Delaware Wetland Monitoring Strategy

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Introduction

The State of Delaware is committed to assessing its wetland resources to understand the current condition of the resource and how this condition is changing over time. Understanding the condition of wetlands will ultimately improve the condition of wetland resources in the state by allowing the State and other conservation partners to better direct resources aimed at restoration and protection efforts by avoiding further impacts to high quality wetlands and promote restoration of degraded wetlands. As wetlands are waters of the State, this wetland monitoring strategy is part of the State's overall Water Monitoring Strategy that directs the State's efforts to assess the condition of all waters.

Wetlands comprise approximately 30% of the State's land surface (Tiner 2001) and perform valuable functions including nutrient transformation, stormwater retention, carbon sequestration, sediment deposition, providing habitat for wildlife and maintaining the State's biodiversity. These wetland functions in turn provide valuable ecosystem services such as improving water quality, reducing flooding, providing recreational opportunities and enhancing aesthetics and viewscapes. Additionally, because of their prominence in the State they are an important cultural resource to the citizens of Delaware that have supported traditions and customs for centuries. Direct and indirect impacts to wetlands can reduce the condition and subsequently the functions and ecosystem services that wetlands provide.

The vision of the Wetland Monitoring and Assessment Program (WMAP) in the Delaware Department of Natural Resources and Environmental Control (DNREC) is to achieve an annual net gain in wetland acreage and condition to be able to support the wealth of services that wetlands provide to the citizens and visitors of Delaware.

The goals of the WMAP which will achieve our vision are:

- **Goal 1.** Obtain up-to-date scientifically valid information on the status and trends (quantity, quality, functions and services) of wetlands to make wise management decisions
- **Goal 2.** Inform the citizens and visitors of Delaware, other State programs, decision makers and conservation partners about the functions and services of wetlands so they can make decisions that will improve the resource
- **Goal 3.** Protect and restore wetlands through a variety of tools including regulatory and voluntary programs including integration with watershed strategies and conservation plans, informing regulatory decisions and the mitigation process, and Clean Water Act reporting

Goal 1. is a direct product of the ongoing efforts to monitor and assess the condition, function, and services of wetlands in the state and integrating the latest research to understand the connection between the metrics and measures that are evaluated and actual processes and implications on services that wetlands provide. Goals 2 and 3 apply the information generated in Goal 1 to positively affect the decisions being made about

the management, restoration, and protection of wetlands (Figure 1.). This monitoring strategy will guide future efforts of the WMAP in each of these three goals.

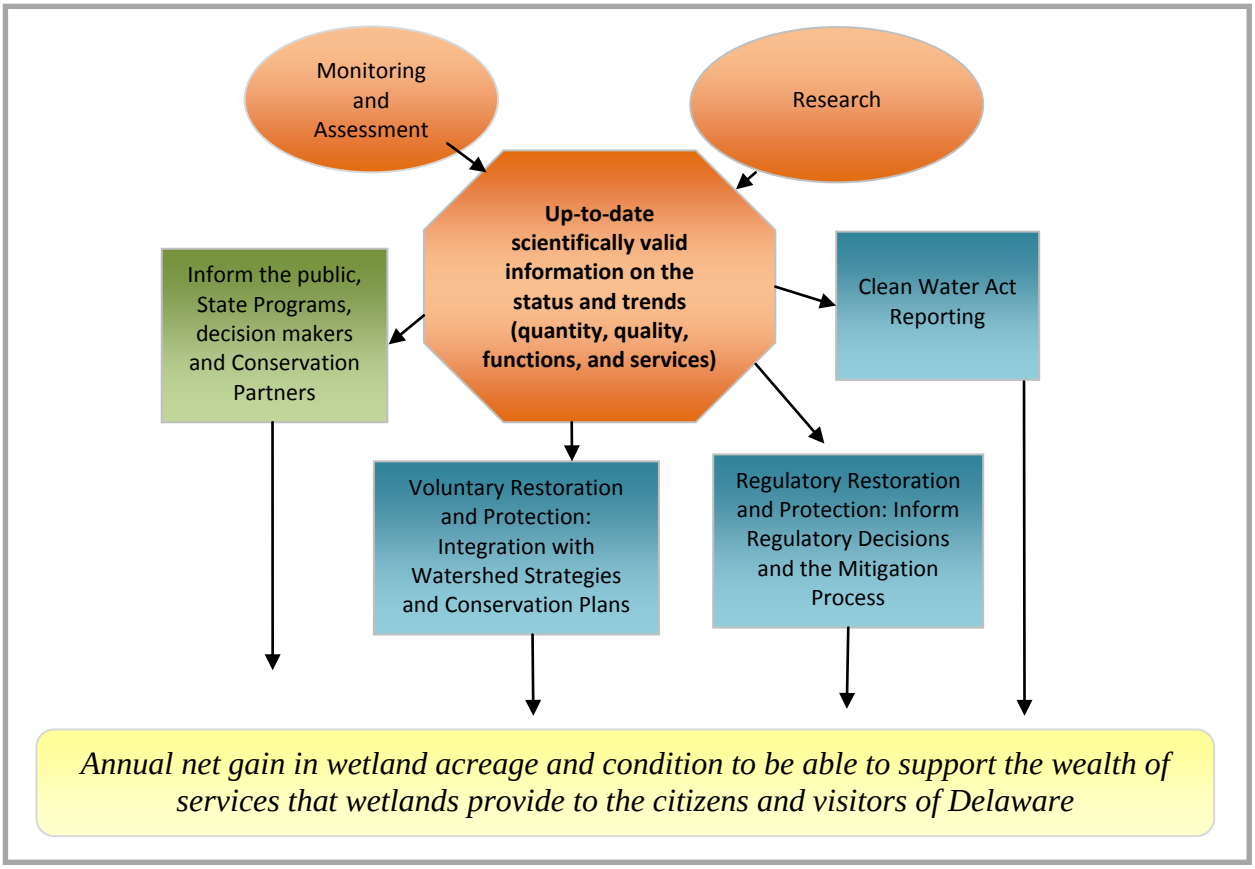


Figure 1. Components of the Delaware Wetland Monitoring and Assessment Program (WMAP). The three goals of the program (shown in orange, green, and blue) needed to achieve the vision of the WMAP in yellow.

Supporting Document to the Delaware Wetland Conservation Strategy

The goals and objectives outlined in the Delaware Wetland Monitoring Strategy (Monitoring Strategy) support many of the goals of the Delaware Wetland Conservation Strategy (http://www.dnrec.delaware.gov/Admin/DelawareWetlands/Documents/Delaware%20Wetlands%20Conservation%20Strategy%2008.29.08.pdf). The Delaware Wetland Conservation Strategy (Conservation Strategy) was developed by representatives from every Division of the Department of Natural Resources and Environmental Control (DNREC) and the Division of Forestry within the Department of Agriculture and is signed by the Secretary of DNREC. The Conservation Strategy is the final product of a process through which current programs in the state were analyzed to identify gaps in protection, management and understanding of wetland resources. Concerns for current programs were expressed by wetland program managers and other professionals. The Conservation Strategy highlights successes, identifies gaps and areas of program overlap, and recommends approaches with measurable outcomes for enhancing and improving wetland protection on various fronts. *The Monitoring Strategy highlights the connection*

between these two documents by including the Conservation Strategy Goal and Action Item in parentheses following each Task in the Monitoring Strategy.

GOAL 1. Obtain up-to-date scientifically valid information on the status and trends (quantity, quality, functions and services) of wetlands to make wise management decisions

Goal 1. Includes protocol development to have scientifically robust assessment methods for evaluating wetlands, monitoring and assessment implementation to guide the process with which wetlands in the state will be evaluated, and research to answer specific questions that arise to support better wetland protection, management, and restoration.

Protocol Development

The assessment of wetland condition requires methods appropriate for the diversity of wetland types in Delaware. The WMAP has been developing methods using a 4-tiered approach that includes levels of assessment methods: intensive assessment, comprehensive field assessment, rapid assessment, and landscape assessment. The four tiers of assessment vary in the detail of data that are collected and the resources that are needed to perform an assessment. The multi-tiered approach provides options depending on the specific goals and resources available for a project.

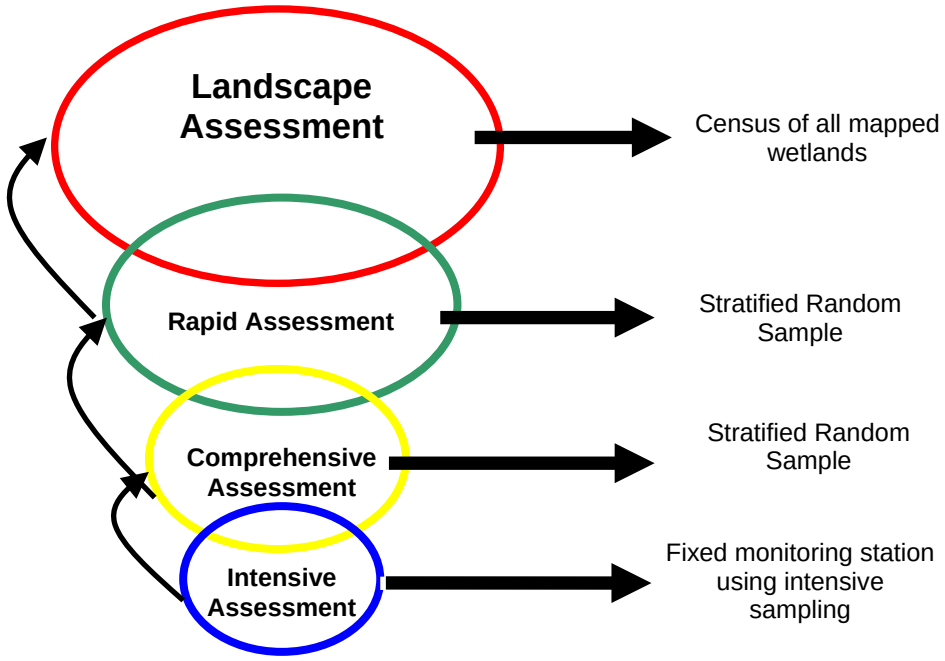


Figure 2. Four tiered approach to wetland assessment. The level of information and amount of effort increases from landscape assessment to intensive assessment.

