising better ways to implement various restoration techniques.

These restoration efforts are accomplished through team work. This requires the sharing of resources (e.g. staff, equipment, funds) between a large number of agencies and organizations. The Team is comprised of individuals representing all the Divisions within the Department along with almost 30 agencies outside of the Department including the Conservation Districts, Natural Resources Conservation Service, U.S. Fish and Wildlife Service, Delaware River & Bay Authority, Center for the Inland Bays, Department of Agriculture, and Department of Transportation. Team members possess expertise germane to all of the applicable scientific fields necessary to monitor, evaluate and implement ecological restoration projects.

Since the Team was formed in 2003, over 480 acres of grasses, forests, wetlands, and riparian corridors have been established with projects located within all of the State's four major drainage basins. Additionally, 7,225 feet of streams and shoreline have been restored and more than 36,000 acres of *Phragmites* have been treated. Through the efforts of the Team, the Department will continue to implement projects utilizing new and innovative wetland and stream restoration techniques and concepts. Early and secondary successional habitats and wetland restoration projects are being established in a variety of settings from marginal agricultural fields to school yards to create additional wildlife habitat, improve water quality, increase the efficiency of farming operations, and create "outdoor classrooms" for students to study and appreciate. Stream restoration is being targeted toward existing tax ditches and degraded natural stream systems to provide long-term stability and improve ecological value by reestablishing natural flood plains and sinuous low-flow channels using geomorphological approaches.

Recognizing the need for the Department to have a single point of contact for restoration projects and to lead the Team, Stephen N. Williams serves as the Ecological Restoration Coordinator for the agency. For more information about the Department's Ecological Restoration and Protection initiative, please contact him at 302-739-9921 or [Stephen.Williams@state.de.us](mailto:Stephen.Williams@state.de.us)

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## **I. Introduction**

Ecological restoration efforts by the Department of Natural Resources and Environmental Control began in the early 1990s with the conversion of some marginal agricultural fields into wetlands. Since then, efforts have expanded to include the restoration of tidal and fresh water wetlands, streams, man-made drainage channels (tax ditches), and riparian corridors (the area within and adjacent to a stream). It also includes the establishment or reestablishment of early successional (native warm season grasses) and secondary successional habitats (trees/shrubs), invasive species control and shoreline stabilization.

DNREC Secretary John Hughes established the Ecological Restoration and Protection Team in the fall of 2003 and made it responsible for implementing ecological restoration projects throughout the state. The team brings together expertise and resources from various agencies within and outside the Department. The success of the Team's efforts over the past three years has resulted in the establishment of a permanent Ecological Restoration Branch within the Division of Soil and Water Conservation.

This report highlights the progress and accomplishments that the team has made over the past two years.

## **II. Ecological Restoration Team Partners**

The Ecological Restoration Team is supported by restoration scientists, engineers, environmental managers and environmentalists from the following agencies:

U.S. Fish & Wildlife Service	U.S.D.A. Natural Resources Conservation Service
New Castle Conservation District	Kent Conservation District
Sussex Conservation District	Division of Soil & Water Conservation
Division of Water Resources	Division of Fish & Wildlife
Division of Parks & Recreation	Division of Air & Waste Management
The Nature Conservancy	Delaware Nature Society
Ducks Unlimited	University of Delaware Water Resources Agency
Brandywine Valley Association	Red Clay Valley Association
U.S. Geological Survey	Delaware Geological Survey
U.S. Environmental Protection Agency	Department of Agriculture
U.S. Army Corps of Engineers	Department of Transportation
Christina Basin Clean Water Partnership	White Clay Creek Wild and Scenic River Program
National Park Service	New Castle County Department of Land Use
Partnership for the Delaware Estuary	Center for the Inland Bays
American Water Resources Agency (DE)	Corporate Wetland Restoration Partnership (DE)
Delaware Riverkeeper Network	Delaware River & Bay Authority

### III. Funding

This section describes the various funding sources that the Ecological Restoration Team utilizes to implement the various types of restoration projects throughout the state.

➤ **EPA National Wetlands Program Grant Ranked No. 1 in the Nation**

In the fall of 2005 the Department of Natural Resources and Environmental Control received \$779,982 in funding over a three-year period from the U.S. Environmental Protection Agency. The funding will be used for protecting and restoring wetlands under the fiscal 2005 Environmental Outcome Wetland Demonstration Pilot. Delaware's proposal ranked first among the proposals submitted by states and tribes in a national competition.

The grant links program activities to measurable environmental outcomes, particularly no net loss, net gain, and protection of vulnerable wetlands. The Department's Ecological Restoration Team will implement the grant in a cooperative effort by expanding efforts in three areas: restoration, monitoring and assessment, and education.

Under the grant, degraded wetlands and streams in Delaware will be strategically identified and restored, and restoration plans will be developed to identify and address environmental impacts for entire watersheds and the state's green infrastructure. These restoration plans will be based upon the results of monitoring and assessment efforts used to determine the health of the state's remaining wetlands, type of impacts affecting them and actions needed to correct the problems. All the work will be non-regulatory and coordinated with landowners to protect and restore wetlands on both private and public lands. The grant will also support the expansion of wetland education and outreach programs.

➤ **Christina Watershed Group Receives \$1 million EPA Grant**

As part of President Bush's Watershed Initiative, the U.S. Environmental Protection Agency conducted a national competition of the nation's most deserving watersheds to receive funding through Watershed Initiative grants. The Christina group was one of 20 community-based groups receiving federal funding under the first national watershed initiative. Grant recipients were selected from 176 nominations nationwide that were reviewed by regional and national experts. The candidates were chosen because they best demonstrated the ability to achieve on-the-ground environmental results in a short time. Each of the watershed organizations exhibited strong partnerships, showed innovation, and demonstrated compatibility with existing governmental programs. Grant totals ranged from \$300,000 to \$1 million.

On November 7, 2003, the EPA presented a \$1 million dollar grant to the Christina Basin partnership, a bi-state group comprised of environmental organizations, federal, state and local governmental agencies. Over a three-year period the Christina Basin watershed group will be using the funds to further restore and protect streams in northern New Castle County by implementing agricultural and stormwater best management practices. Approximately 35 percent of the funds will be directly overseen by DNREC and will be used for stream restoration projects in which severely degraded stream channels will be restored and stabilized using geomorphological techniques.

➤ **Additional Funding Sources**

Financial resources have also been secured from the following agencies/programs to support ecological restoration efforts:

- EPA Non-point Source 319 Program
- DNREC Ecological Restoration Fund (General Fund)
- U.S. Fish & Wildlife Service Landowner Incentive Program
- U.S. Fish & Wildlife Service Wildlife Conservation Restoration Program
- U.S. Fish & Wildlife Service (Partners Program)
- Phragmites Control Program (State Fish & Wildlife and NRCS)
- State Fish & Wildlife's Wildlife Habitat Enhancement Program
- USDA NRCS Red Clay Creek/White Clay PL 566 Program
- EPA Chesapeake Bay Program
- EPA States Wetland Protection Grant
- DNREC Penalty Fund
- DeIDOT
- Partnership for the Delaware Estuary
- Delaware's Corporate Wetland Restoration Partnership

#### **IV. Restoration Projects**

##### **COMPLETED PROJECTS**

The following section briefly describes restoration projects that have been completed over the past three years by members of the Department's Ecological Restoration Team. Restoration activities include stream restoration, wetland restoration, shoreline stabilization, the planting of warm- and cool-season grasses, reforestation, riparian corridor planting, and invasive species control.

➤ **Solberg Stream Channel and Wetland Restoration**

The Carl Solberg stream and wetland restoration project was completed in the winter of 2006 through a cooperative effort between the Department's Ecological Restoration Team and the Kent Conservation District. The project involved 1,700 feet of stream restoration (which was previously a prong of the Marydel Tax Ditch), elevating the ditch bottom, installing three water-control structures (one created to replicate a beaver dam) and creating 2 acres of floodplain wetlands adjacent to the original channel. This is a very unique project in that the entire tax ditch right-of-way has been eliminated and portions of the tax ditch maintenance access-way have been restored to wetlands. It should also be noted that the landowner purchased additional lands along the tax ditch so that the project could be completed. Mr. Solberg has also placed a conservation easement on this restoration site. This project is located in western Kent County and is part of the Chesapeake Bay drainage basin.

➤ **Wright**

In the winter of 2006, a 1.5-acre prior converted wetland habitat was restored on the Wright Property. The Wright property is located in Sussex County within the Chesapeake Bay drainage basin.

➤ **Yoder**

In the winter of 2006, approximately 4.3 acres of prior converted cropland was restored to a forested wetland community. The Yoder property is located in Sussex County within the Chesapeake Bay drainage basin.

➤ **Milford Neck Wetland Restoration**

In the fall of 2006, 10 acres of wetland habitat was restored on poorly-drained marginal farmland throughout the Main tract (Dikerson/Masten/Jester tract) of the Milford Neck Wildlife Area, Kent County, Delaware. The restoration of a 10-acre wetland complex will serve as nesting, brooding, and wintering habitat for waterfowl, shorebirds and other waterbirds. Furthermore, the restoration of emergent wetland habitat and associated buffer will provide habitat for reptiles, amphibians, aquatic invertebrates, and many other species of wildlife. This site is located in the Delaware Bay drainage basin.

➤ **Harmon Wetland**

In the fall 2006 a 3-acre wetland was constructed on the Harmon property located in western Kent County. This site is located in the Chesapeake drainage basin.

➤ **Joseph**

In the summer of 2006, 3 acres of prior converted wetland habitat, 12 acres of secondary successional habitat (trees/shrubs) and 14 acres of early successional habitat were restored/established on the Joseph property to provide habitat for species-at-risk. In addition, 14 acres of the land was allowed to go fallow under the state's Wildlife Habitat Enhancement Program. The Joseph property is located in Sussex County within the Chesapeake Bay drainage basin.

➤ **Luzier**

In the summer of 2006, 4 acres of prior-converted wetlands were restored on the Luzier property. It is hoped that in addition to greater flood control and increased water quality that the Luzier wetland will provide habitat for migratory shorebirds. The site is located in New Castle County, Delaware and is part of the Delaware Bay drainage basin.

➤ **Cains Landing**

In the summer of 2006 a breached dike was repaired at the Cains Landing Wildlife Preserve located in Kent County restoring a 20-acre wetland area.. In addition to greater flood control and increased water quality, the pond will provide habitat for wintering, breeding and nesting waterfowl, shorebirds and other waterbirds. Cains Landing is located within the Delaware Bay drainage basin.

➤ **Hickory Spring Road Stream Restoration Project**

A 350 foot stream restoration project was completed on March 28, 2006 along a tributary to the Red Clay Creek located in the vicinity of Delaware National Country Club. Members of the Department's Ecological Restoration Team gathered the baseline stream data and prepared the design plans. Meadville Land Services, Inc. performed the construction work.

➤ **City of Milford Shoreline Stabilization Project**

During the Spring of 2006, the City of Milford, in a cooperative effort with the Department, installed 175 linear feet of 12-inch diameter coconut fiber biolog and planted a variety of water-

tolerant plant species to stabilize and beautify the south shore of the Mill Pond along the Mispillion River Greenway in the upper reaches of the Mispillion River watershed. The City had identified a shoreline erosion problem in this area after cleaning up accumulated debris there. Plants that were installed in and behind the biolog included Arrow Arum, Button Bush, Winterberry, Blueflag Iris, Cardinal Flower and Softrush.

➤ **Sanford School Riparian Corridor Planting**

To enhance the riparian canopy of a 400-foot stream restoration project that was completed in 2002, students and staff at the Sanford School planted several hundred additional native trees and shrubs on April 8, 2006 along the banks of the stream. This stream is a tributary to Mill Creek and is located in the Christina drainage basin.



To enhance the riparian canopy, the planting of additional native trees and shrubs took place in the spring 2006 at the Sanford School restoration site. This stream is a tributary to Mill Creek and is located in the Christina drainage basin.

