

Development of Wetland Permit Compliance and Community Outreach Tools

Final Report to the Environmental Protection Agency Region III
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Submitted by:

Virginia Department of Environmental Quality
629 East Main Street
Richmond, Virginia 23219

In collaboration with:

Conservation Management Institute
School of Natural Resources
Virginia Polytechnic and State University

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David L. Davis, CPWD, PWS
Director, Office of Wetlands & Water Protection
Phone: 804-698-4105
Dave.davis@deq.virginia.gov

Michelle Henicheck, PWS
Senior Wetland Ecologist
Phone: 804-698-4007
Michelle.henicheck@deq.virginia.gov



Executive Summary

The Virginia Department of Environmental Quality (DEQ)--Water Division--Office of Wetland and Stream Protection (OWSP) has in place an ongoing effort to enhance wetland permit compliance. As part of this effort, DEQ recently completed a study to assess the effectiveness of its Comprehensive Environmental Database System (CEDS) in tracking wetland preservation and evaluation of potential use of remote sensing technologies to identify and quantify wetland loss or changes. DEQ commissioned the Conservation Management Institute (CMI) at Virginia Polytechnic Institute and State University to conduct the study. An overarching goal of the CMI study was to explore ways to enhance the comprehensive spatial record of wetland permits as well as the identification of actual wetland losses and gains over time in support of Virginia's statutory goal of "no net loss" of wetland acreage and function. The two major task components of the CMI study were to:

- 1) Evaluate the accuracy and effectiveness of DEQ's CEDS permit records for wetlands preservation;
- 2) Investigate the use of Landsat Time Series imagery to monitor wetland change dynamics; and conduct a feasibility study on the potential use of Light Detection and Ranging technology (LIDAR) in wetland mapping and assessments.

As part of its CEDS review, CMI provided spatial delineations or locations of wetlands in database form. The review also verified the accuracy of data entered into CEDS versus DEQ's paper files. The CMI study identified a significant number of cases in which preservation areas exhibited some loss of wetlands. Use of cutting edge remote sensing and data collection technologies was evaluated for its potential to recognize and capture subtle disturbances within wetlands that may result in a loss of overall acreage or function. This component of the grant-funded CMI study demonstrated the effectiveness of Landsat Time-Series data not only for identifying wetland conversions but also for its potential ability to capture subtle disturbances within wetlands in temporal context. It was also determined that LIDAR has the potential to capture even finer-grained changes within wetlands that would otherwise escape detection. However, in contrast to Landsat imagery which is free and widely available, LIDAR remains expensive. As LIDAR costs decrease and the data becomes more widely available, its use in wetland permitting compliance will likely become feasible.

DEQ's ongoing effort to enhance our wetland permit compliance also entails a robust Community Outreach component, which was identified in this grant as Task 3. The goal of the Community Outreach is to foster ongoing, meaningful communication between DEQ and all stakeholders in the wetlands regulatory process. DEQ is also committed to the use of digital technology and electronic formats in all aspects of permit processing, issuance, review, and record keeping, if available. Among other benefits, the use of cutting edge remote sensing data collection would benefit the agency with the protection and enhancement of Virginia's wetland resources over the long term.

Introduction

The Virginia Water Protection (VWP) permit program is administered by DEQ's Office of Wetlands & Stream Protection, and derives its regulatory authority from both the Clean Water Act (§401) and State Water Control Law (§62.1-44.20 of the Code of Virginia). The VWP permit regulations were first enacted in May 1992 to serve as the Commonwealth's nontidal wetlands program and Section 401 certification process for federal Section 404 permits.

Before July 1, 2000, applicants seeking a Clean Water Act § 404 permit (<http://water.epa.gov/lawsregs/guidance/wetlands/sec404.cfm>) from the U.S. Army Corps of Engineers (the Corps) for the discharge of dredged or fill materials in wetlands or waters of the United States were also required to submit an application to DEQ for a permit or waiver under § 401 Certification. In 2000, Virginia passed a Nontidal Wetlands Act that amended Title 62.1 of the Code of Virginia relating to wetlands. The Nontidal Wetlands Act establishes the Commonwealth's nontidal wetlands regulatory program to achieve "no net loss" of existing wetland acreage and function, and to develop voluntary and incentive based programs to achieve a net resource gain in wetlands. Amendments to the VWPP program, fully implemented in October 2001, provide additional state jurisdiction and require a state permit for the following activities in a wetland: excavation, filling or dumping, activities in a wetland that cause drainage or otherwise significantly alter or degrade existing wetland acreage or function, and permanent flooding or impounding. A key aspect and statutory goal of Virginia's nontidal wetlands program is ensuring that there is no net loss of wetland acreage and function through permitted impacts.

To improve permit compliance and appropriate preservation of wetlands, DEQ requires a comprehensive spatial record of wetland permits and identification of wetland losses and gains over time to support Virginia's statutory goal of no net loss of wetland acreage and function. Currently, DEQ tracks wetland permits in its Comprehensive Environmental Database System (CEDS). While CEDS is very adept at recording permit related actions, its geospatial referencing ability is somewhat outdated and unable to track mitigation locations.

In part to address this deficiency, DEQ commissioned a study to assess the effectiveness of CEDS in tracking wetland preservation, as well as to identify ways to utilize remotely-sensed data to recognize and quantify wetland loss or changes. The study, funded through EPA grants was conducted by the Conservation Management Institute (CMI) at Virginia Polytechnic Institute and State University. The CMI reviewed the effectiveness of CEDS in capturing geospatial data and focused on providing DEQ with a spatial dataset to locate individual wetlands on a permitted property. Also provided by CMI were specific recommendations to enhance the effectiveness of permitting process as a whole through the adoption of digital format and protocols.