Landscape Assessment

Landscape assessment involves the prediction of wetland condition based on surrounding land use features that can be remotely detected. For example, if a

wetland is surrounded by suburban development, certain predictions can be made about how the wetland functions have been impacted based on studies that have documented the effects of various features associated with development such as increasing impervious surface, increased feral animals, increased noise, etc. The benefits of landscape level analysis are that access to private lands is not limiting, a complete census of all wetlands can be performed, and time and effort is greatly reduced because no field visits are required. The disadvantages to landscape level assessment are that predictions of wetland condition and function are based on documented relationships and may not always apply to specific wetlands. Also, detailed information is limited based on the type of indicators that can be assessed using remote information, and staffing with GIS capabilities are required.

Weller et al. (2007) developed a landscape level assessment method in the Nanticoke watershed to predict the condition of flat and riverine wetlands based on surrounding landscape attributes. This method is a validated assessment because the predictive models were developed based on comprehensive assessment data collected on the same sites. This method can be used to predict the condition of a group of wetlands in the same HGM subclass, but is not able to predict the condition of individual wetlands with a high level of confidence. This method could be useful for prioritizing watersheds based on their level of condition. However, this method will need to be tested in additional watersheds outside of the Nanticoke to determine its applicability to the rest of the state.

Rapid Field Assessment

The Delaware Rapid Assessment Procedure (DERAP) is a rapid assessment method for determining the condition of a wetland based on a short site visit. The DERAP was developed to meet the needs of users that require a rapid assessment of the general condition of a wetland that is based on current site conditions. The DERAP uses a 2-page checklist of stressors and other site features to produce an overall score of wetland condition.

The DERAP is calibrated to the Delaware Comprehensive Assessment Procedure (DECAP) Index of Wetland Condition (DECAP IWC) using step-wise multiple regression analysis to select the stressors that best define differences in sites, and then multiple linear regression (MLR) to assign weights to the stressors. Each wetland class is calibrated separately to produce weights for each wetland type. An overall score for a site is calculated by subtracting the sum of the weights for all the stressors that are present from the possible score if no stressors are present.

The advantages of the DERAP are that it requires less time and field staff to perform, produces an overall assessment of condition that is calibrated to the DECAP, and provides an assessment of the stressors that are impacting the site. The disadvantages to the DERAP are that it does not provide the detail of information to calculate functions and services, and may not provide the level of information needed to make some management decisions.

Comprehensive Field Assessment

The Delaware Comprehensive Assessment Procedure (DECAP) is a comprehensive assessment method for determining the condition of a wetland site relative to reference condition. The DECAP and associated assessment models have been developed and refined by both regional and national wetland scientists following standard HGM development guidelines. Protocols for the DECAP can be obtained by contacting DNREC Watershed Assessment Section.

The DECAP is used to collect data on each reference site and encompasses a variety of parameters including vegetation, hydrology, soils, topography, structure, and surrounding landuses. The goal is to collect data on a wide variety of parameters to determine which ones distinguish sites based on disturbance. These data are then used to scale variables and functions for each wetland subclass. Variables (for example the density of trees per hectare) are scaled based on the reference sites. The highest score of 1.0 indicates that the variable is equivalent to a Reference Standard site (or minimally impacted) ranging down to a score of 0.1 for a highly degraded site where restoration is possible, or 0.0 for a site where restoration is no longer possible for that variable. Variables are then combined into mathematical equations that were developed by a group of wetland scientists to depict functions including maintenance of characteristic hydrology, wildlife habitat integrity, plant community integrity, biogeochemical cycling, and buffer integrity. The final function score is not an absolute value of performance of a function but rather an index of how much that function is departing from a reference standard or minimally altered site.

Field protocols and models are in different stages of development for the various wetland types in Delaware (Table 1). Once a method has been developed for a group of wetlands, it can be implemented for monitoring purposes.

Intensive Assessment

Intensive assessment involves the direct measure of specific wetland functions, processes and ecosystem services. Intensive assessments are performed to validate landscape, rapid, and comprehensive assessments and to determine long term changes in wetlands. Currently, the WMAP is working to establish permanent monitoring stations in wetlands throughout the State to collect baseline data on healthy and impacted wetlands and to determine how they are responding to different stressors and changing overtime.

Monitoring and Assessment Implementation

The WMAP uses the 4-tiered assessment protocols to determine the quality of Delaware's wetlands and assess the functions and ecological services that they are providing. However, to develop a comprehensive strategy from site selection to data analysis, various other factors must be considered. The following is an overview of the components of a wetland monitoring and assessment program as outlined in the EPA

document, “Application of Elements of a State Water and Monitoring and Assessment Program for Wetlands”.

Wetland Mapping

The most recent wetland maps for the State are based on 2007 aerial photography. These maps updated prior NWI and State maps from 1981/2 and 1992, respectfully using existing Soil Surveys, land use data, statewide natural heritage data, and color-infrared photointerpretation. The Cowardin classification system and the LLWW system that identifies landscape position, landform, and hydrology modifiers was used to label each wetland polygon in addition to special state modifiers including exceptional ecological community types.

Wetland Classification

We are using an HGM-based system for classifying wetlands in Delaware that was developed for the mid-Atlantic by Brooks et al. (in press). Appendix A. provides a description of the subclasses including example communities, hydrology, NWI classification, and major sources of variation. The different wetland types can be differentiated using the wetland maps that have been improved with the HGM modifiers.

Survey Design

The wetland monitoring strategy for the State of Delaware involves two levels of survey design. The first is to prioritize the order in which watersheds in the state will be monitored and the second is to define how we will select sampling locations within a watershed.

<u>Prioritization of watersheds</u>

Prioritization of watershed monitoring efforts will be based largely on the TMDL implementation schedule. By following this schedule, comprehensive information about the surface waters and wetlands can be combined to develop the best restoration strategy for each watershed. Figure 3 depicts a tentative schedule for future wetland monitoring efforts. The actual dates that these watersheds will be sampled and how

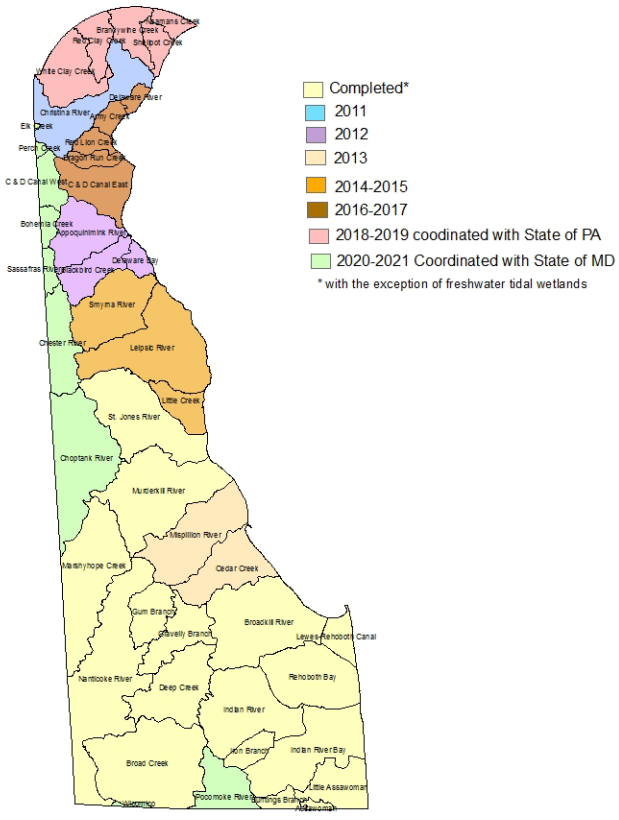


Figure 3. State of Delaware Wetland Monitoring Schedule

many rounds will be sampled in a year will depend on the availability of resources at the State level and development of appropriate methods. The intent of the State is to monitor these watersheds using a rotating basin approach once an initial assessment of the wetlands within each watershed has been performed.

Watershed sampling design - The approach used to select sampling locations within a watershed will be a probabilistic sampling design. We currently rely on technical support from EPA's Ecological Monitoring and Assessment Program (EMAP) to randomly select sampling sites within mapped wetlands in a watershed. DE DNREC supplies the base map and any additional criteria such as excluding manmade ponds or only including tidal or non-tidal wetlands. Currently EPA is working on developing a program that would allow states to perform this operation independently. The base map that will be used for all watersheds will be the most up-to-date wetland layer available.

Assessment Indicators and Methods

The State of Delaware is developing multiple levels of assessment methods to evaluate wetland condition. These levels include a landscape level assessment, Rapid Field Assessment and Comprehensive Field Assessment (Figure 2) and are described in the Protocol section above. Because the DERAP has been calibrated to the DECAP and we are achieving high correlations between the 2 methods, we use a combination of rapid and comprehensive assessments to evaluate the condition of the random sites. We determined that the most efficient use of our resources to collect the most accurate data is to perform comprehensive assessments at approximately 20% of the sites and rapid assessments at the remainder of the sites. We also continue to perform rapid assessments along with the comprehensive protocol to continue to check the correlation of the two methods. Level 1 assessment may be used to provide additional information for prioritizing which watersheds to monitor in the future.

Field Data Collection

Deployment of field crews will be based out of the DE DNREC/ Watershed Assessment Office in Dover, DE. This location will house workspace for field crews and computers in which to produce maps and store data. Field crews will depart from this location daily unless we are partnering with another organization to assess the watershed and there is a more suitable location for field crews to be housed.

Based on our experience, we believe that it is essential to have a fulltime coordinator who is responsible for implementing the monitoring in a watershed. This person should be dedicated full time to this task to be able to effectively manage the large amount of information and oversee the multitude of tasks needed to be accomplished to assess the wetlands within a watershed. This person will work directly under the Project Manager who is a DNREC employee.

Access to private property will be essential to the success of this program. We will only sample sites on private property in which we have received permission from the landowner. We have found that, in general, private landowners in Delaware are very receptive to having field crews collect data on their property that will be used to improve the resources in their watershed. As part of every monitoring effort in a watershed, we will continue to include a public outreach component aimed at distributing information on the goals of the program as well as summaries of the data that we collect.

Quality Assurance Program and Project Plans

The WMAP collects and manages all data under an EPA approved Quality Assurance Project Plan (QAPP). These plans are updated before data are collected in each watershed. The QAPP covers project/ task organization, training, data generation and acquisition, sampling design, sampling methods, quality control, equipment testing, data management, assessment and oversight, and data review verification and validation. A copy of the QAPP can be obtained from DE DNREC/ Watershed Assessment Section.