➤ **University of Delaware**

Approximately 7.1 acres of native warm season grasses were established in plots in the spring of 2006 at the University of Delaware farm in Newark. Plots were comprised of varying grass mixtures and seeding rates so that rates and mixtures could be evaluated for habitat structure and density over a 5-year period. The restoration will also serve as a demonstration project to increase public awareness among conservation partners, private and public land managers and people who are responsible for implementing conservation actions about the value of early successional habitat. In addition, a 1-acre wildflower meadow was established to demonstrate the importance of meadow habitats for variety of species including those that depend on meadow habitats for nectaring plants. This site is located in the Christina drainage basin.

➤ **Boscher**

In the spring of 2006, 2 acres of native hardwoods were established on the Boscher property creating hedgerow habitat to facilitate species movement and provide cover for species-at-risk. In addition, 14 acres of warm season grasses and wildflowers were established to provide cover, travel corridors and connect larger tracts of contiguous wildlife habitat for a variety of species. Finally, 4 acres of shallow water wetland habitat was restored providing habitat for wintering, breeding and nesting habitat for waterfowl, shorebirds and other waterbirds. This site is located in New Castle County and is part of the Delaware Bay drainage basin.

➤ **Donoghue**

In the spring of 2006, a half-acre of secondary successional habitat (trees) was established on the Donoghue property to enhance an existing riparian forest buffer, providing an important travel corridor connecting larger tracts of contiguous wildlife habitat for a variety of species. This site is located in New Castle County and is part of the Delaware Bay drainage basin.

➤ **Hunt**

In the spring of 2006, 13 acres of native warm season grasses and wildflowers were established to benefit species-at-risk to improve conditions for numerous edge-dependant species including small mammals, wintering hawks and owls and several species of butterflies and moths that depend on nectar sources found interspersed within the grasses. More specifically, it is hoped that these restoration efforts will benefit Northern bobwhites, American kestrels, Eastern meadowlarks and Horned larks, Dusted skippers, Meadow fritillary, Common kingsnake, and Smooth earthsnake. This site is located in Sussex County within the Chesapeake Bay drainage basin.

➤ **Merriken**

In the spring of 2006, 3 acres of early successional habitat (native warm season grasses) were established for species-at-risk. More specifically, it is hoped that this planting will provide habitat for dusted skippers a rare butterfly whose larval stage relies on little and big bluestem (native warm-season grasses) for its survival. The Merriken property is located in Sussex County within the Chesapeake Bay drainage basin.

➤ **Carlisle**

In the spring of 2006, 24 acres of warm season grasses and wildflowers were established on the Carlisle property to improve habitat conditions for species-at-risk. The Carlisle property is located in Sussex County within the Chesapeake Bay drainage basin.

➤ **Jefferson**

In the spring of 2006, 24.5 acres of native hardwoods were established creating forest habitat, soft edges and hedgerows to facilitate species movement and provide cover for species-at-risk. In addition, the landowner has started to establish over 53 acres of native warm season grasses and wildflowers to provide nesting habitat for grassland birds. The Jefferson property is located in Sussex County within the Delaware Bay drainage basin.

➤ **Pike Creek at Three Little Bakers Stream Restoration Project**

The Delaware Department of Natural Resources and Environmental Control (DNREC) completed a 5,000 foot stream restoration project in the fall of 2005 along Pike Creek in northern New Castle County. The stream channel and adjacent banks were restored using a host of restoration techniques (e.g., rock toe and log toe protection, cross vanes, log vanes, root wads, riffle and pool sequences, and random bolder placement). This method of stream restoration measures the watershed inputs and valley type (e.g., size of drainage area, topographic relief, overland runoff) and provides a means to change the stream's pattern, profile and dimension to accommodate for the effects caused from urbanization and restore stability, sediment transport and biological functions. The restoration project also included the creation of 3 acres of wetlands and the planting of streamside vegetation that will further protect the banks, improve

and maintain water quality and provide wildlife habitat. Approximately 5-acres of the riparian corridor were enhanced with the planting of native trees and shrubs.

The Three Little Bakers site along Pike Creek was an excellent candidate for stream restoration because of its unique environmental and other related features:

- ❑ part of the White Clay Creek watershed - a designated National Wild & Scenic River System;
- ❑ serves as a source for public drinking water;
- ❑ one of only six trout put-and-take stocked streams in the State;
- ❑ provides a habitat corridor in an area of dense development;
- ❑ potential migration corridor for the endangered bog turtle; and
- ❑ a single landowner that was very interested and willing to participate in a restoration project.

The goals that were accomplished by implementing this project include:

- ❑ stabilization of the stream banks to reduce erosion;
- ❑ creation of habitat – putting in sequences of riffles and pools in the stream channel and planting the banks with a large number of trees and shrubs;
- ❑ improvements to water quality;
- ❑ reduction in the number of out-of-bank flooding events; and
- ❑ maintaining the natural look of the stream as nature would dictate.

A series of meander bends were introduced to the existing stream channel which will help reduce the flow velocity and return the stream to a more natural state. Several stream-side wetlands were also constructed. Construction work started in early March, 2005; work (construction and riparian corridor planting) was completed by mid-October. Partners in this project responsible for providing funding and other resources included: Three Little Bakers, Christina Basin Clean Water Partnership, EPA, DelDOT, USDA Natural Resources Conservation Service, New Castle Conservation District, the Partnership for the Delaware Estuary, and DNREC.

This project is serving as an excellent “outdoor classroom” as numerous site tours have been conducted with students, garden clubs, members of the general public, and a wide array of environmental professionals from the tri-state region. The project was also a topic in a series of environmental short-courses offered by the Delaware Nature Society on April 25, 2006. The site was also featured at the Red Clay Valley Association’s annual meeting on April 27, 2006 where site tours were offered throughout the evening.

The Department is pleased to announce that in October 2006 Mr. John VanStan, leader, and his 4-H group sponsored by the University of Delaware’s Cooperative Extension, adopted the wetland site at Three Little Bakers through the Department’s Adopt-A-Wetland Program. Mr. VanStan also agreed to have his group monitor the stream through the Stream Watch Program overseen by the Delaware Nature Society. Pre- and post-biological monitoring is a component of this project; biologists from DNREC and a private environmental consulting firm performed post-restoration studies of macro-invertebrates and fish populations in October 2006.

The following photos are from the Three Little Bakers site:



Pre-restoration: a lack of streamside vegetation results in undercutting of banks and severe erosion.



Before construction rip-rap was used in some areas to hold the stream banks in place (photo on left). The same area has been restored using logs, tree stumps, boulders, and live-branch willow layering to stabilize the banks and create habitat for fish and macro-invertebrate species.



Stream banks have been stabilized and the sharp bends in the stream channel have been removed (photo on right). The pre-construction photo (left) shows a highly-eroded area with no main channel and banks that have been severely eroded and undercut.



The Three Little Bakers restoration project serves as an excellent outdoor classroom for students and environmental professionals.

➤ **Christ the Teacher Catholic School Wetland**

The Delaware Department of Natural Resources and Environmental Control, in a cooperative effort with the Kent and Sussex Conservation Districts and the Diocese of Wilmington, completed the construction of a 1.5-acre wetland complex at Christ the Teacher Catholic School in the fall 2005. Christ the Teacher is an elementary school located at the intersection of Frazer Road and Route 40 in New Castle County, situated in the Perch Creek watershed that drains to the Chesapeake Bay. The school, which opened in 2002, supports grades K through 8. When the school was built, a stormwater management basin was constructed in the southwest corner of the property for sediment and stormwater controls for the entire site. Adjacent to and east of this basin was an unutilized upland field covered with lawn grasses that was immediately adjacent to a 46-acre wooded wetland owned by the Diocese of Wilmington. The wetland project involved the conversion of this open field into a wetland complex.

Restoration efforts like this create wildlife habitat, increase biodiversity and improve water quality, all vital components of a Livable Delaware. This project also creates the perfect “outdoor classroom” for the school to teach the fundamental principles of ecology and the importance of environmental stewardship.

On October 18, 2005, over 240 enthusiastic students and teachers from Christ the Teacher Catholic School located near Glasgow participated in a wetland “planting party” sponsored by the Department’s Ecological Restoration Team. A total of eight 30-student teams made up of first through eighth graders planted hundreds of native trees, shrubs and wetland grasses throughout the school’s newly constructed 1.5-acre wetland complex created by the Ecological Restoration Team in late August through mid-September. One of the unique features is that this wetland was designed to improve water quality by directing the surface water runoff from the parking lots, building, roadways and athletic fields on the school campus through the wetlands before entering the previously existing stormwater basin, ultimately finding its way to the Chesapeake Bay. This is the first project of its kind in Delaware where a wetland has been incorporated into an existing stormwater basin.

This project became possible because of some excellent teamwork demonstrated by a number of individuals and organization. The partners that made this project possible include: U.S. Environmental Protection Agency’s Chesapeake Bay Program (funding source for this effort);

Delaware's Corporate Wetland Restoration Partnership (providing signage for the plants); New Castle County, Sussex Conservation District, Kent Conservation District; Department of Natural Resources and Environmental Control; Christ the Teacher Catholic School and the Catholic Diocese of Wilmington.



Unutilized area adjacent to athletic fields has been converted into a wetland which will be used as an “outdoor classroom” by students and faculty at Christ the Teacher Catholic School. All of the surface water runoff from the fields is filtered through the wetland before making its way to the Chesapeake Bay.



Field adjacent to existing stormwater basin and 46-acre wooded wetland was restored to a wetland. Water from the school's parking lots, building and fields is directed through the wetland before discharging into the stormwater basin.

Over 240 students from Christ the Teacher School participated in the planting of *their* wetland in an event sponsored by DNREC's Ecological Restoration Team on October 18, 2005. The school has already enrolled in the Department's Adopt-a-Wetland Program.



➤ **Jerry Lynch Wetland**

In the fall of 2005, two acres of prior converted wetland habitat were restored on the Lynch property. The site is located in Sussex County in the Chesapeake drainage basin.

➤ **Bog Turtle Restoration Project 1**

In the fall of 2005, two acres of marginal wetland habitat were enhanced through invasive species control and management of woody vegetation to improve conditions for the federally listed endangered bog turtle. The site is located in New Castle County in the Christina (Northern Piedmont) drainage basin.

➤ **Wheaton Project**

In the fall of 2005, two acres of forest habitat were enhanced through invasive species control to benefit a plant species (rough horsetail, *Equisetum hymale*) that is currently at risk in the state. The site is located in Sussex County in the Chesapeake drainage basin.

➤ **Bog Turtle Restoration Project 2**

In the fall of 2005 approximately .37 acres of phragmites were controlled by mechanical and chemical means to improve wetland conditions for species-at-risk including the Mulberry wing, Bog-turtle and Carpenter frog. The site is located in New Castle County in the Christina (Northern Piedmont) drainage basin.

➤ **Bog Turtle Restoration Project 3**

In the fall of 2005 approximately .4 acres of phragmites were controlled by mechanical and chemical means to improve wetland conditions for species-at-risk including the Mulberry wing, Bog-turtle and Carpenter frog. The site is located in New Castle County in the Christina (Northern Piedmont) drainage basin.

➤ **Hengst Farm Wetland**

A 5-acre wetland complex was constructed on marginal agriculture lands in the summer 2005 at the Hengst farm. The farm, located in northwest Kent County, is part of the Chesapeake drainage basin.

➤ **Addix Farm Wetland**

The Ecological Restoration Team constructed a 5-acre wetland complex on the Addix farm located in northwest Kent County. The project, completed in the summer 2005, ties the outlet pipe from the wetland into a clay-tile drainage system that has existed on the farm for more than 75 years. An additional component of this project involved the installation of a water control structure in a drainage ditch on the farm with wetlands constructed on each side of the channel. This site is located in the Chesapeake drainage basin.

➤ **Mill Creek Riparian Corridor Enhancement at Delaware Park**

Riparian corridor enhancement and invasive species control (Japanese Hops) took place in the summer 2005 along a reach of Mill Creek at Delaware Park, the site of the Department's first stream restoration project completed in the spring 2001. Approximately 3-acres of the riparian corridor were enhanced with the eradication of invasive species and the planting of additional native species to maintain the habitat quality of the corridor. This site is located along Mill Creek and is part of the Christina basin.