Data Management Procedures

Training - All persons involved in the data collection process will be required to complete training to properly use the assessment protocols. One to two day training sessions will be offered by DNREC and will consist of lectures on how to properly use the protocols, high quality data collection practices, and field training to demonstrate the techniques. Field crew leaders will be required to have additional training consisting of participating on a field crew to collect data until the program manager is confident that they are proficient with the techniques. While collecting data, the current QAPP will be followed to ensure the highest quality of data.

Data Collection – All data collection will be performed using the standardized DE Comprehensive Assessment datasheets and DE Rapid Assessment datasheets. DERAP may also be recorded using a palm computer which has the current version of the DERAP datasheets. Current versions of both methods are available from the DE DNREC/ Division of Watershed Stewardship/ Watershed Assessment Section.

Data Storage – All data will be entered into an Access computer database that has been developed to consistently store wetland assessment data. Additionally, if STORET becomes compatible with entering this type of information we will consider its use for including all or parts of the data collected.

Project Reporting Venues

A final report for documenting the condition of wetlands on the watershed scale and the wetland watershed profile will be produced. The condition of wetlands on the watershed scale will be included in Delaware's 305(b) report for the State.

Other information will be produced as needed from the data collected including information to assist with prioritizing restoration and protection efforts.

Program Evaluation

A team of scientists and managers will be assembled to review our wetland monitoring strategy every 5 years. This team will consist of individuals with knowledge of sampling methods and techniques, survey design, as well as individuals that will be users of this information including planners and managers. After the team performs a review, the comments will be incorporated into Delaware's wetland monitoring strategy.

Research

Research is an integral component of the WMAP to ensure that we are using appropriate methods to assess wetlands as well as obtain a more in-depth understanding between our assessment methods and the functions and processes that they predict. Research provides information on the effects of land use decisions and management actions to inform our efforts to protect and restore wetlands. Research is also needed to respond to unexpected events that affect wetlands.

Goal 1. Actions and Future Tasks (associated tasks from the Delaware Wetlands Conservation Strategy are listed in parentheses). A time-line for tasks is outlined in Appendix B.

1 Develop scientifically valid assessment methods for wetlands that evaluate the condition of the resource relative to reference condition

- Task A Develop regional flat HGM model using reference data from Delaware, Maryland, and Virginia (B-1)
- Task B Update Riverine flat HGM model to incorporate beaver impoundments (B-1)
- Task C Adapt DECAP and DERAP to evaluate freshwater tidal forested wetlands (B-1)

2 Assess the ambient condition of wetlands by watershed in Delaware and identify major stressors that are impacting wetlands

- Task D Assess wetlands in specified watersheds based on monitoring schedule (Figure 3; B-1)
- Task E Participate in National Wetland Condition Assessment in 2011 (B-1)

3 Maintain long-term monitoring sites in every HGM subclass

- Task F Establish long-term monitoring sites in riverine and flat wetlands (B-1)

Task G Evaluate the use of long-term data to improve assessment methods (DECAP and DERAP; B-1)

4 Perform research to improve our understanding of wetland functions, the impact of stressors, and ecosystem services

Task H Evaluate the relationship between wetland condition and the services that they provide (B-1, E-10)

Task I Determine the relationship between NWI functions based on LLWW codes and functional scores from site assessment using DECAP

Task J Evaluate if tidal wetlands in Delaware are keeping pace with sea level rise (A-4)

Task K Evaluate the use of beneficial dredge material as a method of restoring tidal wetlands

GOAL 2. Inform the citizens and visitors of Delaware, other State programs, decision makers and conservation partners about the functions and services of wetlands so they can make decisions that will improve the resource.

Outreach and education is a critical link between obtaining information on the status of wetlands in Delaware and improving the condition of wetlands on the ground. Outreach and education efforts will focus on relaying information from the monitoring, assessment, and research efforts as well as the overall value and services of wetlands.

The condition of wetlands including the identification of major stressors that are impacting wetlands as determined through the monitoring program will be valuable for wetland education efforts. The goal is to share wetland condition information and the identified stressors with conservation partners, decision makers and the public to gain their support in reducing wetland stressors through restoration, management and protection. Literature and online resources are being designed to share with the public in order to educate them in ways that they can work with their local land use decision makers to protect wetlands from encroaching development. The website also serves the public by instructing homeowners on steps to minimize their footprint on their local watershed. A wetland restoration guidebook has been published and distributed to inform private landowners of programs, funding and options available to restore wetland areas.

The information collected through the monitoring and assessment program will be shared with the public and other conservation partners through a Delaware Wetlands Website, Delaware Wetlands literature, and a biennial Wetlands Conference. Wetland Workshops

will be held and presentations will be conducted focusing on public participation in wetland restoration and protection.

Goal 2. Actions and Future Tasks (associated tasks from the Delaware Wetlands Conservation Strategy are listed in parentheses). A time line for tasks is outlined in Appendix B.

1 Use wetland monitoring data to educate State programs, decision makers, conservation partners, and the general public to improve efforts to protect and restore wetlands.

Task L Post wetland assessment results via technical reports and wetland report cards as each watershed assessment is completed on the Delaware Wetlands Website (A-5, A-7, B-4)

Task M Make the most recent versions of the assessment methods and protocols available on the Delaware Wetlands Website (A-5, A-7)

Task N Host a biennial Wetlands Conference to encourage communication amongst biologists, managers, educators, and decision makers in 2012 and 2014 (D-2)

Task O Create Data Portal to allow access to all wetland related information in the state (A-6, A-7, A-8)

2 Distribute information about the value of wetlands and the services they provide to the public and decision makers through the Delaware Wetlands Website and brochures.

Task P Maintain the Delaware Wetlands Website with up-to-date information (A-5, A-7)

Task Q Expand Delaware Wetlands message through the use of social media

Task R Create literature for non-technical audiences on the status, condition and the monetary and biophysical values of wetland functions to use during presentation and outreach opportunities (D-1, E-9)

Task S Create literature on the monetary and biophysical values of wetlands for natural resource professionals and managers, the public, and decision makers (E-10)

3 Provide training for wetland professionals, the public, and decision makers.

Task T Host training workshops for wetland scientists, educators, and volunteer participants to disseminate updates on monitoring protocols, data collection methods, and quality assurance techniques (B-3)

Task U Host workshops for local decision makers in Kent and Sussex County about the benefits of wetlands while providing them with tools available for wetland protection (E-7)

Task V Provide technical training on the use of the DECAP, DERAP, and MidTRAM to wetland professionals (B-3)

GOAL 3. Protect and restore wetlands through a variety of tools including regulatory and voluntary programs including integration with watershed strategies and conservation plans, informing regulatory decisions and the mitigation process, and Clean Water Act reporting

The results generated from monitoring efforts will be used to enhance regulatory and voluntary wetland restoration, management, and protection programs in the state. Data will also be compiled and included in the State's 305(b) report as part of the Clean Water Act requirements. The data obtained during monitoring efforts will serve to inform State restoration partners of the type of wetlands most in need of restoration and protection, which will be shared in summaries generated by the WMAP.

The assessment results will be used to enhance existing regulatory programs and evaluate the need for additional regulations. Based on the recommendations from the wetland monitoring reports for assessed watersheds, regulations that would address dominant stressors impacting wetlands will be evaluated to determine how to make them more effective. Additionally, mitigation provides an opportunity to incorporate the assessment methods (DERAP, DECAP, and MidTRAM) to improve restoration practices and focus future sites in areas identified as priorities in the watershed restoration plans.

Voluntary restoration will be promoted through the development of watershed restoration plans. Based on assessment results, restoration can be focused on the dominant stressors that are impacting different wetland types. Watershed level restoration plans in watersheds with completed wetland assessments will be developed using the wetland data as well as other relevant science-based information that is available (i.e. rare species and communities, soils, hydrology, land use). These plans will provide direction and detail for restoration and protection project planning. Once the plan is completed, outreach will be performed to landowners in priority areas to initiate restoration in these areas.

The National Water Quality Inventory Report to Congress (305(b) report) is the primary vehicle for informing Congress and the public about general water quality conditions in the United States. This document characterizes our water quality, identifies widespread water quality problems of national significance, and describes various programs implemented to restore and protect our waters. The condition of wetlands on the watershed scale was included in Delaware's 305(b) report for the State beginning in 2008 for the Nanticoke Watershed.

Goal 3. Actions and Future Tasks (associated tasks from the Delaware Wetlands Conservation Strategy are listed in parentheses). A time line for tasks is outlined in Appendix B.

1 Enhance existing regulations and evaluate the need for additional regulations based on the assessment results

Task W Adapt DERAP and test the use of the assessment method for use in making CWA Sec. 401 decisions (F-3)

Task X Evaluate the performance of wetland restoration and other compensatory wetland mitigation in replacing wetland acreage and function (FF-1, F-2, F-3, F-6)

Task Y Work with Army Corps and other organizations to incorporate assessment methods (DECAP, DERAP, MidTRAM) and reference data into the mitigation process to improve site performance

Task Z Work with the Army Corps to use completed restoration plans to locate future mitigation sites (C-1)

Task AA Facilitate discussions with legislators and decision makers on the status and value of wetlands (E-7)

2 Improve voluntary restoration and protection based on the assessment results

Task BB Integrate monitoring and assessment data into watershed restoration plans and other conservation strategies (C-1)

Task CC Assess pre- and post conditions at restoration sites to determine habitat, water quality, and flood storage changes (C-5)

Task DD Disseminate information on programs that are available to landowners to perform voluntary restoration (B-5)

3 Include assessment results in state's Clean Water Act Reporting

Task EE Report on the condition of wetlands in compliance with the Clean Water Act

HYDROGEOMORPHIC CLASS[1] Subclass	Dominant water sources of class and flow dynamics	Major source of variation within subclass	NWI vegetation classes[2]	Regional example	Protocol Development
FLAT	Precipitation; Vertical fluctuation				
Mineral soil		Hydroperiod and fire frequency	FO, SS, EM	Wet flatwoods/ Broad areas with poor drainage on mineral soils	Completed combined protocol for organic and mineral flats in the Coastal Plain
Organic soil		Peat depths (from histic epipedons to histosols)	FO, SS, EM	Great Cypress Swamp/ Broad areas with poor drainage that accrete organic matter	
SLOPE	Groundwater discharge and interflow; Unidirectional & horizontal				
Mineral soil		None available	FO, SS, EM	Spring seep	In development by UDE
Organic soil		None available	FO, SS, EM	Forested fen	
Sea-level fen	Groundwater seepage, oligotrophic, acidic freshwater		EM	Sea-level fens	Low priority because there are only a few in the State and Heritage monitors them
DEPRESSION	Precipitation or groundwater; vertical fluctuation				
Inland	With our without inlet and outlets	Hydrology	FO, SS, EM,	Coastal plain ponds, forested depressions	Completed for Coastal Plain
Interdunal Swale	Groundwater driven	Groundwater withdrawal causing intrusion of salt water, ditching, dune crossings, OMWM, invasive species	PEM	Along Atlantic coastal strand and barrier islands, shallow depressions behind primary dune ridges	Not developed
Human impounded or excavated		Size of catchment	SS, EM, AB	Borrow pits; some farm ponds;	Not developed

[1]Upper case in bold are HGM classes; lower case in bold are regional subclasses, except for deepwater environments.

[2] NWI vegetation classes: forested (FO), scrub-shrub (SS), emergent (EM), aquatic bed (AB), unconsolidated shore (US), unconsolidated bottom (UB), riverine (R), Lacustrine (L), estuarine (E), marine (M).

RIVERINE – non-tidal	Overbank flow from channel and groundwater discharge; Unidirectional				
Intermittent-Upper perennial	Non-tidal	Range of hydroperiods within riparian zone (usually < third order), gradient high, water velocities fast.	FO, SS, EM, AB	Riparian forest	Completed combined model for Riverine wetlands on Coastal Plain
Lower Perennial	Non-tidal	Range of hydroperiods within 100-y floodplain, including in-stream terraces and bars (usually > third order) Gradient is typically low; water velocities slow.	FO, SS, EM, AB	Bottomland or floodplain forest	
Beaver-impounded		Dam more temporary than human-impounded; usually < third order	FO, SS, EM, AB	Beaver pond	In development
Human-impounded[4]		Range of water residence times based on impoundment volume and discharge	FO, SS, EM, AB	Mill ponds; large farm ponds created in stream	Not developed
ESTUARINE TIDAL FRINGE	Mixture of sea and fresh water; bi-directional and horizontal				
Estuarine lunar intertidal					
	Freshwater tidal **(ETF)**		FO, EM, AB	Freshwater tidal swamps	Not Developed
	Brackish tidal **(ETB)**	Meso-polyhaline (>5 ppt)	EM, AB	*Spartina alterniflora*-dominated zone	Meso-polyhaline model in development
		Oligohaline (.5 – 5ppt)		*Nuphar advena, Zizania aquatica dominated*	Not developed
Estuarine subtidal		Low energy regime allows SAV establishment (Salinity ranges - 0 to >30ppt)	FO	Mud and sand flats; SAV beds; Oyster reefs	Not developed
Estuarine impounded		Flow is blocked by dike, gate, or dam; water source precipitation except for controlled delivery of estuarine water of varying salinity	FO, EM, AB	Waterfowl impoundments?	Not developed
MARINE TIDAL FRINGE	Marine source; bi-directional and horizontal				
Marine intertidal		N/A	US	High energy beach	Not developed

Appendix B. 5-Year Schedule for Completing Tasks Associated with each Goal.

Goal 1. Obtain up-to-date scientifically valid information on the status and trends (quantity, quality, functions and services) of wetlands to make wise management decisions

Task	2011	2012	2013	2014	2015
A. Develop regional flat HGM model using reference data from Delaware, Maryland, and Virginia	X	X			
B. Update Riverine flat HGM model to incorporate beaver impoundments		X			
C. Adapt DECAP and DERAP to evaluate freshwater tidal forested wetlands			X		
D. Assess wetlands in specified watersheds based on monitoring schedule	X	X	X	X	X
E. Participate in National Wetland Condition Assessment in 2011	X	X			
F. Establish long-term monitoring sites in riverine and flat wetlands		X	X		
G. Evaluate the use of long-term data to improve assessment methods		X	X		
H. Evaluate the relationship between wetland condition and the services that they provide		X	X		
I. Determine the relationship between NWI functions based on LLWW codes and functional scores from site assessment using DECAP				X	X
J. Evaluate if tidal wetlands in Delaware are keeping pace with sea level rise	X	X	X	X	X
K. Evaluate the use of beneficial dredge material as a method of restoring tidal wetlands		X	X	X	

Goal 2. Inform the citizens and visitors of Delaware, other state programs, decision makers and conservation partners about the functions and services of wetlands so they can make decisions that will improve the resource

Task	2011	2012	2013	2014	2015
L. Post wetland assessment results via technical reports and wetland report cards as each watershed assessment is completed on the Delaware Wetlands Website	X	X	X	X	X
M. Make the most recent versions of the assessment methods and protocols available on the Delaware Wetlands Website		X	X	X	X
N. Host a biennial Wetlands Conference to encourage communication amongst biologists, managers, educators, and decision makers in 2012 and 2014		X		X	
O. Create Data Portal to allow access to all wetland related information in the state	X				
P. Maintain the Delaware Wetlands Website with up to date information	X	X	X	X	X
Q. Expand Delaware Wetlands message through the use of social media	X	X			
R. Create literature for non-technical audiences on the status, condition and the monetary and biophysical values of wetland functions to use during presentation and outreach opportunities	X	X			
S. Create literature on the monetary and biophysical values of wetlands for natural resource professionals and managers, the public, and decision makers	X	X			
T. Host training workshops for wetland scientists, educators, and volunteer participants to disseminate updates on monitoring protocols, data collection methods, and quality assurance techniques	X	X	X	X	X
U. Host workshops for local decision makers in Kent and Sussex County about the benefits of wetlands while providing them with tools available for wetland protection		X	X		
V. Provide technical training on the use of the DECAP, DERAP, and MidTRAM to wetland professionals	X	X	X	X	X

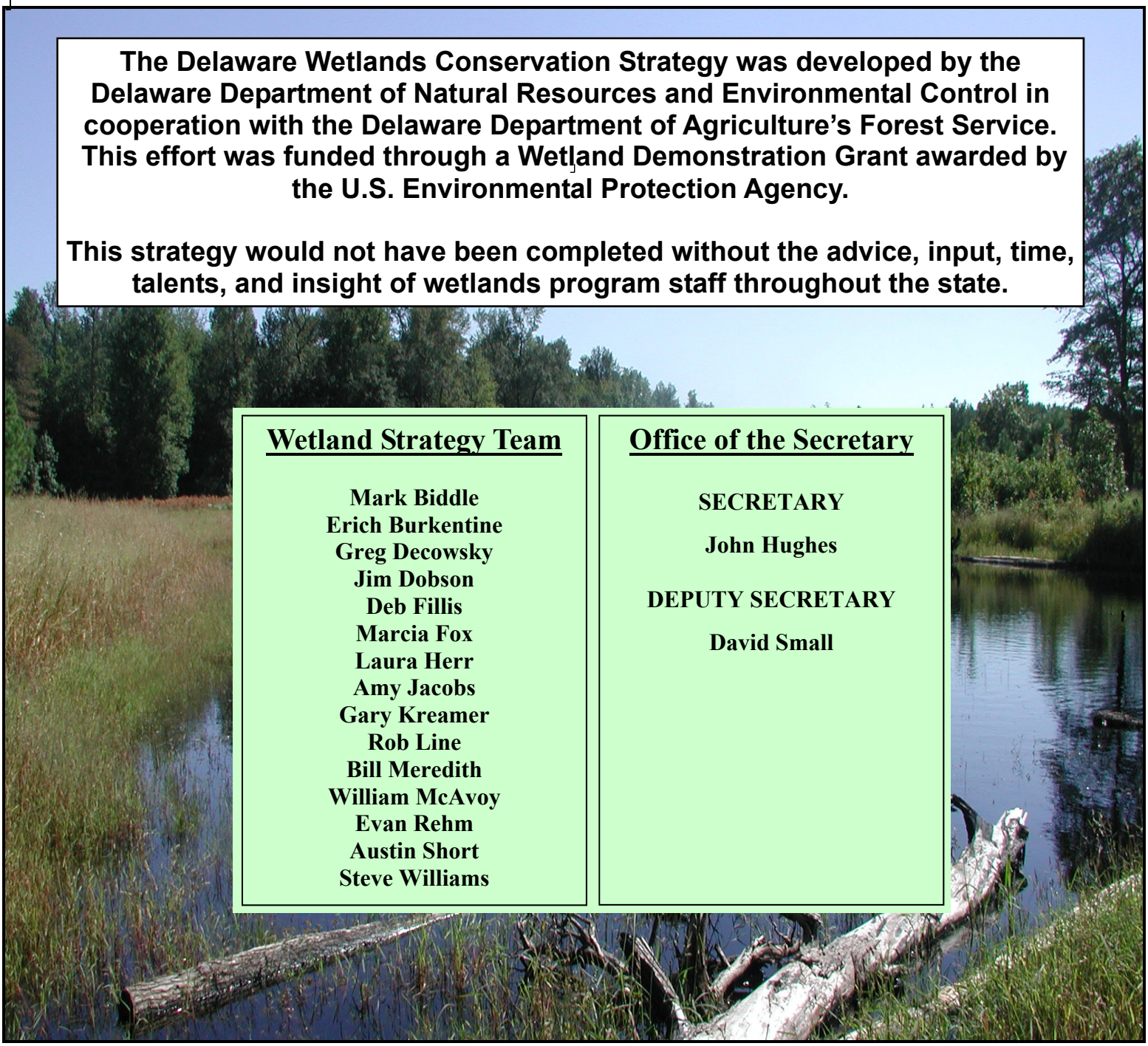
GOAL 3. Protect and restore wetlands through a variety of tools including regulatory and voluntary programs including integration with watershed strategies and conservation plans, informing regulatory decisions and the mitigation process, and Clean Water Act reporting

Task	2011	2012	2013	2014	2015
W. Adapt DERAP and test the use of the assessment method for use in making CWA Sec. 401 decisions	X	X			
X. Evaluate the performance of wetland restoration and other compensatory wetland mitigation in replacing wetland acreage and function			X	X	X
Y. Work with Army Corps and other organizations to incorporate assessment methods (DECAP, DERAP, MidTRAM) and reference data into the mitigation process to improve site performance	X	X	X		
Z. Work with the Army Corps to use completed restoration plans to locate future mitigation sites	X	X	X		
AA. Facilitate discussions with legislators and decision makers on the status and value of wetlands	X	X	X		
BB. Integrate monitoring and assessment data into watershed restoration plans and other conservation strategies	X	X	X	X	X
CC. Assess pre- and post conditions at restoration sites to determine habitat, water quality, and flood storage changes	X	X	X		
DD. Disseminate information on programs that are available to landowners to perform voluntary restoration	X	X			
EE. Report on the condition of wetlands in compliance with the Clean Water Act		X		X	


Delaware
Wetlands Conservation
Strategy
2008

The Delaware Wetlands Conservation Strategy was developed by the Delaware Department of Natural Resources and Environmental Control in cooperation with the Delaware Department of Agriculture's Forest Service. This effort was funded through a Wetland Demonstration Grant awarded by the U.S. Environmental Protection Agency.