➤ **Whipkey**

In the summer of 2005, four acres of land was allowed to go fallow to improve conditions for numerous edge dependant species including small mammals, wintering hawks and owls and several species of butterflies and moths that depend on nectar sources found interspersed within the grasses. The site is located in Kent County and is part of the Delaware Bay drainage basin.

➤ **Fish and Wildlife's Fire Tower Tract Wetland**

In the summer 2005 a 4-acre wetland was constructed on this Division of Fish & Wildlife property located in western Kent County. The wetland is located in a retired agricultural field, all part of the Chesapeake drainage basin.

➤ **Lake Forest High School**

In the summer of 2005 approximately 12.7 acres were restored to early successional (warm season grasses), riparian and wetland habitat at Lake Forest High School. The school is located in Kent County and is part of the Delaware Bay drainage basin.

➤ **Lulu Ross Elementary School**

In the summer of 2005 approximately 3 acres of early successional habitat were established at Lulu Ross Elementary School. The site is located in Sussex County and is part of the Delaware Bay drainage system.

➤ **Milford High School**

In the summer of 2005 approximately 10.6 acres of early successional habitat were established and 0.5 acres of wetland habitat restored at Milford High School. The site is located in the Delaware Bay drainage basin.

➤ **Steve Conner Farm Wetland**

In the spring 2005 a 1.5-acre wetland complex consisting of three separate cells in very close proximity to one another was constructed on the Conner farm. The farm is located in western Kent County and is part of the Chesapeake drainage network.

➤ **Taber State Forest Wetland**

A 4-acre wetland was constructed in a cooperative effort with the Department of Agriculture's Division of Forestry at the Taber State Forest located in southwest Sussex County in the spring 2005. The project involved the restoration of a wetland in an agriculture field. Runoff from the agriculture field is being directed through the wetland before it outlets into the adjacent tax ditch channel. This project is located in the Chesapeake drainage basin.

➤ **Purple Loosestrife Control (Lythrum salicaria)**

In the spring of 2005, two species of Galerucella (9,000 insects) were released on state-owned wildlife management areas in New Castle County as a form of biological control for Lythrum salicaria L.(purple loosestrife). Release locations were in the Delaware Bay drainage basin.

➤ **Pike Property**

From the spring of 2005 to present approximately 3.3 acres of marginal forest habitat has been enhanced by controlling invasive species by both mechanical and physical means. In addition, over 200 trees and shrubs have been planted to reestablish the understory of this forest habitat. Restoration efforts were completed in eastern Sussex County in the Delaware Bay drainage basin.

➤ **Fish and Wildlife's Willow Grove Tract Wetland**

This 4-acre wetland was constructed in the summer 2004 and is located in western Kent County on property owned by the Division of Fish & Wildlife. The site is part of the Chesapeake drainage basin.

➤ **Battista Wetland**

In the summer 2004 a 3-acre wetland was constructed on the Battista property located in western Kent County. A portion of this project involved converting ½-acre of their lawn into a wetland resulting in a true "backyard habitat." In the spring 2005, students from Polytech High School planted native trees, shrubs and wetland grasses at this site which consists of several interconnected wetland cells. This site is located in the Chesapeake drainage basin.

➤ **Fish and Wildlife's Ommelanden Hunter Education Center Wetland**

In the summer 2004 three interconnected wetland cells were constructed at the Ommelanden Hunter Education Center in New Castle County. The 2-acre wetland complex will be incorporated into the hunting education courses taught by the Division of Fish & Wildlife. The site is located in the Delaware Bay and Estuary drainage basin.



Wetlands at the Ommelanden Hunter Education Center constructed in the summer 2004. On September 19, 2005 this wetland complex was dedicated to Arthur L. Spingarn (deceased) who worked as a wetland scientist with the EPA.

➤ **Branham Corporation Wetlands**

In the summer of 2004 two wetlands were created on the Branham Corporation property located in western Kent County. The wetlands were 0.5 and 1 acre in size. This site is part of the Chesapeake Bay drainage system.

➤ **Delaware Wild Lands Inc. – Cux Farm**

This 4-acre wetland was constructed in the summer 2004 and is located in eastern New Castle County on property owned by Delaware Wild Lands Inc. The site is part of the Delaware Bay drainage basin.

➤ **Delaware Wild Lands Inc. – Liston Farm**

In the summer of 2004 a 4-acre wetland was constructed on property owned by Delaware Wild Lands Inc. located in the eastern part of New Castle County. The site is part of the Delaware Bay drainage basin.

➤ **Hudson Farm Wetland**

In the summer of 2004 a 2-acre wetland was constructed on the Hudson farm located in Sussex County. The site is part of the Delaware Bay drainage basin.

➤ **Fish and Wildlife's Caulk Property Wetland**

A large 5-acre wetland complex was constructed in the spring 2004 on the Caulk property owned by the Division of Fish & Wildlife. The site, located in Kent County, also had an additional 25 – 30 acres of wetland restoration work done in 2004, some resulting from plugging several water outlet pipes. The property is located in the Delaware Bay and Estuary drainage basin.

➤ **Fish and Wildlife's Urban Tract Wetland**

In the spring 2004 an 11-acre wetland complex consisting of multiple cells was constructed on the Urban farm. This site is located in western Kent County and is part of the Chesapeake drainage basin.

➤ **Mike Brown Farm Wetland**

In the spring 2004 a 2-acre wetland was constructed on the Brown farm located in western Kent County. The wetland complex is located in the vicinity of an existing shallow-water pond. This site is part of the Chesapeake drainage system.

➤ **Dave Smith Wetland**

A total of three acres of farm fields have been restored to wetlands with future plans to convert and additional 16 acres that surround the wetlands to hardwood forests and cool-season grasses on Dave Smith's property located in western Sussex County. Sussex Tech High School students assisted with completing the project by planting over 250 wetland trees and shrubs at the site on December 10, 2003. Some of the students also assisted the Sussex Conservation District and the Drainage Section with the installation of a water-control outlet pipe. This site is located in the Nanticoke watershed, part of the Chesapeake drainage basin.



Students assist with installation of outlet pipe.



A proud 98-year old Mr. Smith admires the results of the Sussex Tech students' planting effort.

➤ **Bethany Marina Wetland**



Boy Scouts install the few remaining plugs of *Spartina alterniflora* in disturbed tidal wetland.

On September 27, 2003, a 0.5 acre tidal wetland restoration was done by a Boy Scout Troop from New Castle County as part of an Eagle Scout project utilizing 319 NPS funds. The Eagle Scout candidate qualified for funding by preparing an application and plans for the project and submitting them to a review team comprised of individuals from DNREC and the Sussex Conservation District. The Boy Scouts planted approximately 1,800 plugs of *Spartina alterniflora* along a previously disturbed marsh zone adjacent to White Creek. This site is located in the Inland Bays drainage basin.

**SUMMARY TABLE OF IMPLEMENTED ECOLOGICAL RESTORATION PROJECTS**

Restoration efforts have involved a variety of initiatives including stream restoration, invasive species control, establishment or reestablishment of early successional (native warm season grasses) and secondary successional habitats (trees/shrubs), wetland restoration, *Phragmites* control, shoreline stabilization and riparian corridor planting. These efforts are accomplished through a number of programs. The following table summarizes the ecological restoration projects that have been implemented from September 2003 through December 2006:

<b>Project</b>	<b>Project Type*</b>	<b>Area Restored (acres)**</b>	<b>Year</b>	<b>Drainage Basin</b>
Solberg	W, S	1,700 lf – S 2 - W	2006	Chesapeake Bay
Wright	W	1.5	2006	Chesapeake Bay
Yoder	W	4.3	2006	Chesapeake Bay
Milford Neck	W	10	2006	Del. Bay & Estuary
Harmon Property	W	3	2006	Chesapeake Bay
Joseph	W,G,T	5 – W,14 – G, 12 – T	2006	Chesapeake Bay
Luzier	W	4	2006	Del. Bay & Estuary
Cains Landing	W	20	2006	Del. Bay & Estuary
Hickory Spring Road	S	350 lf	2006	Christina
City of Milford	SL	175 lf	2006	Christina
Sanford School	R	0.4	2006	Christina
University of Delaware	G	7.1	2006	Christina
Boscher	W,G,T	4 – W,14 – G, 2 – T	2006	Del. Bay & Estuary
Donoghue	T	0.5	2006	Del. Bay & Estuary
Hunt	G	13	2006	Chesapeake Bay
Merriken	G	3	2006	Chesapeake Bay
Carlisle	G	24	2006	Chesapeake Bay
Jefferson	G, T	53 – G, 24.5 – T	2006	Del. Bay & Estuary
Reynolds <sup>#</sup>	G	5.4	2006	Del. Bay & Estuary
Hickman <sup>#</sup>	G	5	2006	Del. Bay & Estuary
Pike Creek at Three Little Bakers	S, R, W	5,000 lf – S 5 – R; 3 - W	2005	Christina
Christ the Teacher School	W	1.5	2005	Chesapeake Bay
Jerry Lynch	W	2	2005	Chesapeake Bay
Bog Turtle Project #1	W, I	2	2005	Christina
Wheaton Project	T, I	2	2005	Chesapeake Bay
Bog Turtle Project #2	W, I	0.4	2005	Christina
Bog Turtle Project #3	W, I	0.4	2005	Christina
Hengst Farm	W	5	2005	Chesapeake Bay
Addix Farm	W	5	2005	Chesapeake Bay
Mill Creek - Delaware Park	R	3	2005	Christina

Whipkey	G	4	2005	Del. Bay & Estuary
F & W Fire Tower Tract	W	4	2005	Chesapeake Bay
Lake Forest High School	W, R	12.7	2005	Del. Bay & Estuary
Lulu Ross Elem. School	G	3	2005	Del. Bay & Estuary
Milford High School	W, G	10.6 - G; 0.5 - W	2005	Del. Bay & Estuary
Conner Farm	W	1.5	2005	Chesapeake Bay
Taber State Forest	W	4	2005	Chesapeake Bay
Purple Loosestrife Control	I	F & W Lands	2005	Del. Bay & Estuary
Pike Property	T, I	3.3	2005	Del. Bay & Estuary
Chris Hill <sup>#</sup>	G	4	2005	Del. Bay & Estuary
Jerry K. Rider <sup>#</sup>	G	15	2005	Chesapeake Bay
Josephine M. Hearn <sup>#</sup>	G	5	2005	Chesapeake Bay
Charles P. West II <sup>#</sup>	G	1	2005	Inland Bays
F & W Willow Grove Tract	W	4	2004	Chesapeake Bay
Battista Property	W	3	2004	Chesapeake Bay
F & W Ommelanden Center	W	2	2004	Del. Bay & Estuary
Branham Corporation	W	1.5	2004	Chesapeake Bay
Cux Farm	W	4	2004	Del. Bay & Estuary
Liston Farm	W	4	2004	Del. Bay & Estuary
Hudson Farm	W	2	2004	Del. Bay & Estuary
F & W Caulk Property	W	35	2004	Del. Bay & Estuary
F & W Urban Tract	W	11	2004	Chesapeake Bay
Brown Farm	W	2	2004	Chesapeake Bay
Delaware Nature Society <sup>#</sup>	G	5	2004	Del. Bay & Estuary
Masten Holdings, Inc. <sup>#</sup>	G	10.5	2004	Chesapeake Bay
Allen Rogers <sup>#</sup>	G	4	2004	Inland Bays
KGB Properties <sup>#</sup>	G	7.5	2004	Chesapeake Bay
Richard Clifton <sup>#</sup>	G	5	2004	Del. Bay & Estuary
Harvey O. Thomas Sr. <sup>#</sup>	G	5	2004	Chesapeake Bay
Branham Corporation <sup>#</sup>	G	5	2004	Chesapeake Bay
Dave Smith	W	3	2003	Chesapeake Bay
Bethany Marina	W	0.5	2003	Inland Bays
Norman "Eddie" Davidson <sup>#</sup>	G	5	2003	Inland Bays
Benjamin L. Moore <sup>#</sup>	G	5	2003	Chesapeake Bay
Rodney Smith <sup>#</sup>	G	5	2003	Inland Bays
Dean Stoakley <sup>#</sup>	G	7	2003	Chesapeake Bay
Morris Tatman <sup>#</sup>	G	16.5	2003	Chesapeake Bay
TOTAL AREA RESTORED		7,050 lf – S; 175 lf - SL 482.1 acres – W,T,G,R,I		

\*W – wetland; T – trees; G – grasses; S – stream; R – riparian corridor planting; I – invasive species control; SL - shoreline

\*\* all units are in acres unless linear feet (lf) is noted

# site description not included – early successional stage habitat provided through Wildlife Habitat Enhancement Program

### **PHRAGMITES CONTROL PROGRAM**

The Phragmites Control Program, a joint initiative between DNREC's Division of Fish & Wildlife and U.S.D.A. Natural Resources Conservation Service, has treated record-breaking acres of land over the past several years. Since 2003, the program has been responsible for treating 36,345 acres as highlighted below.

#### **2006**

The Division of Fish & Wildlife coordinated the aerial spraying of a total of 9,700 acres of phragmites on public and private properties in 2006. This represents the second highest total of acres treated by the Division in its history. A total of 5,958 acres of phragmites were treated on private property through the Division's cost-sharing program and 3,742 acres were sprayed on public properties such as wildlife areas, state parks, Northern Delaware Wetland Rehabilitation Project sites, and Delaware Forest Service wildland fire prevention projects.

#### **2005**

A record 6,766 acres of phragmites were treated for 91 landowners requiring the Division to provide \$64,588 in match. An additional 4,302 acres were treated on wildlife areas, NDWRP and other DNREC properties at a cost of \$136,889.

#### **2004**

A total of 5,751 acres were treated on private properties of 90 individuals through the cost-share program with the Division providing \$53,916 in match. The Division coordinated the spraying of 3,628 acres of phragmites on public projects at a cost of \$113,375.

#### **2003**

Through the cost-share program, the initiative is responsible for treating 3,067 acres of phragmites for 63 different landowners. The Division provided \$35,938 in match to these landowners. A total of 3,131 acres were sprayed on state wildlife areas as part of the Northern Delaware Wetland Rehabilitation Project (NDWRP) at a cost of \$123,500.

### **SUMMARY TABLE OF RESTORATION EFFORTS BY CALENDAR YEAR**

The following table depicts the total land area restored for each calendar year from 2003 through December 2006 by the Ecological Restoration Team:

<b>Year</b>	<b>Area Restored*</b>	<b>Phragmites Treated</b>
2006	231.7 acres 2,225 lf - S & SL	9,700 acres
2005	97.9 acres 5,000 lf - S	11,068 acres
2004	110.5 acres	9,397 acres
2003	42 acres	6,198 acres
<b>TOTAL</b>	7,225 lf – S and SL 482.1 acres – W,T,G,R,I	36,345 acres

\* Includes (W) wetland, (T) trees, (G) grasses, (R) riparian corridor planting, (I) invasive species control; SL – shoreline and S – stream in linear feet (lf)

## **UPCOMING PROJECTS**

The following section briefly describes restoration projects that are in the process of being completed, or are in the planning phase and targeted for completion in the near future.

### ➤ **Meadowdale Stream Restoration Site**

A 500-foot stream restoration project will begin in November 2006 along Pike Creek where it flows through the Meadowdale development located on the north side of Paper Mill Road (Route 72) immediately north of Independence School in northern New Castle County. This is a joint restoration project between the New Castle Conservation District and DNREC's Ecological Restoration program.

### ➤ **Pike Creek Stream Restoration at Independence School**

A 3,200 foot stream and wetland restoration project is being planned by members of the Ecological Restoration Team. Biohabitats, an environmental restoration firm, completed the conceptual design plans on March 24, 2006 and submitted 90% detailed design plans on October 20, 2006. The restoration project also includes the creation of stream-side wetlands and plants that will further protect the banks, improve and maintain water quality and provide wildlife habitat. This project is upstream of the recently completed (October 2005) Three Little Bakers stream and wetland project along Upper Pike Creek Road in northern New Castle County. The site is located in the Christina drainage basin and is part of the White Clay Creek Wild & Scenic River System. Post-restoration biological monitoring will be done; biologists from DNREC and a private environmental consulting firm performed pre-restoration studies of macro-invertebrates and fish populations in October 2006.

An on-site field review of this project was completed by the Department's Heritage Program on June 21, 2006. The site was evaluated with respect to rare and endangered species, with particular focus on the endangered bog turtle. While it was determined that the surrounding habitat was not conducive for bog turtles, the stream channel may serve as a potential migratory corridor. Because of this, special permitting requirements will be in place during the construction phase.

On-site inspections were performed by representatives of the State's Historic Preservation Office on June 22<sup>nd</sup> and July 26<sup>th</sup>. They are still in the process of researching and preparing recommendations.

While current plans are to fund this project with EPA funding, negotiations are underway with the Delaware River and Bay Authority (DRBA) and the U.S. Army Corps of Engineers to use approximately 1,750 feet of this project as a mitigation site to offset stream and wetland impacts resulting from the DRBA's runway expansion project at the New Castle County Airport. If this endeavor is successful, EPA funds will be used for 1,450 linear feet of stream restoration which will not be a part of the mitigation project. Working with the DRBA may allow the Ecological Restoration Team to secure a non-traditional source of funds and allow EPA funds to be redirected to additional restoration projects. Construction activities are being planned for the spring 2007.

➤ **University of Delaware Newark Farm Wetland Sites**

Ecological Restoration Team members have evaluated the University of Delaware farm property near Newark and have identified 5 – 7 potential sites to construct wetlands and a low-flow intermittent channel through the farm complex with a series of fringe wetlands. The wetlands will have various functions: serve as buffers between actively farmed fields and mature forests; detain and filter surface water runoff from cattle grazing areas and farmed fields before waters enter the main stormwater basin, all headwater tributaries of Cool Run; serve as “connectors” to existing habitat areas. Plans are also underway for the University to conduct monitoring of the waters to evaluate the effectiveness of the wetlands for filtering nutrients. These sites will also serve as “outdoor classrooms” for students at the University.

This area is being targeted for restoration work for the following reasons:

- ❑ Headwaters of Cool Run, a tributary of the White Clay Creek, which is a congressionally-delegated Wild and Scenic River system;
- ❑ White Clay Creek discharges into the Christina River, which has been targeted for nutrient reductions as part of the Environmental Protection Agency’s total maximum daily load (TMDL) program;
- ❑ Serves as a public drinking water source;
- ❑ Restoration sites will be “outdoor classrooms” for use within College of Agriculture and Natural Resources’ teaching, research, and extension program; and
- ❑ Creation of highly functioning wetlands allows for ground-water recharge, flood control, and reduced sediment and nutrient loads to surface waters.

On March 1, 2006, representatives of the Ecological Restoration Team meet with representatives of the University of Delaware: Dr. Tom Sims and Jenny McDermott (College of Agriculture and Natural Resources), and Scott Hopkins (Farm Manager) and Jon Hummel (Assistant Farm Manager). The meeting involved taking the University representatives on a tour of wetland and stream restoration sites in western Kent County so they could develop a better understanding as to the type of restoration sites that would be put in place on the farm. The farm managers were initially hesitant to take pasture and cropland out of production for the construction of the proposed wetlands and stream channel. The site tour proved to be extremely successful and the University officials agreed to allow the Department to move ahead with what was proposed for the farm.

A site survey was completed in June 2006 and members of the Ecological Restoration Team are currently designing the wetland complexes and low-flow intermittent channel. A project agreement has been drafted and is awaiting signature from the University. Final permitting issues are currently being evaluated by DNREC staff. Construction is being planned for the early spring 2007.

➤ **Ponders Tract**

In the spring of 2006 and 2007, a 30-acre loblolly pine plantation on the Pemberton Forest Preserve, Ponders Tract owned by The Nature Conservancy will be converted to a mixed native hardwood forest community. Efforts include establishing native hardwoods in depressional wetlands, removing small patches of loblolly plantings and replanting these areas with native hardwoods, and invasive species control, specifically phragmites control within the depressional wetlands. The reestablishment of a mixed hardwood forest could potentially provide habitat for over 24 species-at-risk that are currently known or suspected given suitable habitat present on the

Ponders Tract. The site is located in Sussex County and is part of the Delaware Bay drainage basin.

➤ **Brandywine Rod and Gun Club**

In the winter of 2006 and spring of 2007, 13 acres of native warm season grasses and wildflowers will be established at the Brandywine Rod and Gun Club to benefit species-at-risk. In addition, 3 acres of shallow-water wetland habitat will be restored on the property. This site is located in New Castle County and is part the Delaware Bay drainage basin.

➤ **Hindu Temple Wetland**

The Hindu Temple, located in Hockessin, is proposing to expand their existing temple facility. Because this expansion will require them to reconstruct their existing stormwater basin, they would like to incorporate a wetland into the revised stormwater basin design. The wetland would be used as an “outdoor classroom” by the younger members of the congregation and the Charter School of Wilmington (a temple member is the science teacher at the Charter School). Members of the Department’s Ecological Restoration Team have provided several alternatives to the proposed design which would maximize the efficiency of the stormwater basin and proposed wetland taking into account the limited amount of land area that is available. Representatives from the temple are working with their consultants and New Castle Country Department of Land Use to ensure that the revised design plans incorporate the necessary recommendations. This site is located in the Christina drainage basin. Construction is expected to take place in 2007.

➤ **Fairway Falls Stream Restoration Site**

The Department’s Ecological Restoration Team is in the process of evaluating a degraded stream channel along a tributary to Pike Creek through the Fairway Falls development to determine if any type of bio-restoration techniques could be utilized to stabilize the banks and channel. Representatives from the Department’s Ecological Restoration Team participated in a public meeting with the residents of Fairway Falls on February 15<sup>th</sup> an engineer with DNREC explained to the group what needed to be done to control serious erosion problems that are being caused by several failed water control structures which were placed in the drainage channel behind their homes when the area was developed decades ago. The New Castle Conservation District is working with the Department as a partner on this project.

➤ **Ham Run Stream Restoration Site**

Steve Williams and Robert Grabowski, Vice President of the Historic Village of Marshallton Civic Association, met with the Community Involvement Penalty Fund Council on October 17, 2006. The purpose of the meeting was to address any questions that the Council had regarding the funding application that was submitted by Mr. Grabowski on behalf of the Historic Village of Marshallton Civic Association. Williams, the project sponsor, assisted with developing the project details which involves the implementation of a stream restoration project along a 400 – 500 feet reach of Ham Run, a tributary to Red Clay Creek near the intersection of Duncan Road and Greenbank Road. The tributary presents several challenges (e.g., constricted channel, trash and construction debris, numerous outfall pipes, invasive plants, very unsightly) which, if corrected, could improve the overall aesthetics, health and stability of the stream. On October 24, 2006, Secretary Hughes informed the Historic Village of Marshallton Civic Association that the project, based on a favorable recommendation from the Community Environmental Penalty Fund Council, was approved for funding. The next step involves a site survey and then preparation of design plans.

## V. Wetland and Stream Monitoring and Assessment

The Wetland Monitoring and Assessment Program (Division of Water Resources, Watershed Assessment Section) in Delaware is based on assessing the condition of wetlands on the watershed level. A probabilistic sampling design is used to select random sites within mapped wetlands. Landowner permission is gained to access all sites and the condition of the wetland is determined using one of the assessment methods described below. Data from all the points sampled in a watershed (typically 50-100 sites) are compiled to report on the overall condition of the watershed and determine the dominant stressors that are lowering condition. To date the program has completed the assessment of non-tidal wetlands in the Nanticoke watershed and have completed data collection in the Inland Bays watershed. The Appoquinimink, St. Jones, and Murderkill will be sampled in 2007.