This strategy would not have been completed without the advice, input, time, talents, and insight of wetlands program staff throughout the state.



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AND ENVIRONMENTAL CONTROL

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August 14, 2008

Dear Fellow Delawareans:

Delaware's one-hundred miles of shoreline define its character and heritage. Due to our proximity to the coast, and our generally low elevation, we are endowed with hundreds of thousands of acres of wetlands representing approximately 36% of the land surface of Delaware. However, since Delaware was settled, we have lost roughly 54% of our original wetlands and many of the wetlands that remain have been negatively impacted through the centuries. Stressors that wetlands have suffered include filling, excavation, channelization, ditching, introduction of invasive species, contamination, dumping, fragmentation, and increased runoff or disturbance caused by adjacent land uses. Therefore, it is critical that we work together to improve these vital resources.

Delaware's natural landscape includes headwater forested wetlands where small tributaries originate. These large wetlands are nature's kidneys, filtering precipitation and runoff while providing habitat for wildlife. These headwater areas also support one of our signature wetland types - Delmarva Bays - also known as coastal plain ponds. These transient ("ephemeral") wooded wetlands are havens for biodiversity, providing essential nursery sites for amphibians and habitat for many of our rarest animals and plants. They also serve as water recharge areas that clean and sustain our vital ground-water resources that supply twenty-five percent of New Castle County's drinking water. In Kent and Sussex Counties, we rely solely on ground-water for our drinking water supply.

Our tributaries then flow into streams bordered by wetlands. When heavy storms occur, rainwater filters through these wetlands, helping to clean and cool water before it reaches larger waterways. As streams rise and overflow into these adjacent wetlands, they further cleanse the water and substantially reduce flood impacts. Moving toward the coast, Delaware's wetlands become broad expanses of emergent vegetation providing shelter and food resources to some of our most cherished wildlife. These coastal wetlands and their estuaries serve as nursery grounds for many commercially and recreationally important fish and shellfish, protect us from storm damage, and serve as one last purification stop before water reaches the Inland Bays, Delaware Bay, Chesapeake Bay and the Atlantic Ocean. Coastal salt marshes are among the most productive ecosystems in the world, surpassing modern agriculture in biological productivity.

Every part of our State is within thirty miles of the Delaware Estuary or the Atlantic Ocean, and most areas are within one mile of wetland habitat. The value of our wetlands is undeniable and their holistic functions on the landscape are irreplaceable. The major forces threatening the services provided to us by wetlands include climate change, sea level rise, runoff, and development. Protection of our resources will best be accomplished by utilizing good science to quantify the impacts befalling wetlands and then determining the best means to reverse damage that has already occurred including ways to prevent harm from happening in the future. The facts obtained through the research currently underway will be shared with wetland practitioners, decision makers, and the public. Collaboration amongst Delaware's wetland practitioners will only enhance their achievements in the care of wetlands and in the interest of protecting Delaware's native beauty and natural services for the citizens of the First State.

The development of this document was a collaborative effort between State agencies. Implementation will include working with private landowners and local governments, providing professional training for resource managers, mapping, monitoring and assessment based on national standards, prioritizing and performing effective restoration, protecting vulnerable wetlands, educating the public, promoting volunteer stewardship of wetland areas, and engaging in public policy-making. Renowned preservationist and writer John Muir once said, "When one tugs at a single thing in nature, he finds it attached to the rest of the world." All of us have a role to play in the stewardship of wetlands.

Please join us in our initiative to protect and improve Delaware's wild and wonderful wetland resources!

Sincerely,

John A. Hughes
Secretary

Delaware's Good Nature depends on you!

CONTENTS

EXECUTIVE SUMMARY

The Delaware Wetlands Conservation Strategy is a collaborative effort among the Delaware Department of Natural Resources and Environmental Control (DNREC) and other State partners. This strategy will guide the efforts of State agencies to improve Delaware's wetland resources through increased agency coordination, data availability, education, monitoring, and restoration efforts. Goals will be implemented over the next five years and will be reevaluated in 2013. We encourage other government and private wetland stakeholders in Delaware to adopt this strategy and collaborate with the State to enhance our capacity to conserve wetlands.

In 2006, DNREC completed an interview and survey based assessment of current wetland programs administered by government agencies and private organizations including, five Federal, fifteen State, three local, and eight nonprofit conservation programs. During this assessment we cataloged current programs, identified gaps in protection, and listened to concerns expressed by wetland program managers. This document grew out of recognition of those needs, and represents an effort to develop a comprehensive strategy to assess the current status of wetland protection, highlight successes, identify gaps and areas of program overlap, and recommend approaches with measurable outcomes for enhancing and improving wetland protection on various fronts.

To slow wetland loss and improve existing wetland conditions, new and innovative ideas are being used. For example, the formation of DNREC's Ecological Restoration and Protection Team created a core group of scientists, program managers, and citizens who implement restoration projects (including wetlands). This team's accomplishments highlight the potential benefits that can be garnered through the coordination of programs and sharing of resources. Similarly, monitoring and assessment of natural, restored, and enhanced wetlands are occurring through the collaborative efforts of DNREC, federal agencies, non-governmental organizations, and citizen monitoring groups with the intent of assessing wetlands of all watersheds. There is a wide range of education programs that effectively provide information to school and youth groups, develop and disperse instructional materials, and promote hands-on citizen involvement. While federal, state and local wetland programs are making progress towards protecting, preserving, enhancing, and restoring wetlands, they still need additional support to tackle these daunting tasks.

Therefore, The Delaware Wetlands Conservation Strategy outlines six goals to focus efforts with the aim of maximizing the use of resources to best protect wetland resources in the state and the services that they provide:

- ✧ Update wetland inventory maps and improve access to wetland related data.
- ✧ Increase monitoring efficiency and effort to provide insight into wetland function and health.
- ✧ Integrate wetland restoration, creation, enhancement, and protection efforts to ensure efficient use of resources.
- ✧ Coordinate information and resources sharing among wetland protection programs, professionals, and agencies.
- ✧ Enhance education and outreach efforts to broaden wetland stewardship among all wetland stakeholders.
- ✧ Work with partners to provide support and enhancement for existing regulatory programs and to provide protection of wetlands that are not covered by state and federal regulations.

The above goals when completed will produce comprehensive data and coordinated efforts to better protect wetlands in Delaware. However, wetlands should not be considered in isolation of other habitats when considering conservation actions, but rather as one component of a functioning landscape. Improved wetland information and programs should be integrated with other conservation efforts to best protect and enhance Delaware's natural systems. Funding and resources above what are currently available will be needed to make these goals attainable. Funding from federal grants, state sources, and cost-share opportunities will be vital and will serve as the catalyst for this strategy's success. This document is intended to serve as an identification tool for objectives and needs. The Wetland Workgroup will be convened every two years to evaluate progress towards meeting the objectives and to develop implementation plans.

Background

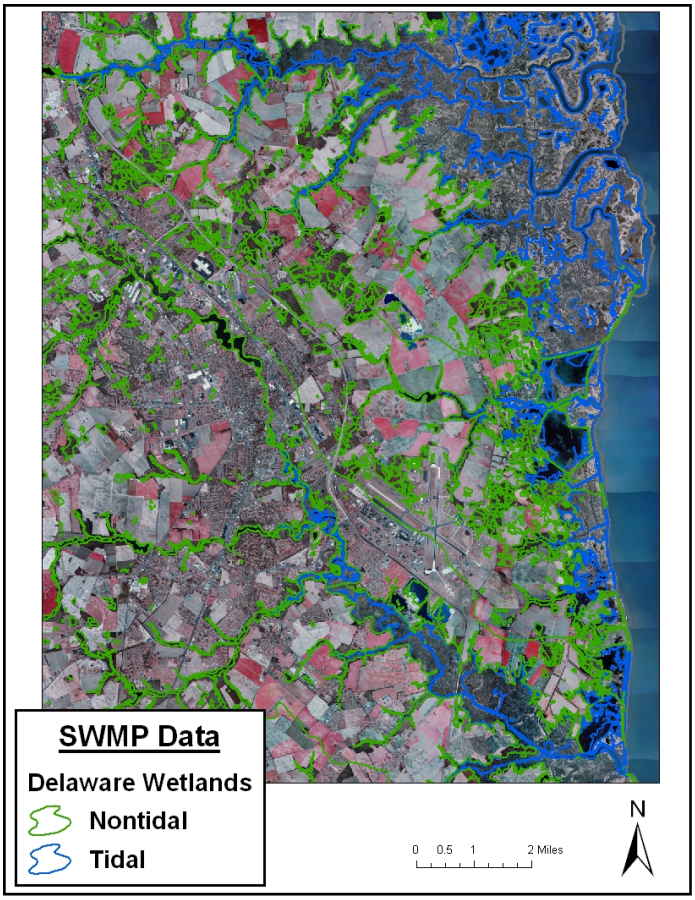
Delaware features a wealth of wetland resources both in abundance and variety, but wetland loss remains a major environmental and social concern. Historically 36% of the land area in Delaware was wetlands. However, between 1780 and 1992 well over 100,000 acres were lost, leaving only 46% of the original acreage[a]. Of the remaining approximate 350,000 acres[b], the majority is in private holdings and much of it has already been degraded or converted to other land uses. Therefore, the success of almost any wetlands program is based on public support and awareness.