The Wetland Monitoring and Assessment Program has developed two levels of assessment methods to assess wetland condition. These levels include the Delaware Comprehensive Assessment Protocol (DECAP) and the Delaware Rapid Field Assessment Protocol (DERAP).

Delaware Comprehensive Assessment Protocol (DECAP) – The DECAP is a detailed assessment of the condition of a wetland based on the hydrology, vegetation, soils, and surrounding land use of the site. This method typically takes a field crew of 4 about 4 hours to complete a field assessment. The field data are then used to score hydrogeomorphic models that calculate functional scores and an index of wetland condition. The HGM models are all based on reference wetlands from Delaware and the Eastern Shore of Maryland. Scores from these models rate the performance of a wetland compared to least altered or minimally disturbed sites, (i.e., providing the function of biogeochemical cycling and storage at 80% of reference). This method has been developed and refined by both regional and national wetland scientists and is continually tested as new watersheds are sampled and the landscape changes in Delaware. To date models have been developed for non-tidal depressional, flat, and riverine wetland subclasses in the Coastal Plain physiographic region and are in development for the other subclasses.

Delaware Rapid Assessment Protocol (DERAP) – The DERAP provides a rapid assessment of the condition of a wetlands that takes approximately 2 hours to assess a site with a field crew of 1-2 people. This method is based on identifying the presence or absence of stressors or alterations to the site in three categories: hydrology; habitat and plant community; and surrounding buffer. An Index of Wetland Condition is calculated for a site based on the stressors that are observed at a site. The DERAP is calibrated to the DECAP to ensure that both methods produce similar ratings of condition. Additionally, because the DECAP is scaled to reference, both methods produce a score that is relative to a least altered condition.

### ➤ Research on Wetland Restoration Techniques

In addition to assessing the condition of existing wetlands, the Delaware Wetland Monitoring and Assessment Program also performs research on topics that will contribute to better restoration and protection of wetlands.

In August 2003, a \$105,359 Wetland Program Development Grant was awarded to the Wetland Monitoring and Assessment Program to evaluate the effect of microtopography, coarse woody debris, and organic matter on the biotic community of restored wetlands in Delaware. Currently

no quantifiable information is available to assess the effect (positive or otherwise) that these new construction techniques are having on the biotic communities of restored wetlands in Delaware. Determining the biological effects of these construction techniques would provide wetland managers and practitioners valuable information to plan future restoration activities. Additionally, the information collected can be used as baseline monitoring data to begin a long-term dataset to assess how these sites develop over time. The information obtained during this study will be shared with other organizations that are performing wetland restoration in Delaware including other divisions within DNREC (Fish & Wildlife, Soil and Water Conservation), Natural Resource Conservation Service, U.S. Fish and Wildlife Service, Chesapeake Bay Foundation, Ducks Unlimited, Conservation Districts, Delaware Department of Agriculture and Delaware Department of Transportation. A workshop will be sponsored to present the findings of this research and to provide hands-on experience with the field monitoring and construction techniques. The goal is to provide the transfer of information to improve future wetland restoration projects in Delaware. The following information provides an update on this research effort:

Effect of coarse woody debris, microtopography, and organic matter amendments on the biotic communities of restored wetlands A study is near completion that evaluates several techniques that are being used in wetland construction to emulate natural wetlands and determine the effect of these methods on the avian, vegetative, and amphibian communities. When constructing wetlands, DNREC typically includes coarse woody debris (CWD) (e.g., snags, logs, and stumps), substrate micro-topography, and organic matter amendments (OM) (e.g., straw). The Monitoring and Assessment Program conducted a study of 20 restored wetlands in Kent County, DE with varying amounts of CWD, microtopography, and OM amendments. Preliminary results indicate that each of these amendments positively affected at least one biotic community. CWD increased plant species richness and insect biomass, microtopography increased bird and plant species richness, and organic matter amendments increased insect richness and macroinvertebrate biomass. These results support the continued use of these techniques to promote biodiversity in restored wetlands.

The use of soil amendments to deter cattail establishment In cooperation with the U.S. Fish and Wildlife Service, the Monitoring and Assessment Program is investigating methods to deter the establishment of cattails in restored wetlands. Cattails often colonize newly constructed wetlands and produce monotypic stands of vegetation which out-competes other species and reduces wildlife habitat. Additionally, some landowners that are considering restoring wetlands on their property are hesitant because of the potential for these areas to become cattail stands. The Monitoring and Assessment Program is conducting an experiment to test the efficacy of applying Alum to these sites to bind the phosphorus in the soils and deter the establishment of cattails; results are forthcoming in 2007.

### ➤ **Wetland Status and Trends in Delaware**

In Delaware, wetlands comprise >30% of the land area of the state. Wetlands perform valuable functions including nutrient cycling, stormwater retention, carbon sequestration, sediment deposition, providing habitat for wildlife and maintaining the State's biodiversity. As a result of performing these functions, wetlands provide ecosystem services including improving water quality, reducing sediment loads to surface waters, holding water to reduce flooding downstream, improving air quality, and hunting and recreational opportunities. Additionally,

because of their prominence in the State, they are an important cultural resource to the citizens of Delaware.

Statewide, 54% of wetlands have been lost since European settlement began with the greatest losses occurring in forested wetlands. Additionally, many of the remaining wetlands have been degraded. However, until recently, there was no comprehensive assessment of the conditions of the wetlands in Delaware. The State is now expanding water monitoring to include wetlands. The conditions and impacts to the wetlands which diminish their ability to function must be understood in order to effectively protect and restore these valuable resources.

➤ **Condition of Wetlands in the Nanticoke Watershed**

The condition of non-tidal wetlands in the Nanticoke River watershed was assessed in 2000 through 2003. Only 17% of the wetlands were considered in good condition or scoring between 85-88% of reference condition depending on the wetland type. Forty-eight percent of the wetlands were in fair condition and 35% were in poor condition. Flats or wetlands occurring in headwater and interfluv landscape positions account for the majority of the non-tidal wetland area (88%) and had an average index of wetland (IWC) condition of 71 for the watershed. Riverine wetlands account for 12% of the non-tidal wetlands in the watershed and had an average IWC of 69. The stressor that were impacting wetlands and lowering their condition and functions were primarily alterations to hydrology and vegetation alterations. The State is currently using this information to develop a restoration strategy to target areas for wetland restoration.

➤ **Pike Creek In-Stream Environmental Monitoring**

A private consultant performed pre- and post-restoration macroinvertebrate sampling in October 2006 at several sites along Pike Creek. Benthic macroinvertebrates served as biotic indicators of stream health to assess the effects of stream restoration for Pike Creek. Four stream reaches were sampled in October 2006; three in the restoration area and one from a regional reference stream. The methods used for pre and post restoration sampling were the same as those used for pre-restoration data collected in 2002 at the Three Little Bakers site. The first section of stream sampled was a 5,000 linear foot restored reach located at the Three Little Bakers Golf Course in Newark, Delaware. This area was sampled to assess one-year post-restoration effects. Data are being compared to baseline data collected prior to the restoration in 2002 by scientists from the Delaware Department of Natural Resources and Environmental Control (DNREC), Division of Water Resources, Environmental Laboratory Section. The second stream reach is a 3,200 linear feet area located upstream of the restored section near Independence School. It was sampled to establish baseline data prior to restoration efforts scheduled to begin in the spring 2007. The third reach was an approximately 500 linear feet reach located near the development of Meadowdale and was also sampled to establish pre-restoration baseline data. The fourth reach was the regional reference site at Middle Run, located within the same watershed (i.e., White Clay Creek).

Fish monitoring was also done at these same sites in October 2006 by staff from the Division of Fish and Wildlife. Pre- and post-restoration monitoring was done to evaluate species size and types to determine the effectiveness of restoration efforts and collect baseline data prior to restoration.

## **VI. Initiatives**

The section highlights some of the initiatives that members of the Ecological Restoration Team have been involved with since the fall of 2003 when the team was established.

### ➤ **Red Clay Creek Watershed Initiative**

In November 2003, the Department, in cooperation with the Delaware Emergency Management Agency, New Castle County, New Castle Conservation District, Department of Transportation, Duffield Associates, Delaware Nature Society, University of Delaware Water Resources Agency, Delaware Geological Survey, U.S. Geological Survey, Red Clay Valley Association and the U.S. Army Corps of Engineers, began to evaluate the need to conduct a detailed assessment of the Red Clay Creek concerning issues relating to flood control, ecosystem restoration, recreation, watershed planning, and stream stabilization. In December 2004 the Feasibility Study Project Management Plan was finalized.

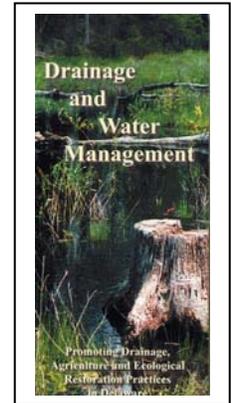
On February 23, 2005 the Department entered into a Feasibility Cost Share Agreement with the U.S. Army Corps of Engineers for the Red Clay Creek Watershed. The feasibility study will identify potential projects which can be implemented in a partnership with the Corps to address issues like flood damage reduction; riparian buffer restoration; stream reach improvements and stabilization; sediment, nutrient, and pollutant load reduction; wetland creation and/or restoration; and fish passage restoration.

On December 13, 2005 representative from the Department met with the U.S. Army Corps of Engineers Philadelphia District Office to discuss the status and future direction of the Red Clay Creek Feasibility Study. At the request of Kevin Donnelly, the Corps agreed to evaluate the possibility of performing a focused feasibility study which would only address the critical elements of the work plan. The goal is to initiate the study in early 2006.

In September 2006 representatives from DNREC, New Castle County, DELDOT and the New Castle Conservation District, met with management and technical staff from the U.S. Army Corps of Engineers Philadelphia District Office to discuss specific details of tasks that are being implemented as part of the Red Clay Creek Feasibility Study Project Management Plan. This effort is a result of the cost-share agreement that the Department entered into with the Corps in 2005 calling for the Corps to conduct a detailed environmental assessment of the Red Clay Creek watershed. Following the meeting a representative from Duffield Associates led a field trip throughout the watershed highlighting areas of concern for the Corps: in-stream dams, degraded stream banks, and numerous areas prone to flooding (e.g., Glenville, Marshallton). Duffield Associates was recently hired by the Department (October 2006) to provide assistance with those Project Management Plan tasks that the State agreed to fulfill as part of the cost-share agreement.

➤ **Drainage, Water Management and Ecological Restoration Brochure**

A brochure was completed on 10/23/03 and 10,000 copies have been printed. Funded by the Center for the Inland Bays, this document describes the need for water management, the tax ditch program, historic channel-construction practices, and the current techniques being implemented for stream and wetland restoration. The document is currently being distributed to schools; federal, state and local governmental agencies; conservation districts; environmental organizations; and various farming-related facilities (e.g., tractor equipment companies, Southern States, etc.).



➤ **Inventory of Restoration Sites**

Members of the Ecological Restoration Team, in a cooperative effort with numerous state, federal and non-profit agencies, are in the process of developing an inventory of all ecological restoration projects throughout the state. The information is being entered into an Access database and will eventually be incorporated into the Environmental Navigator. The datasheet is located in Appendix A.

➤ **Ecological Restoration Conference 2006**

Members of the Department's Ecological Restoration Team (Amy Jacobs, Evan Rehm, Deb Fillis and Mark Biddle - Division of Water Resources; Gary Kreamer – Division of Fish & Wildlife; and Steve Williams – Division of Soil & Water Conservation) held the *2006 Delmarva Wetlands Conference* on October 11<sup>th</sup> and 12<sup>th</sup> in Dover. Managers and scientists from around the Delmarva Peninsula met to discuss wetland restoration and protection across the Delmarva region. Over 140 scientists and managers from government, nonprofit, academic, and private consulting firms participated in the conference. Organizations represented included the Delaware Department of Natural Resources and Environmental Control (DNREC), Delaware Department of Transportation, Maryland Department of Natural Resources, U.S. Environmental Protection Agency, U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, U.S. Department of Agriculture Natural Resources Conservation Service, National Oceanic and Atmospheric Administration, National Aeronautics and Space Administration, University of Delaware, Delaware State University, University of Maryland, Virginia Institute of Marine Sciences, Ducks Unlimited, The Nature Conservancy, the Partnership for the Delaware Estuary, the Delaware Center for the Inland Bays and multiple private consulting firms.

The first day of the conference started with an opening address by DNREC's Cabinet Secretary John Hughes. The morning plenary speaker was Dr. Dennis Whigham from the Smithsonian Environmental Research Center who discussed changes that have occurred over the last few decades in wetland assessment, conservation, and restoration. Dr. Whigham talked about the importance of the quality of restoration projects to replacing lost functions and the movement of assessment methods towards the use of remote sensing technologies. Two concurrent sessions of presentations were held to highlight ongoing efforts to restore and protect wetlands across Delmarva. Presenters highlighted unique programs and projects occurring around Delmarva related to wetland monitoring, restoration, and outreach efforts.

The afternoon featured three moderated breakout sessions that discussed pathways to improve our wetland resources through education and outreach, monitoring and assessment, and restoration and protection. Breakout groups provided valuable insight into top issues affecting

wetlands around Delmarva and approaches to tackle those issues. Top needs identified to improve wetland protection include a freshwater wetlands law, prioritized lists of wetlands to be restored and protected, increased research on mitigation/restoration sites, and improved public awareness of wetland values and functions.

The afternoon plenary speaker was Suzanne Klimek, the Director of Operations for the Ecosystem Enhancement Program in the North Carolina Department of Environment and Natural Resources. Ms. Klimek discussed a unique program in North Carolina that involves the Army Corps of Engineers, N.C. Department of Transportation, and N.C. Department of Environment and Natural Resources and maximizes the opportunity afforded by mitigation funds to benefit North Carolina's wetland resources.

The second day of the conference offered a variety of field trips depicting the various types of habitats and restoration initiatives in Delaware and Maryland. Steve Williams, Tom Barthelmeh and Gary Kreamer and Mark Biddle led a trip throughout the northern part of the state featuring pre-restoration (University of Delaware Newark Farm and Independence School) and post-restoration (Christ the Teacher Catholic School and Three Little Bakers Golf Course) sites. A strong emphasis was placed on the importance of volunteer monitoring and the need to maintain sites after the actual construction and planting phases through programs like Adopt-A-Wetland and Stream Watch. Amy Jacobs (Division of Water Resources) led a field trip which demonstrated the natural wetland diversity on the Delmarva Peninsula including coastal plain ponds, large forested wetlands, Atlantic white cedar swamps, interdunal swales, and headwater riparian complexes. These wetlands are home to many rare and unique plants and animals and also perform a variety of functions that are important to sustaining our natural ecosystems and water quality. Additionally, Bob Meadows (Division of Fish & wildlife) led a tour to the Wilmington Wildlife Refuge. The trip started with a brief visit to the revitalized Christina River Front in Wilmington to establish the landscape in which the Refuge is framed. The group proceeded to the refuge proper where they viewed the various restoration elements implemented during the restoration. Stops were made at former spoil areas that were excavated to restore tidal hydrology; pools and channels created to enhance habitats available to resident and migratory fish and bird species; mile-a-minute weed and purple loosestrife test plots where beneficial beetles have been released as control measures; forested test area where invasive plant removal has been implemented; and view areas where introduced *Phragmites* has been controlled and narrow-leaf cattail is currently being removed.

➤ **Ecological Restoration Conference 2004**

On April 20th and 21<sup>st</sup>, 2004, a two-day conference was held at the Dover Sheraton Inn. The conference, sponsored by the Department's Ecological Restoration Team, focused on professional presentations and discussions about wetland and stream restoration issues and techniques. The second day of the workshop consisted of a field trip throughout the state which provided attendees with an opportunity to see the types of stream and wetland restoration projects that exist in Delaware.

➤ **Ecological Restoration and Protection Displays**

Two photo-intensive display boards were created/updated by the Ecological Restoration Team which depict key stream restoration and wetland projects throughout the state and the scientific techniques and methodologies used when implementing these types of projects. The display

boards and related brochures and articles have been featured at numerous conferences and workshops throughout the tri-state region and at national conferences over the past three years.

➤ **Delaware's Corporate Wetland Restoration Partnership**

At the October 20, 2004 meeting, Delaware's Corporate Wetland Restoration Partnership agreed to provide funds to support two ecological restoration projects: Diamond Back Terrapin protection and habitat enhancement along Coastal Highway 1; and signage to identify trees and shrubs at a wetland at Christ the Teacher Catholic School (wetland constructed fall 2005). The Delaware Chapter of the Corporate Wetlands Restoration Partnership, with Delmarva Power (Conectiv Energy) as the lead agency, is made up of several businesses and governmental agencies.

➤ **Regional Applied Research Effort**

In the fall 2003 the Ecological Restoration team received a \$75,000 Regional Applied Research Effort (RARE) grant from the EPA to evaluate the effectiveness of restored wetlands for the treatment of agricultural runoff. This team is performing a research assessment and chemical analysis on surface runoff water as it enters various wetland systems to determine its chemical composition. Samples are also collected and analyzed after the water passes through the wetland systems to evaluate the level of treatment provided by the wetland. This data will be utilized to develop a model that will indicate the size and type of wetlands that are required for treatment based on surface water characteristics. Members of the Ecological Restoration Team are working with staff from EPA's Research and Development office located in Ada, Oklahoma. The Department's Laboratory Services Section is currently in the process of collecting and analyzing samples from the various sites selected for this project.

➤ **Adopt-a-Wetland Program**

The Adopt-a-Wetland program continues to be a strong education and outreach mechanism for delivering wetland information and stewardship of wetland systems. Currently there are participating volunteers numbering in the thousands who represent over 80 adopting groups that are responsible for watching over more than 10,000 acres of wetlands throughout Delaware. The Adopt-a-Wetland program is housed in the Division of Fish and Wildlife at the Aquatic Resources Education Center.

## **VII. Outreach & Education**

The Ecological Restoration Team has been working in a coordinated manner on numerous public outreach efforts. This section provides details about the Team's activities over the past two years.

### **CONFERENCE SPEAKERS**

- On December 14, 2006, Steve Williams gave a presentation to the Christina Basin Clean Water Partnership Policy Committee about the status of ecological restoration projects required to fulfill the EPA Watershed Initiative Grant commitments for the Christina Basin. Williams informed the Policy Committee that Delaware has not only met, but has exceeded its grant commitments (required to restore 5,000 feet of stream; actually restored 6,250 feet with an

additional 3,900 feet being planned for construction in 2007). Williams' presentation featured the following stream and wetland projects: Pike Creek at Three Little Bakers, Sanford School, Red Clay Creek at Hickory Spring Road, Pike Creek at Meadowdale, Pike Creek at Independence School (spring 2007), and University of Delaware Newark Farm complex (spring 2007). Williams also reported on the pre- and post-restoration fish and macro-invertebrate monitoring that has been conducted at these sites.

- ❑ On October 25, 2006, Tom Barthelmeh, Steve Williams and Al Rizzo (U.S. Fish & Wildlife Service) conducted an interactive, 3-hour training seminar on wetland restoration construction techniques. The seminar focused on almost every aspect of restoration starting from landowner contacts, planning and project agreements to numerous on ground construction techniques such as microtopography and amenities to jump start a new wetland project. The "Wetland Academy Training Course" was offered as part of the *Ninth Annual Wetlands and Watershed Workshop* in Atlantic City, New Jersey which was sponsored by the U.S. Environmental Protection Agency. Following a 1.5-hour presentation (180 slides), the participants were asked to apply what they learned in the "classroom setting" by constructing a wetland and stream system in a farm setting complex. They simulated a model farm and ecosystem complex utilizing a three foot by four foot sandbox. All the material necessary to construct a wetland complex (e.g., soil, clay, woody debris, organic matter, construction equipment, etc.) was provided. Participants had to utilize Best Management Practices to ensure that pastures, crop fields and livestock areas drained into wetlands via structures, streams and ditches. The feedback from the participants was very positive. The detail in which they planned and constructed their farm complex demonstrated that they were extremely pleased with this hands-on opportunity which allowed them to apply and understand the techniques that they were exposed to during the presentation.
- ❑ On September 27, 2006, Steve Williams made a presentation at the 7<sup>th</sup> Coastal and Marine Shallow Water Science and Management Conference sponsored by the EPA. Williams' presentation, *Stream Restoration Techniques*, was included in a session that featured initiatives being funded by EPA's Targeted Watershed Grants Program. The presentation featured numerous stream restoration projects that DNREC's Ecological Restoration Team has implemented in the Piedmont area of northern Delaware over the past few years.
- ❑ Steve Williams represented DNREC by participating in the American Water Resources Association's Annual Mid-Atlantic Conference from June 14 – 16, 2006 at the New Jersey School of Conservation in Stokes State Forest. Supporting the theme of the conference, stream restoration and protection, Williams gave a presentation about the Three Little Bakers Pike Creek Stream Restoration project. Williams also participated in a four-state (PA, NY, NJ, DE) regulatory panel session and also manned a stream restoration display in the exhibit hall.
- ❑ Jennifer Holmes spoke about ecological restoration efforts at the 2006 Project Wet National Coordinators Conference which was held in Lake George, NY from May 13 – 17, 2006.
- ❑ Tom Barthelmeh spoke about wetland and tax ditch restoration at the 2006 U.S.D.A. Cooperative State Research, Education, and Extension Service National Water Conference February 5-9, 2006 in San Antonio, Texas.
- ❑ On January 24, 2006, Stephen N. Williams was the keynote lunchtime speaker at the Delaware State Golf Association Green Section's Sixth Annual Luncheon. Williams' presentation, entitled

“*Pike Creek Stream Restoration at Three Little Bakers Golf Course*,” featured the various stream restoration techniques utilized on the project along with a series of pre- and post-restoration photographs.

- ❑ Tom Barthelmeh spoke at the National Arbor Day Foundation’s “Restoring Native Ecosystems” conference held November 7-8, 2005, in Nebraska City, Nebraska and at the North American Lakes Management Society’s 2005 Symposium held in Madison, Wisconsin held November 9-11, 2005. The presentations were entitled “Wetland Restoration in Marginal Agricultural Fields/Innovative Wetland Restoration Techniques” and “Tax Ditch Best Management Practices.” The wetland restoration display was taken to the Madison symposium.
- ❑ On October 21, 2005, Stephen N. Williams was the keynote lunchtime speaker at the *Water-Friendly Landscape Design: A Prescription for Healthy Watersheds* forum sponsored by the University of Delaware’s Water Resources Agency. Williams’ presentation was entitled “Stream and Wetland Restoration in Delaware: Featuring Pike Creek Stream Restoration at Three Little Bakers and a Wetland Complex at Christ the Teacher Catholic School.” Tom Barthelmeh and Jim Chaconas, members of the Department’s Ecological Restoration Team, were also present and served as technical experts, fielding numerous questions on the topic of stream and wetland restoration. The team also had a photo-display available which featured the various construction techniques used on restoration projects.
- ❑ Amy Jacobs and A. Alsfeld gave a presentation at the Society of Wetland Scientists Conference, July 7-10, in Charleston, SC. The title of her talk was “Evaluating the Effects of Coarse Woody Debris and Substrate Microtopography Additions on the Biotic Community of Constructed Wetlands.”
- ❑ In February 2005, Jennifer Holmes and Tom Barthelmeh spoke at the New Jersey Nursery and Landscape Association’s Trade Show in Somerset, New Jersey. Their presentations focused on the restoration efforts of the Department.
- ❑ On December 5 – 10, 2004, Steve Williams and Tom Barthelmeh participated in the First National Conference on Ecosystem Restoration in Orlando, Florida. Williams and Barthelmeh each made presentations describing stream and wetland restoration techniques and projects being implemented in Delaware and the significant strides that have been made in Delaware citing the Green Infrastructure Conservation Coordination Executive Order signed by Governor Minner in October. Their presentations also noted the coordination taking place between other state agencies (e.g., Agriculture, DelDOT) and NGOs on restoration initiatives as well as the support given by the State Legislature by approving a funding category in DNREC’s current budget specifically designated for Ecological Restoration.
- ❑ Amy Jacobs, Abby Rokosch, and J. Lister gave a presentation entitled “Using HGM Data to Develop a Matrix of Management Options for Wetland Protection and Restoration” at the Society of Wetland Scientists Conference July 19-23, 2004 in Seattle, WA.
- ❑ Amy Jacobs gave a presentation entitled “Development of a rapid wetland condition assessment method based on HGM models” at the Delaware Wetland and Stream Restoration Conference in Dover on April 20-21, 2004.