These lush and essential ecosystems are often situated between the upland areas where people live and work and our rivers, bays, and other deep water habitats. As such, they play a vital role in reducing the impacts of storms and floods. They also act as water filters removing nutrients, contaminants, and potential carcinogens keeping our waters safe for drinking, swimming, and fishing. This means the rain that falls in our backyard and trickles across the road picking up pollutants, such as gasoline, pesticides, and fertilizers, is filtered by wetlands before flowing to our rivers or streams eventually ending up in the places we fish and swim. By some estimates, wetlands provide ~ 4.9 trillion dollars[c] worth of economic goods (e.g., food) and services (e.g., floodwater control) annually worldwide. Wetlands also provide habitat for endangered species like the bog turtle, game species like the American black duck, and 57% of Delaware's native plant species.

While the major contributor to past wetland loss was direct conversion to agriculture and drainage for other land use purposes, more recent threats include residential, commercial, industrial and urban development, and sea level rise. In addition to outright wetland loss, remaining wetlands are being degraded or altered through fragmentation, establishment of invasive species, hydrologic alteration, sediment budget and transport alterations, unsustainable forest harvesting, and increased input of nutrients, stormwater, and other pollutants. With the constant threat of development and human-induced changes, it is increasingly important to efficiently use the resources available to ensure wetland services continue to support our needs through future generations. In addition, wetlands must be considered in a larger landscape context by considering and including connected habitats such as upland forests, grasslands, and open space.

[a] Dahl, Thomas E. 1990. Wetlands losses in the United States 1780's to 1980's. U.S. Department of the Interior, Fish and Wildlife Service, Washington, D.C. 13 pp.
[b] Statewide Wetland Mapping Project (SWMP) maps which were derived from photo interpretation of 1992 aerial photography.
[c] Constanza et al. 1997. Nature vol. 387.

GOAL A: UPDATE WETLAND INVENTORY MAPS AND IMPROVE ACCESS TO WETLAND RELATED DATA



Updating and combining wetland GIS layers allows project managers to track wetland acreage and status including restoration acreage.

CURRENT STATUS AND INITIATIVES

The most recent statewide inventory of wetlands in Delaware is the 1994 Statewide Wetland Mapping Project (SWMP), which identifies the location and type of wetlands based on photo interpretation of 1992 aerial photography. The last wetlands "status and trends" report documents changes from 1981/1982-1992. Data layers containing past wetland restoration and enhancement sites have been created and are currently being updated to include additional sites. Similarly, data layers containing State owned and protected lands are constantly updated as properties are acquired.

Wetland projects and programs have generated a wealth of data including monitoring reports, watershed level wetland condition reports, management plans, natural heritage data, and GIS mapping of wetlands, restoration and protection sites. Consequently, there is valuable information that could be applied by various users, such as landowners, biologists, students, volunteers, land use planners, decision makers, and those seeking permits. But, because the majority of these data are scattered in various locations within and outside of DNREC, they are not currently easily accessible or utilized. Currently, most wetland data is only disseminated to the public through outreach programs and events. It should be more accessible to the public through electronic avenues (e.g., Delaware wetlands website and data portal).

VISION STATEMENT

Improved wetlands data and user access should provide the best available information to program managers, policymakers, regulatory agencies, researchers, and public entities. Updating the SWMP maps would give managers an up-to-date spatial context on which to base program action. The updated SWMP maps would also provide the basis for a new wetland "status and trends" report, to identify more recent changes in wetland type and acreage. The creation of a wetlands restoration database in conjunction with updated wetland maps would provide a comprehensive catalog of previously restored wetlands and give managers insight into the success of programs.

A consolidated database where the majority of wetland related information is copied and stored would provide a comprehensive reference source that could be utilized by all wetland stakeholders. The completed database should be updated regularly and made available through electronic means to provide easy access by DNREC, partners, and the general public. The database would be best accessible through a Delaware Wetlands Website. The website would serve as a window for the public into the types and biology of Delaware's wetlands, and the functions, services and values provided to our state by wetlands, while sharing the work performed by DNREC and our partners to better understand and protect such valuable habitats.

ACTION ITEMS

A-1 **COMPLETE UPDATE OF DELAWARE SWMP MAPS AND PRODUCE AN UPDATED WETLANDS "STATUS AND TRENDS" REPORT** based on 2007 aerial photography and LIDAR. Include mapping of wetlands most susceptible to sea level rise (SLR), restored, created, and mitigated sites The report will determine issues affecting wetlands (e.g., development, SLR).

A-2 **DEVELOP GIS DATA LAYERS** that combine and compare SWMP layers with mapping resources from other State plans (e.g., Wildlife Action Plan) to highlight overlapping areas prioritized for protection or restoration.

A-3 **CREATE A COMPREHENSIVE RESTORATION TRACKING DATABASE** to integrate information from existing and newly completed restoration projects.

A-4 **CREATE A CENTRAL LOCATION FOR RESEARCH PROJECTS** to facilitate access by multiple Divisions or agencies when funding is available.

A-5 **CREATE A COMPREHENSIVE WETLAND WEBPAGE** that provides basic wetland information, descriptions and contact information for restoration programs, and guidance on how to obtain wetland related information.

A-6 **CREATE AN INFORMATION PORTAL** to store all data, metadata, and materials related to wetlands. The portal should include data from a variety of sources and contain diverse types of information (e.g., educational materials, technical documents, management plans).

A-7 **WIDELY DISTRIBUTE INFORMATION ON THE CENTRAL PORTAL** to educators, local governments, policymakers, resource planners and other groups.

A-8 **DESIGNATE OR CREATE A POSITION OR STAFF MEMBER** to regularly update, monitor, and track the information portal.

GOAL B: INCREASE MONITORING EFFICIENCY AND EFFORT TO PROVIDE INSIGHT INTO WETLAND FUNCTION AND HEALTH

Monitoring data can be used to track the function and health of wetlands throughout the state.

CURRENT STATUS AND INITIATIVES

Monitoring of natural, restored[c], and created wetlands produces baseline ecological information, providing the scientific basis on which to assess damage or improvement, identify trends, and make sound management decisions. In Delaware, statewide monitoring assesses the condition of natural wetlands on a watershed basis, and evaluates their function and health. Mitigation[d] sites are monitored in compliance with permit conditions using various methods to document whether sites are meeting basic function requirements for hydrology and vegetative cover. However, additional monitoring above and beyond what is required for mitigation sites is needed. Also due to limited staffing resources and a general lack of monitoring requirements, relatively few voluntarily restored or created sites are monitored. Post-restoration and post-creation monitoring of voluntary and to understand the functions and services that these wetlands are establishing on the landscape and to provide a sound basis for mid-course corrections when needed.

A comprehensive wetland report for the Nanticoke Watershed has been completed and prioritizes areas for restoration and protection based on wetland condition. Over several years, similar efforts will be duplicated in watersheds across Delaware. Parallel projects such as the Wildlife Action Plan, Pollution Control Strategies, and the creation of State Resource Area and Land Use/Land Cover maps highlight the importance of wetlands and will also be used in producing watershed specific reports. To ensure sound management decisions, the prioritization process should be a collaborative effort among scientists, managers, and citizens incorporating concerns from a variety of stakeholders.

Currently citizen monitoring groups also collect data on wetland condition and function as a learning opportunity for their members. Citizen groups, with tailored training, could collect relevant data with the potential to assist in program affiliated monitoring efforts which would instill a greater sense of accomplishment while improving assessment efficiency. Some groups in Delaware have made great strides in their collection of defensible data.

[c] The term "restoration" is used to encompass wetland restoration, enhancement, and rehabilitation practices.
[d] Mitigation can include wetland restoration or creation as a means of requisite compensation for permitted wetland loss or degradation.

VISION STATEMENT

Increased baseline data collection on natural, restored, created, and mitigated wetlands will provide a scientific basis for decisions made by managers and planners. These data can be incorporated into watershed based planning, help prioritize areas for restoration, and support ongoing statewide initiatives such as Pollution Control Strategies or Watershed Management Plans. The Divisions within DNREC and stakeholders interested in performing monitoring should develop and utilize a standard protocol to determine the condition, functions, and services of natural wetlands. In addition, specialized protocols for monitoring restoration sites should be developed to track restoration projects and programs. Discussions should be initiated with involved parties to develop monitoring requirements on mitigation and creation sites based on the standardized protocols.

To supplement current Department monitoring initiatives, volunteer monitoring programs should be coordinated to collect data that can be directly utilized by exiting programs. The data collection should be conducted in ways that optimize the output's utility to wetland scientists and managers. Groups such as DNREC's Adopt-a-Wetland, Delaware Nature Society's Stream Watch, the University of Delaware's Inland Bays Citizen Monitoring, and the Nanticoke Watershed Alliance's Creek Watchers programs should coordinate with the Department and each other to develop a network of volunteers collecting operative data.

Volunteers collect valuable data, which can be used to make sound scientific decisions to restore and protect wetlands.

ACTION ITEMS

B-1 **DEVELOP STANDARD SAMPLING PROTOCOLS** for all wetland assessment and monitoring activities including those in natural, restored, and created wetlands. Protocols should use a tiered approach to account for varying staff expertise, schedules, and financial resources.

B-2 **ADOPT AND USE STANDARDIZED MONITORING PROTOCOLS** within DNREC Divisions and organizations conducting wetland restoration, mitigation, or creation. Create a Memorandum of Understanding (MOU) with organizations and groups outside of DNREC to adopt and use the protocols.

B-3 **HOLD TRAINING WORKSHOPS** for wetland scientists, educators, and volunteer participants to disseminate updates on monitoring protocols, data collection methods, and quality assurance techniques.

B-4 **PLACE MONITORING AND ASSESSMENT DATA RESULTS ON THE DELAWARE WETLANDS WEBSITE** in order to better inform the public, policy makers, and their decisions.

B-5 **PROMOTE OPPORTUNITIES FOR VOLUNTEER PARTICIPATION** through the Adopt-a-Wetland and other programs via monitoring projects by students, educators, service organizations, and other members of the community.

B-6 **CREATE A DATABASE OF MONITORING ACTIVITIES** completed by volunteer groups that will be maintained and re-evaluated as a means of assessing program enterprises.

B-7 **DEVELOP A WEB-BASED MAP** that allows volunteers involved in monitoring to access and input data and compare project information statewide.

GOAL C: INTEGRATE WETLAND RESTORATION, CREATION, ENHANCEMENT, AND PROTECTION EFFORTS TO ENSURE EFFICIENT USE OF RESOURCES

Restoration of formerly degraded or farmed wetlands attempts to reinstate wildlife habitat and other ecosystem functions.

CURRENT STATUS AND INITIATIVES

DNREC's creation of the Ecological Restoration Team, Northern Delaware Wetland Rehabilitation Program, and Open Spaces Program, as well as the adoption of the federal Landowner Incentive Program were significant in expanding restoration[e] efforts while completing ecologically significant projects. Collaborative efforts already occur among the U.S. Fish and Wildlife Service, Natural Resources Conservation Service, National Oceanic and Atmospheric Administration, DNREC Divisions, County Conservation Districts, DOA's Forest Service, DelDOT, and private organizations. Through these initiatives, project planning has become more organized while financial and staffing resources have been combined to accomplish on-the-ground results. However, currently there is no strategic plan outlining locations for restoration, creation, and protection and what types are needed across Delaware. Increased coordination and dialogue among stakeholders could improve results while utilizing current resources as efficiently as possible.

Strategic restoration, creation, and protection plans are compulsory for providing program guidance and prioritization of the types and locations of wetlands in need, allowing resources to be dedicated to projects with the maximum positive ecological impact. Additionally, with the diversity of programs working to restore and create wetlands, it is important to develop consistent construction standards to ensure quality projects. The technical expertise relating to wetland restoration and creation is shared among wetland experts in numerous agencies and organizations, but could be channeled into the production of helpful manuals and instructional workshops. The manuals could provide guidance for contractors and consultants who are completing on-site construction. The completion of projects by qualified contractors using established techniques should minimize problems after a project has been completed. Currently, the limited funding and staff available to revisit sites and correct complications may result in less than optimal performance of restored and created sites. A standard reporting method for parties involved in restoration and creation would help track projects over time and identify sites where maintenance activities are needed.

[e] The term "restoration" is used to encompass wetland restoration, enhancement, and rehabilitation practices.

VISION STATEMENT

Through increased stakeholder coordination and development of watershed priorities, restoration, creation, and protection efforts would be focused maximizing ecological results. Watershed-level science-based plans would guide restoration, creation, protection and management decisions and facilitate a holistic approach toward improving watersheds. A network of communication should be established among practitioners within DNREC, governmental agencies, non-governmental programs, and private organizations to share information relating to wetland restoration, creation and protection and to jointly prioritize sites and projects. Standardized methods for construction of and reporting on wetland projects would ensure high quality results throughout the state while creating a means to identify projects in need of revisiting. These best available techniques should be applied to all State lands to set high standards of wetland protection and restoration.

Sharing information about successful wetland construction techniques, such as the addition of organic matter, would help programs and wetland restorers complete more effective projects.

ACTION ITEMS

C-1 **DEVELOP AND USE WATERSHED LEVEL RESTORATION PLANS** in watersheds with completed wetland assessments to provide direction for restoration, creation, and protection project planning. Wetlands will be prioritized using a holistic approach including ecological condition data, economic, social and political concerns, input from governmental agencies, private organizations, and citizen groups.

C-2 **DEVELOP WETLAND PROJECT STANDARD OPERATING PROCEDURES (SOPs)** for construction techniques and reporting comprising a variety of wetland types and projects. The SOPs should provide detailed direction for wetland construction techniques, but be flexible enough to be adapted to varying conditions and projects. Investigate the need for Memoranda of Understanding (MOUs) with government agencies, non-governmental agencies, and private groups.

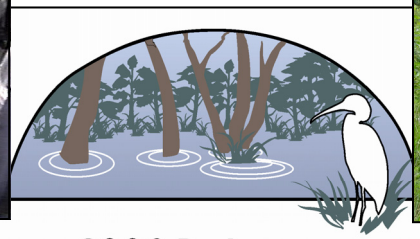
C-3 **CREATE A REFERENCE MANUAL COMPOSED OF THE WETLAND PROJECT SOPs** focusing on successful procedures and reporting methods.

C-4 **HOST WORKSHOPS TO INFORM** construction managers, wetland ecologists, and interested stakeholders about advancements in wetland project techniques.

C-5 **DEVELOP A PROGRAM WITH STAFF AND ADDITIONAL RESOURCES** designed to maintain and improve existing wetland projects.

GOAL D: COORDINATE INFORMATION AND RESOURCE SHARING BETWEEN WETLAND PROTECTION PROGRAMS, PROFESSIONALS, AND AGENCIES

Regular training and workshops can keep wetland scientists up to date with monitoring protocols and restoration efforts.



Coordinating planning, monitoring and education efforts ensures the most efficient use of program resources.

CURRENT STATUS AND INITIATIVES

Within DNREC, programs are working together to protect and restore wetland resources by integrating restoration, protection, education, and monitoring efforts to improve how we direct resources and provide information to the public. In several cases, wetland restoration projects have included an educational component by involving schools or citizens groups. A biennial wetlands conference is hosted by DNREC to enhance sharing and communication among scientists, researchers, managers, and the general public. The integration of program areas can provide additional resources, technical advice, restoration, and outreach opportunities that will ultimately strengthen individual programs.

While strides have been made to increase collaboration amongst projects, program coordination among disciplines (e.g., wetland constructors, educational staff, monitoring scientists) is still limited, which leads to programs not reaching their full potential of audiences. Moreover, wetland programs are not always connected with other projects striving towards similar ecological goals, resulting in similar minded programs becoming disconnected and the duplication of efforts. By increasing communication through a variety of new avenues and by expanding existing efforts, programs will operate more efficiently and effectively.

Another area where State agency coordination is critical is the Preliminary Land Use Service, or PLUS. In Delaware the Office of State Planning Coordination, along with several other State agencies, provides guidance and coordination and serves as a resource for local governments. Their guidance includes assisting local governments with comprehensive planning and land use decisions. Additionally, PLUS offers a forum for numerous State agencies to engage landowners, land planners, landscape architects, engineers, and other consultants as they work through the land development process. For the process to be most effective, agencies must have the opportunity to provide input as early as possible, preferably during the concept phase. From a wetlands protection perspective, PLUS allows several DNREC agencies to provide comments regarding the potential impacts a development project may have on the resource and offer redesign options that will avoid or minimize those impacts.

VISION STATEMENT

Increased communication among wetland professionals should lead to collaborative efforts between programs and agencies and create new opportunities to increase wetland protection efforts. Coordinating programs would reduce duplication of efforts and lead to more efficient use of resources. The PLUS process could be improved with more cohesive and inclusive wetland comments from within DNREC. The safeguards offered to wetlands through the PLUS process could also be enhanced by better informing Delaware residents about the role they can play as advocates for wetlands by voicing their concerns to local decision makers.

A wetlands newsletter should be created to highlight the success of programs and keep staff up to date on current wetland activities. Consideration should be given to non-wetland resources to ensure wetland projects are not completed at the expense of other important natural resources. A series of conferences, technical workshops, meetings and public forums should be held to update and increase dialogue among wetland scientists, managers, researchers, and the general public. The increased dialogue would support other strategy goals such as increased monitoring efficiency and the integration of wetland restoration efforts. While reaching out to the general public, efforts should also be made to establish positive relationships with the business community to garner their support.

Wetlands provide valuable habitat for wildlife such as birds and amphibians.

ACTION ITEMS

D-1 **CREATE A WETLANDS NEWSLETTER** to update professionals on ongoing wetland activities and encourage partnerships.

D-2 **HOST A BIENNIAL CONFERENCE** to share information relating to current wetland activities (e.g., monitoring, restoration, education) among wetland professionals and interested public.

D-3 **ASSIST NON-GOVERNMENTAL ORGANIZATIONS** with the completion of wetland related projects. Examples of assistance include grant writing advice and support, technical advice or planning of restoration projects, and support in the development of monitoring programs.

D-4 **ENCOURAGE CORPORATE SPONSORSHIP** by marketing specific projects and programs that will appeal to corporate interests.

D-5 **INTEGRATE WETLAND ASSESSMENT DATA INTO PLUS PROCESS** by documenting the consequences of land use changes on representative wetland habitat types for purposes of identifying and mitigating potential wetland impacts from a given project, while providing management and protection options for developers, planners, and wetland advocates.

D-6 **PRODUCE MORE COHERENT WETLANDS COMMENTS AS A PART OF PLUS REVIEWS** by improving coordination amongst DNREC staff.

GOAL E: ENHANCE EDUCATION AND OUTREACH EFFORTS TO BROADEN WETLAND STEWARDSHIP AMONG ALL WETLAND STAKEHOLDERS

Education and outreach programs enable hands-on experience while introducing and informing citizens to the many benefits of wetlands.

CURRENT STATUS AND INITIATIVES

In Delaware, State run wetland-focused environmental education programs are numerous and varied. Many of these target K-12 school groups, including field trips, outreach programs, teacher workshops, summer camps, special events, and a variety of audio-visual and other curriculum support materials. Materials and programs offered through and developed by DNREC's Aquatic Resource Education Center, are integrated into school curriculums at particular grade levels on a statewide basis, and as a result, are achieving a substantial and sustainable reach.

Though adult and general public-targeted wetland education and outreach programs are less widespread, in recent years efforts in this area have expanded in recognition of the need to inform the public of ongoing conservation work, raise awareness of the benefits of wetlands, increase technical information sharing, and engage landowners in positive wetland experiences. A key component of this effort has been the state's Adopt-a-Wetland program, which matches wetland sites with citizen volunteers in order to increase wetland stewardship and monitoring, while amplifying personal connections to the wetland resource. As part of that approach, customized loan kits have been developed for volunteer use in monitoring key components of wetland habitats. A restoration guidebook is also being developed to inform private landowners of incentives, approaches and voluntary opportunities for preserving, enhancing, and restoring wetlands. Interactions with landowners during requested site visits to their property is a valuable outreach opportunity to better inform them about the importance of wetlands. For instance, the Forestry Service's development of management plans for timber lot owners often includes delineating wetlands and wetland buffers aiding in the protection of those habitats while apprising landowners of their function and value to the landscape.

Although wetland education and outreach programs are having positive impacts in Delaware, awareness of and access to such resources among teachers, youth leaders, and other potential user groups could be improved. For example, a recent survey of Delaware citizens regarding green infrastructure showed water quality concerns to be the highest priority issue in the state. Yet in the same survey, wetlands were considerably further down the list of priorities. This suggests a need and an opportunity to inform the public regarding the key role wetlands play in improving water quality.