- ❑ Amy Jacobs and Abby Rokosch gave a presentation entitled “Delaware’s wetland restoration database” at the Delaware Wetland and Stream Restoration Conference in Dover on April 20-21, 2004.
- ❑ Steve Williams gave the opening presentation entitled “Delaware’s Ecological Restoration Initiative” at the Delaware Wetland and Stream Restoration Conference in Dover on April 20-21, 2004.
- ❑ On March 3, 2004, Tom Barthelmeh and Steve Williams gave presentations at the 13<sup>th</sup> Annual Native Plant / Ecological Restoration Conference sponsored by Pinelands Nursery in Columbus, NJ. The presentations focused on best management practices that Delaware utilizes for wetland and stream restoration as well as Secretary Hughes’ Ecological Restoration Team initiative for the Department. In addition to the presentations, display boards were also showcased highlighting the various stream and wetland restoration techniques implemented on projects throughout the State. Over 150 individuals attended the conference from New Jersey, Maryland, New York and Pennsylvania.
- ❑ On October 26, 2004, Steve Williams spoke at the 6th Annual Wetlands Workshop in Atlantic City, NJ. Williams’ presentation focused on the development of the Department’s Ecological Restoration Team and highlighted the various restoration projects and techniques being developed and utilized by the team when implementing on-the-ground restoration projects.
- ❑ Tom Barthelmeh and Steve Williams served as co-moderators for a series of presentations entitled “Landowners Perspective on Restoration” at the Wetlands Workshop in Atlantic City, New Jersey on 10/27/05. The series of presentations featured the viewpoints from four different Delaware landowners that worked with the Department’s Ecological Restoration Team to construct wetlands on their property.

**POSTER DISPLAY AND SPEAKING ENGAGEMENTS**

- ❑ Over 45 members of the Christina Basin Clean Water Partnership had the opportunity to tour restoration sites located in the Christina River Basin on Friday, September 8<sup>th</sup>, as part of the 11<sup>th</sup> Annual Christina Basin Bus Tour. Tour participants visited projects in both Pennsylvania and Delaware seeing first hand examples of restoration and best management practices put in place to protect and improve water quality in the Basin. Steve Williams with the Division of Soil and Water Conservation featured the Hickory Spring Road stream restoration project that was completed in the spring along a tributary to the Red Clay Creek. Williams, in a cooperative effort with Dr. Tom Sims and Jenny McDermott with the University of Delaware’s College of Agriculture and Natural Resources, also provided a tour of the University’s Newark farm complex highlighting the stream and wetland projects that are being planned by the Department’s Ecological Restoration Team for construction in the fall.
- ❑ On September 21, 2006, Amy Jacobs, Mark Biddle, Steve Williams and Tom Barthelmeh participated in the Chesapeake Bay Watershed Restoration Fair at Sandy Point State Park near Annapolis, Maryland. Wetland monitoring, stream and wetland restoration displays depicting the various types of restoration work being done in Delaware and how it benefits the Chesapeake Bay watershed. The Restoration Fair was held by the Chesapeake Bay Executive Council and

was organized to showcase the extensive work being done across the watershed by state and local governments, watershed organizations, non-governmental organizations and private landowners. Williams also did an interview with the University of Maryland's campus television station explaining the purpose of the fair and the importance of on-the-ground restoration efforts.

- ❑ On the evening of April 27, 2006, Steve Williams provided streamside tours of the Pike Creek Three Little Bakers stream and wetland restoration project to members of the Red Clay Valley Watershed Association as part of their 54<sup>th</sup> Annual Business Meeting. Approximately 60 members of the association participated in the tour to learn about restoration techniques and view the restored stream and wetland complex. During the formal business meeting Williams provided the group with a Power Point presentation of the project which featured a series of pre- and post-restoration photos. Over 100 members were present for the indoor presentation which was followed by a lot of positive feedback about the Department's ecological restoration initiative and the differences it is making on Delaware's environment.
- ❑ On December 9, 2005, Steve Williams gave a presentation to the Christina Basin Clean Water Partnership Policy Committee about the status of various ecological restoration projects in the Christina Basin. Williams' presentation featured the Pike Creek stream restoration project at Three Little Bakers as well as plans that are currently being developed for stream restoration work along Pike Creek at the Independence School and several wetland complexes at the University of Delaware farm in Newark.
- ❑ On December 7, 2005, Steve Williams gave a presentation to the State's Source Water Protection Advisory Committee about the recently completed Pike Creek stream restoration project at the Three Little Bakers Golf Course. In addition to improving habitat, the Pike Creek project has helped to improve water quality in a stream that is a source of public drinking water for the residents of northern Delaware.
- ❑ On October 21, 2005, Stephen N. Williams, Tom Barthelmeh and Jim Chaconas had a photo-display available which featured the various construction techniques used on stream and wetland restoration projects at the *Water-Friendly Landscape Design: A Prescription for Healthy Watersheds* forum sponsored by the University of Delaware's Water Resources Agency.
- ❑ On October 18, 2005, Steve Williams made a presentation to the entire student body at Christ the Teacher Catholic School prior to the wetland planting event. Williams, in speaking to over 480 students and teachers, explained the importance of wetlands and the various functions they serve. Williams went on to explain the step-by-step process that was involved in constructing the wetland at Christ the Teacher School.
- ❑ Two photo-intensive display boards which depict key stream restoration and wetland projects throughout the state and the scientific techniques and methodologies used when implementing these types of projects were featured at the Sixth Annual Wetlands Workshop in Atlantic City, NJ on October 25 – 28, 2004.
- ❑ Steve Williams and Tom Barthelmeh manned an ecological restoration display at the First National Conference on Ecosystem Restoration in Orlando, Florida from December 5 – 10, 2004. Their exhibit was a photo-intensive display that demonstrated the various types of restoration techniques and restoration projects being implemented in the First State. The display was

located in the Exhibition Hall throughout the entire conference. Individuals from all over the country, and even some international attendees, were extremely impressed with the practical and on-the-ground approach that Delaware is implementing with regard to ecological restoration. Several states (e.g., North Carolina, Florida, and Wisconsin) asked the Delaware representatives if they would be willing to travel to their state and assist with jump-starting their programs by walking them through a project utilizing the restoration techniques being deployed in Delaware. Delaware certainly made a lasting impression on numerous individuals that participated in the First National Conference on Ecosystem Restoration. It was very evident that the “First State made a “first rate” impact. Additional information regarding the conference is available at <http://conference.ifas.ufl.edu/ecosystem/>

- ❑ In conjunction with the Non-Point Source National Monitoring Conference held in Ocean City, Maryland from 9/26/04 through 9/28/04, Tom Barthelmeh conducted a field trip to the Haines Farm stream and wetland restoration project in Kent County, Delaware.
- ❑ During August 2004, at the 24<sup>th</sup> Annual ESRI International GIS conference, Mark Biddle participated in a seminar/panel discussion on “Wetlands Restoration and GIS Mapping”. Delaware’s wetland mapping efforts have been well recognized for a few years at this conference of geographic information system mapping experts from around the world.
- ❑ Tom Barthelmeh, Steve Williams and Bill Whitman attended the Sussex Conservation District 2003 Cooperators’ Dinner on the evening of December 3<sup>rd</sup> at the Bridgeville Fire Hall. They shared their ecological restoration displays and brochures highlighting stream and wetland restoration projects and techniques. Tom Barthelmeh also participated in the 2005 Cooperators Dinner.
- ❑ *The Ecological Restoration Team’s displays were also featured at the following events:*
  - Coast Day – Lewes, Delaware (10/3/05)
  - National Hunting and Fishing Day – Ommelanden Hunter Education Center (9/25/05)
  - Delaware State Fair – (7/22/05 – 7/30/05)
  - Pinelands Nursery’s Native Plant/Restoration Symposium on March 2005 in Columbus, NJ
  - Gumboro Fire Hall - Delaware Sportsman Dinner (1/28/05)
  - Delaware Agronomy Day – Delaware State Fair (1/25/05)
  - Inland Bays – “Pollution Control Strategies Meeting” at Roxanna and Rehoboth (2005)
  - Watersheds and Wetlands Workshop – Atlantic City, New Jersey (October 25-28, 2004)
  - Non-Point Source National Monitoring Conference – Ocean City, Maryland (9/26/04 – 9/28/04)
  - University of Maryland Drainage Ditch Symposium (August 2004)
  - Pinelands Nursery’s Native Plant/Restoration Symposium on March 2, 2004 in Columbus, NJ

## MISCELLANEOUS EFFORTS

- ❑ A special Summer 2006 issue of *Outdoor Delaware* (released November 2006) focuses on the theme of “Keeping Common Species Common.” It reflects on years of work undertaken by the Natural Heritage Program and numerous conservation partners to examine the health of Delaware’s fish and wildlife, identify issues and recommend actions to conserve species and vital habitats before they become rarer and more costly to protect. The resulting *Wildlife Action Plan* is a blueprint for conservation of all the state’s native flora and fauna and the places they live.
- ❑ An article written by Steve Williams entitled “Stream Restoration Project Hits ‘Hole in One’ at Delaware Golf Course” has been published in the September/October issue of the U.S. Golf Association’s *Green Section Record*. The article features the Three Little Bakers stream restoration project along Pike Creek. The magazine is circulated in all 50 states and approximately 40 countries worldwide. Williams was invited by the U.S.G.A. to submit the article after making a presentation about the project at the Delaware State Golf Association Green Section’s Sixth Annual Luncheon in January.
- ❑ On October 4, 2006, Steve Williams had the opportunity to teach 65 students at Christ the Teacher Catholic School about the values and functions of watersheds and wetlands. As part of the instructional session, the students visited their “outdoor wetlands classroom” that was constructed by the Ecological Restoration Team and planted by the students last fall. With the help of a dip net, the students truly enjoyed identifying all of the various aquatic insects, fish, and amphibians that are now living in their wetlands. The students also learned about the various trees, shrubs and herbaceous grasses that they planted and spent some time observing the different birds and terrestrial insects that are now part of their wetland complex.
- ❑ Steve Williams participated in the South Wilmington Neighbor Plan Implementation Workshop that was held on September 28<sup>th</sup> at the Chase Center on the Riverfront. As members of the Parks, Open Space and Environmental Quality Work Group, Steve Williams, Tom Moran (Division of Fish & Wildlife) and Christina Wirtz (Division of Air & Waste Management) were responsible for drafting the implementation plan for the recommendation that was determined to be the number-one priority by the Work Group. The recommendation calls for restoring the Southbridge Marsh and using the area as the core of a central park system that will include a network of open spaces, ponds for natural flood retention, trails and boardwalks traversing over the restored wetlands. These amenities will be linked to active recreational facilities in the area.
- ❑ On July 14<sup>th</sup> Steve Williams met with Bob Carpenter, owner of the Hockessin Athletic Club which is currently being built just off of Valley Road and Route 7 in northern New Castle County. The athletic club is being constructed on lands there were formerly designated as a Brownfield site. The site is located in the center of Tweed’s Tavern Park, owned and currently being developed by DELDOT. Mr. Carpenter requested suggestions on what could be done from a restoration standpoint pertaining to the small creek that flows through the property (unnamed tributary to Mill Creek). After reviewing the site, Williams advised Mr. Carpenter that he is going to recommend the site to the Natural Resources Conservation Service for enrollment into the Wildlife Habitat Enhancement Program and the Riparian Buffer Program. These programs will assist with the removal and control of invasive plant species which exist at the site. The

NRCS staff will also develop and implement a streamside planting plan to create a riparian buffer along the stream. Additionally, because Mr. Carpenter is interested in developing some outdoor environmental education programs, Williams is also going to contact the Delaware Nature Society and the Red Clay Valley Association, both non-profit environmental organizations which excel in developing outdoor environmental education activities.