VISION STATEMENT

Education and outreach are paramount to promoting the importance of wetland protection and helping mobilize people to translate awareness into action. Expansion of efforts should target key adult audiences that have previously been overlooked - particularly legislators, local land use decision makers, and landowners. Endeavors should focus on transforming negative impressions and misconceptions about wetlands into positive pathways for action and involvement in their protection, stewardship, and restoration by optimizing buy-in and addressing concerns from the viewpoints of the respective audiences. Better awareness of, and access to, wetland education materials and opportunities through website development and other means should encourage more educators, and the young people they teach, to become involved and make a difference.

Incorporating a field component into education programs helps to engage students in making real-world connections to wetlands.

Bolstered communication and collaboration is needed among volunteer organizers to ensure efforts are geared effectively to meet the needs of multiple programs while increasing and guiding volunteer participation. Improved volunteer coordination should increase involvement and sharing of resources while cultivating political, economic, and personal support for wetland protection attempts.

ACTION ITEMS

E-1 **IDENTIFY AND ADDRESS GAPS IN COVERAGE OF WETLAND** topics, issues, and audiences reached by utilizing program assessments (e.g., Green Infrastructure Assessment).

E-2 **COMPILE AND DEVELOP A WETLAND EDUCATION TOOLKIT** (e.g., powerpoint presentations, brochures, videos, activity kits and other resources) that can cover a broad range of audiences and integrate them into the wetland webpage for easier access by educators.

E-3 **CREATE A LIST OF CONTACTS OR LEAD AGENCIES** to refer citizens interested in becoming involved with wetland stewardship, monitoring, or restoration projects.

E-4 **HOST WORKSHOPS FOR ENVIRONMENTAL EDUCATION PROGRAM MANAGERS** to promote networking and collaboration on projects, programs, and events that promote wetland conservation.

E-5 **ESTABLISH AND EXPAND PARTNERSHIPS** between governmental, non-governmental, and non-profit groups to better coordinate existing education efforts and target groups identified as overlooked.

E-6 **INCREASE VOLUNTEER STEWARDSHIP AND MONITORING** of wetlands statewide through additional adoptions of Adopt-a-Wetland sites.

E-7 **DEVELOP AND IMPLEMENT A SERIES OF WORKSHOPS** to educate local decision makers about the benefits of wetlands and provide them with tools available for wetland protection.

E-8 **PUBLISH AND DISTRIBUTE A WETLAND RESTORATION GUIDEBOOK** to inform private landowners of programs, funding, and options available to restore wetland areas.

E-9 **DEVELOP FACTSHEETS AND OTHER MATERIALS** to dispel myths about wetland regulations, "takings", and other negative impressions the public may hold, while emphasizing the benefits of wetlands to water quality and other areas of citizen concern.

E-10 **DEVELOP NEW MARKETING APPROACHES AND TOOLS** to promote wetland protection to the general public and other government agencies such as an Ecosystem Services Model.

GOAL F: WORK WITH PARTNERS TO PROVIDE SUPPORT AND ENHANCEMENT FOR EXISTING REGULATORY PROGRAMS AND TO PROVIDE PROTECTION OF WETLANDS THAT ARE NOT COVERED BY STATE AND FEDERAL REGULATIONS

Reducing impacts to wetlands through appropriate regulations could help decrease future flooding and property damage.

CURRENT STATUS AND INITIATIVES

The Federal and State governments in Delaware have made significant advancements towards regulatory protection of wetlands since the adoption of legislations beginning in the 1970s. At the federal level, the Army Corps of Engineers is given regulatory power over "navigable waters" and their "adjacent" wetlands through Section 404 of the Clean Water Act, and through Section 10 of the Rivers and Harbors Act. Activities occurring in tidal wetlands and lands under tidal and nontidal waterways are also regulated by the State through two primary means, the Wetlands Act and the Subaqueous Lands Act. Proposed modifications to jurisdictional wetlands and waters are scrutinized through a detailed permitting and review process which works to minimize potential impacts. The 401 Water Quality Certification Program requires the State to approve any actions in wetlands and waters in which the federal government has authority to issue approvals for regulated activities. The 401 Program ensures that activities will not be incongruent with defined State Water Quality Standards.

Additionally, direct federal activities, federal funding to local governments, and federal permits and licenses within Delaware are reviewed and permitted by the Division of Soil and Water Conservation's Coastal Program pursuant to the Coastal Zone Management Act of 1972. This Act requires federal actions that affect the designated Coastal Zone of the State to adhere to State coastal management policies. Delaware's approved coastal management policies apply to state laws and regulations pertaining to coastal waters management, subaqueous lands, wetlands, beaches, flood hazard areas and others. The entire state is considered the Coastal Zone which provides an additional layer of protection to the state's wetland resources. The Food Security Act of 1985 and the subsequent Food, Agriculture, Conservation and Trade Act of 1990 also discourage landowners from converting wetlands to agricultural use by making lands ineligible for agricultural benefit programs if wetlands are farmed, with the exception of prior converted wetlands.

Even with numerous federal and state level protection efforts, many nontidal (e.g., headwater tributaries) and isolated (e.g., flooded forests, seasonal ponds) wetlands are threatened because of gaps in existing regulations or are being impacted illegally due to limited enforcement activity. Legally wetlands are permitted to be impacted on a small scale with blanket approvals with no reporting or mitigation requirements. The sum of the small scale impacts can be detrimental to ecosystems as a whole. In addition, some previously converted wetlands do not fall under regulatory control or disincentive programs. Recent court challenges (SWANCC and Rapanos/Carabell decisions) question the extent of waters covered by the Clean Water Act and have created quandaries in discerning which wetlands and waterways are currently under the U.S. Army Corps of Engineer's jurisdiction. This ambiguity has resulted in a period of vulnerability for some wetlands due to an uncertainty in enforcement responsibilities.

VISION STATEMENT

Increased enforcement of current regulations would lead to a decline in the amount of wetlands illegally destroyed. Funding and support for increased enforcement should be pursued through federal agencies by soliciting for greater assistance in enforcing both federal and State regulations. To build upon better oversight, new and unused avenues to protect wetlands should be explored and implemented, including research to document the effects of wetland impacts on wetland functions and services. Any unused existing mechanisms should be addressed and utilized to their full practicable extent.

If these avenues are fully exhausted and do not provide full protection of all wetlands, new or expanded regulatory oversight which could involve DNREC assuming wetland regulatory capacity from the federal government, should be considered. This assumption of such capacity should be a collaborative process involving DNREC, other state and federal agencies, the general public, and stakeholders in order to create viable mechanisms. There would be advantages to the people of Delaware in having wetlands and waters oversight within one agency including timely reviews, consistency, and resource-based protection.

Many nontidal and isolated wetlands are threatened because of gaps in existing regulations or are being impacted illegally due to limited enforcement activity.

ACTION ITEMS

F-1 **ORGANIZE A COLLABORATIVE REVIEW** of all existing state, county, and municipal wetland programs to investigate their full intent, whether they are being used to their full extent, and to identify gaps in wetland protection.

F-2 **CONDUCT A REVIEW OF REGULATORY PROGRAMS** that could affect construction in and around wetlands. Identify gaps in protection and seek changes to the regulations.

F-3 **SUPPORT THE STATE'S EXISTING REGULATORY DECISION MAKING PROCESS** by researching impacts resulting from commonly approved projects while exploring and assessing techniques for avoiding and minimizing wetland impacts.

F-4 **INCREASE REGULATION ENFORCEMENT** efforts by working with EPA, USACOE, and USFWS to designate personnel to Delaware.

F-5 **EVALUATE THE EFFECTS ON ISOLATED WETLANDS** due to the SWANCC ruling and the USACOE's implementation of new guidelines, including number of acres permanently or temporarily impacted.

F-6 **PURSUE STATE AND LOCAL REGULATORY CHANGES** necessary to maintain and improve Delaware's wetland resources based upon the statewide Wetland Monitoring and Assessment Program's findings and upon the results of the studies listed above.

EVALUATING PROGRESS

Achievement of the goals presented in the preceding pages will lead to better protection and restoration of wetland resources in Delaware. We will evaluate progress toward meeting these goals and improving wetland protection in Delaware in five years (2013). The answers to the following questions will be used to evaluate areas where we've met our goals, areas that require more work, and to determine if there is a need to develop new goals or action items.

GOAL A: Update wetland inventory maps and improve access to wetland related data.

- Which wetlands/wetlands-associated data layers and maps are currently up to date and which data layers are out-dated?
- Which data layers are available to the public and other program staff?

GOAL B: Increase monitoring efficiency and effort to provide insight into wetland function and health.

- How many wetlands in Delaware have been sampled using standardized assessment protocols?
- How much of this information is available to the public and other program staff?

GOAL C: Integrate wetland restoration, creation, enhancement, and protection efforts to ensure efficient use of resources.

- What strategic watershed restoration and protection plans have been developed for priority watersheds?

GOAL D: Coordinate information and resource sharing between wetland protection programs, professionals, and agencies.

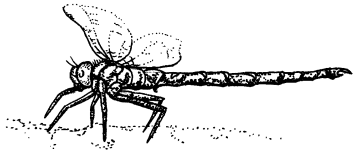
- How many workshops and public forums have been conducted to update and increase dialogue among wetland scientists, managers, researchers, and the general public?
- Have wetlands benefitted from the inclusion of wetland assessment data in the PLUS process?

GOAL E: Enhance education and outreach efforts to broaden wetland stewardship among all wetland stakeholders.

- Are the tools, resources and other wetlands education materials we have developed for decision makers, landowners, teachers and volunteers being utilized to protect wetlands and receiving positive feedback from their intended users?
- Who is using these materials to improve wetland awareness and protection in Delaware?

GOAL F: Work with partners to provide support and enhancement for existing regulatory programs and to provide protection of wetlands that are not covered by state and federal regulations.

- Have extensive reviews of and additional support to existing regulatory programs been completed to clarify where increased regulatory enforcement and regulatory changes/additions are needed for impacts on non-tidal wetlands, most importantly those considered isolated?



"We abuse land because we regard it as a commodity belonging to us. When we see land as a community to which we belong, we may begin to use it with love and respect."

Aldo Leopold