- ❑ On June 2, 2006, at the eighth-grade graduation ceremony at Christ the Teacher Catholic School south of Newark, Steve Williams presented Michael Lenihan and Anthony Sposato with Delaware's Ecological Restoration Student Achievement Award. Michael and Anthony were recognized for their contributions to improve Delaware's wildlife habitat and water quality by assisting with the planning and construction of the wetland restoration project that the Department's Ecological Restoration Team created at Christ the Teacher Catholic School this past fall. The awards were presented to Tony and Michael on behalf of Governor Minner and Secretary Hughes.
- ❑ On February 2, 2006, Steve Williams and Jim Chaconas met with John Mizikar, Superintendent of the Delaware Park Golf Course, and his field staff. Williams and Chaconas evaluated several areas of the golf course and provided assistance on how to control invasive plant species, stabilize upland-bank areas experiencing severe erosion problems, enhance wetlands located adjacent to Mill Creek, and eliminate some drainage problems. Mr. Mizikar was very appreciative of the environmentally-friendly solutions that were recommended to address these issues of concern.
- ❑ Over 50 members of the Christina Basin Clean Water Partnership from Delaware and Pennsylvania had the opportunity to tour the Christina River Basin on Friday, September 9<sup>th</sup> 2005, as part of the 10th Annual Christina Basin Bus Tour. Tour participants visited the sites of Christina Basin restoration projects in both Pennsylvania and Delaware, seeing first hand examples of watershed management strategies put in place to protect this important resource. Bob Struble and Jim Jordan of the Brandywine Valley Association coordinated the tour. This year's itinerary was put together by Dan Greig, Steve Williams, and Jerry Kauffman and included stops at the following sites: Chester County, PA - Phillip's Mushroom Farms, waste water management pond and spray field; Floodplain Forest Restoration, Bucktoe/Red Clay Creek, Kennett Township; Norwood Road-Ludwig's Creek Stormwater Retrofitting Project; New Castle County, DE - Newark Reservoir; University of Delaware, WRA Rain Garden; Pike Creek Stream Restoration at Three Little Bakers Golf Course (Tour led by Steve Williams - Ecological Restoration Coordinator, Department of Natural Resources). As the largest stream restoration project in Delaware's history, this project is in the process of restoring 5000 feet of the stream channel and adjacent bank on Pike Creek, which is part of the White Clay Creek Wild and Scenic River System. This undertaking is the work of the Delaware Department of Natural Resources and Environmental Control, in partnership with Three Little Bakers Golf Course, which owns the land surrounding this portion of the stream. Project goals include: bank stabilization and erosion reduction, habitat creation, improvement of water quality, and maintaining the natural look of the stream. Stream-side wetlands and meander bends to the stream channel were also added. Riffle-pool-run sequences have been put in the stream channel as well. Construction and planting was completed in October.

- ❑ Amy Jacobs participates on the Wetland Evaluation Task-group that is part of the Chesapeake Bay Program. This group was formed to evaluate and assess progress being made toward the Chesapeake Bay restoration and enhancement goals.
- ❑ Mark Biddle represents Delaware for input on Region 3 issues to the Mitigation Action Plan Interagency Workgroup for development of the National Wetlands Compensatory Mitigation Action Plan. The plan is in various stages of development and the 2005 Stakeholder Forum was postponed until 2006 as the workgroup waits for the release of National Mitigation Rulemaking called for in 2004 by the National Defense Authorization Act.
- ❑ Numerous site tours were conducted at Pike Creek Three Little Bakers restoration site over the summer, fall and winter: the Delaware River Basin Commission sponsored a stream restoration class where Pike Creek was used as an outdoor classroom; the Christina Basin Task Force comprised of scientists and managers representing the USGS, Chester County Water Resources Agency, Chester County Conservation District, Brandywine Valley Assoc., Red Clay Creek Valley Assoc. U of D, New Castle County, Trout Unlimited, NRCS, EPA and state environmental officials toured the site on 9/9/05; DNS summer environmental students toured the site on 7/20/05; Delaware Riverkeeper; Partnership for the Del Estuary; EPA.
- ❑ On May 25, 2004, members of the Ecological Restoration Team (Jim Chaconas and Steve Williams, DNREC; Carol Sullivan, DelDOT) met streamside with Joy Ford, Anna Montone and Pam Steinebach (DelDOT), Tom Carroll (Landmark Engineering), and Craig Smith (McCulley Environmental Consultants) to discuss ways of utilizing stream restoration techniques for improvements to Brackenville Road along a tributary of Red Clay Creek near Ashland Nature Center. Several areas were identified where stream cut-banks are encroaching toward the foundation of the roadway. The goal is to maintain the integrity of the stream channel and riparian habitat and still be able to provide long-term structural stability to the roadway. The meeting proved to be very productive as DelDOT and their subcontractors were very receptive to incorporating various restoration techniques into their design plans. Jim Chaconas offered to assist DelDOT with surveying the stream channel and marking the locations for stream stabilization structures.

### **UPCOMING EVENTS**

The Delaware Estuary Environmental Summit 2007

**VIII. APPENDIX A --- Restoration Datasheet**

**Site Name** \_\_\_\_\_

Existing project \_\_\_ Potential project \_\_\_

**Information Source** \_\_\_\_\_

**Funding needed?** \_\_\_

**Type of funding:** \_\_\_ federal  
 \_\_\_ non-federal  
 \_\_\_ in-kind services

**Landowner Information**

**First Name** \_\_\_\_\_

**Street address** \_\_\_\_\_

**Last Name** \_\_\_\_\_

\_\_\_\_\_

**Organization** \_\_\_\_\_

**City** \_\_\_\_\_

**Phone number** \_\_\_\_\_

**State** \_\_\_\_\_

**Other phone** \_\_\_\_\_

**Zip code** \_\_\_\_\_

**Additional Landowners:**

**Site Information**

**Date construction completed** \_\_\_\_\_

**Public property?** \_\_\_ **Photos taken?** \_\_\_

**Total restoration size (actual):** \_\_\_\_\_  
 {in ha or linear feet for streams;  
 includes all types of restoration  
 at this location}

**Permits required** **Date obtained**  
 permit 1 \_\_\_\_\_

permit 2 \_\_\_\_\_

permit 3 \_\_\_\_\_

**Site watershed** \_\_\_\_\_

**Easement?** \_\_\_ **easement type** \_\_\_\_\_

**Site county** \_\_\_\_\_

**Lat** \_\_\_\_\_ **Long** \_\_\_\_\_

**Conservation program** \_\_\_\_\_  
**term** \_\_\_\_\_

**Tax parcel ID** \_\_\_\_\_

**Long-term goal** \_\_\_\_\_

Directions to site:

**Restoration Type**

Type (federal definitions – \*see below)

- Restoration                       Establishment       Enhancement       Protection/Maintenance
- re-establishment
- rehabilitation

Habitat Type	Actual Size (ha or linear feet)	Estimated Size (ha or linear feet)	Description
<input type="checkbox"/> upland _____ (list type: wildflower meadow, open space, urban garden, warm season grass meadow, shrub, or forest)	_____	_____	_____
<input type="checkbox"/> wetland			
<input type="checkbox"/> tidal	_____	_____	_____
<input type="checkbox"/> non-tidal	_____	_____	_____
<input type="checkbox"/> invasive species	_____	_____	_____
<input type="checkbox"/> buffer	_____	_____	_____
cover: grass or forest			
target: stream/ditch or wetland			
<input type="checkbox"/> selective thinning	_____	_____	_____
<input type="checkbox"/> stream	_____	_____	_____

**Partners**

Organizations	Contribution Type (technical or financial)	Amount	Contribution Source
Lead group _____	_____	_____	_____
Contact name _____			
Contact phone _____			

**Partner 1** \_\_\_\_\_

**Partner 2** \_\_\_\_\_

**Partner 3** \_\_\_\_\_

**Partner 4** \_\_\_\_\_

**Partner 5** \_\_\_\_\_

**Construction Techniques**

**General techniques**

\_\_\_ inlet

\_\_\_ outlet

\_\_\_ closed basin

\_\_\_ ditch plug

\_\_\_ microtopography  
     score (1-10) \_\_\_\_\_

\_\_\_ islands/macrotopography

\_\_\_ excavation

\_\_\_ control structure  
     \_\_\_ boards  
     \_\_\_ pipe

\_\_\_ burning

\_\_\_ log toe protection

\_\_\_ rock toe protection

\_\_\_ cross vanes  
 \_\_\_ log vanes

\_\_\_ rock vanes

**Amenities**

\_\_\_ top soil

\_\_\_ horse bedding

\_\_\_ straw/hay

\_\_\_ coarse woody debris

\_\_\_ biologs

\_\_\_ coconut mats

\_\_\_ rip rap

\_\_\_ liners

\_\_\_ native plantings

\_\_\_ live branch layering

\_\_\_ herbicide control  
     date of last application \_\_\_\_\_

\_\_\_ other \_\_\_\_\_

**Hydrology**

% permanent water \_\_\_\_\_

primary water source \_\_\_\_\_

% open water \_\_\_\_\_

**Invasive species management**

\_\_\_ wet-glove

\_\_\_ backpack sprayer

\_\_\_ mechanical

\_\_\_ drip

\_\_\_ biological control

\_\_\_ injection

\_\_\_ cut stump

\_\_\_ burn

**Invasive species**

percent *Typha* \_\_\_\_\_

percent *Phragmites* \_\_\_\_\_

other invasives \_\_\_\_\_ percent

species 1 \_\_\_\_\_

species 2 \_\_\_\_\_

species 3 \_\_\_\_\_

\_\_\_ root wads

\_\_\_ j-hooks

**Site Management**

Long-term management needed? \_\_\_\_\_

Type \_\_\_\_\_

Party responsible \_\_\_\_\_

**Site Comments**

**\*Federal Agency Definitions for Wetland Tracking  
([www.epa.gov/owow/wetlands/restoration/defs.htm#Fed](http://www.epa.gov/owow/wetlands/restoration/defs.htm#Fed))**

**Restoration:** the manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning natural/historic functions to former or degraded wetland. For the purpose of tracking net gains in wetland acres, restoration is divided into:

- *Re-establishment:* the manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning natural/historic functions to a former wetland. Re-establishment results in rebuilding a former wetland and results in a gain in wetland acres.
- *Rehabilitation:* the manipulation of the physical, chemical, or biological characteristics of a site with the goal of repairing natural/historic functions of degraded wetland. Rehabilitation results in a gain in wetland function, but does not result in a gain in wetland acres.

**Establishment:** the manipulation of the physical, chemical, or biological characteristics present to develop a wetland that did not previously exist on an upland or deepwater site. Establishment results in a gain in wetland acres.

**Enhancement:** the manipulation of the physical, chemical, or biological characteristics of a wetland (undisturbed or degraded) site that heighten, intensify, or improve specific function(s) or for a purpose such as water quality improvement, flood water retention or wildlife habitat. Enhancement results in a change in wetland function(s) and can lead to a decline in other wetland function, but does not result in a gain in wetland acres. This term includes activities commonly associated with the terms enhancement, management, manipulation, directed alteration.

**Protection/Maintenance:** the removal of a threat to, or preventing decline of, wetland conditions be an action in of near a wetland. Includes purchase of land or easement, repairing water control structures or fences, or structural protection such as repairing a barrier island. This term also includes activities commonly associated with the term preservation. Protection/Maintenance does not result in a gain of wetland acres or function.