Another component of the CMI study evaluated the Landsat Time Series data with respect to its potential to track wetland conversions through time as well as to differentiate subtle disturbances within wetlands. The potential use of Light Detection and Ranging technology (LIDAR) in wetland mapping and assessments was also explored.

A. Project Goals

Project Background/Need

The EPA grant funded studies were commissioned to address several needs previously identified in the DEQ wetlands permitting program. Among these was the ability to assess the overall effectiveness of CEDS. Also addressed was the potential use of new technologies to enhance geospatial analysis in context of wetlands permitting. Currently, the DEQ can map wetland permit locations using latitude and longitude recorded in the existing CEDS database. However, unpermitted activities are difficult to assess due to a lack of GIS capabilities associated with CEDS. Over time, DEQ plans to link CEDS with GIS applications. Until these geospatial linkages are established, the VWP program must create GIS layers using existing CEDS data so that staff and management can make informed, risk-based inspection decisions. Having full GIS data capabilities could highlight areas with potential compliance problems, which could then be targeted for more frequent or intensive inspections, or educational outreach.

This grant allowed for DEQ to obtain an assessment of the accuracy of wetland preservation data recorded in CEDS, as well as providing DEQ with a spatial database of permit related preservation sites. In helping DEQ improve its ability to identify, regulate, and protect wetlands in Virginia, this grant specifically addressed EPA's national wetland program priorities for regulation and protection enhancements and Goal 4 of the federal agency's current strategic plan.

Using funds from an EPA grant (BG-98392503) dispersed in 2009, DEQ studied the feasibility of using remotely sensed data to detect unpermitted activities in wetlands. DEQ envisioned this technology would have the potential to allow VWPP inspectors to focus their efforts in areas where wetland losses are highest, thereby resulting in the greatest environmental benefit. Should such remote sensing applications enter practical use, the DEQ VWP program would have the ability to readily identify unpermitted wetland impacts and initiate enforcement, as warranted.

B. Project Objectives

Scope of Work

CMI was contracted by DEQ to evaluate DEQ's CEDS database and study methods to utilize remotely-sensed data to identify wetland change and loss. The work conducted by CMI was divided into three specific tasks with the aim of providing DEQ better means to meet its responsibility to protect wetland resources in the permitting process through the use of advanced technology and new protocols. These were tasks were:

Task 1. Geolocate preserved wetlands and evaluate the completeness of DEQ CEDS wetland permit records for preserved wetlands

Task 2.1. Investigate the use of Landsat Time Series imagery to monitor wetland change dynamics

Task 2.2. Conduct a feasibility study on the potential use of Light Detection and Ranging technology (LIDAR) in wetland mapping and assessments

Task 3. Community Outreach (conducted by DEQ)

Also included in the CMI submittal were recommendations for changes in permit processing protocols through which certain efficiencies could be realized. These recommendations focused on use of digital formats and other technologies, both in permit issuance and in record keeping.

In tandem with the EPA grant-funded review of the CEDS system and remote sensing pilot studies, the DEQ VWP revamped its Community Outreach program. As with the EPA grant-funded studies, the overarching goal of this effort was to find ways to enhance the efficiency of the VWP permitting process and its effectiveness in protecting wetlands and other water resources in Virginia.

Findings

Task Components

Task 1. Geolocate preserved wetlands and evaluate the completeness of DEQ CEDS permit records for preserved wetlands

CMI concluded a study that verified the accuracy and completeness of wetland preservations recorded in the CEDS database. Additionally, where possible, CMI provided DEQ spatial delineations or locations of wetland preservations in a database form.

The data set analyzed by CMI in the study consisted of VWP individual and general permits issued between 1988 and 2010 that contained wetland preservation as a permit condition. CMI visited each DEQ regional office and recorded 195 wetland preservation areas (37.5 percent of the CEDS total). After a thorough review of the permit files, CMI did not discover any significant discrepancies between the CEDS database and the paper files.

A spatial database with detailed information on wetland permit locations and areas of preserved wetlands (delineated as polygons or point locations) was provided by CMI. Further review of these permits is recommended. No preservation violations were noted when comparing the CEDS records to the 2006/2007 Virginia Base Mapping Program (VBMP) air photo imagery. However, when comparing the 2006/2007 VBMP imagery and 2011 high resolution imagery, available from the National Agriculture Imagery Program (NAIP), 47 preservation sites appeared to show deviations from recorded preservation data. Further review of these specific permits is recommended to determine if potential loss indicated on the 2011 NAIP imagery is attributable to actual physical ground changes (violations) or inaccurate photo interpretation.

In addition to photo-interpretation, other factors could account for apparent wetland loss. These include:

- Permit modifications not identified by CMI
- Compensation converted to a different mitigation type (i.e. preservation to mitigation bank), and/or
- Design limitations of CEDs for entry and extraction of permit data and program reporting. CEDS was originally developed for numeric entry of water quality standards and reporting. The VWP program has restructured the general permits section of CEDS to improve the utilization towards reporting of VWP permits. Our current EPA funded grant (EPA # BG98392504-0) is working to develop a technical specifications document that can be used to either internally complete the necessary database programming for the Individual Permits section of CEDS or obtain a contract to complete such programming.

Task 2.1 Investigate the use of Landsat Time Series imagery to monitor wetland change dynamics

The recent release of free Time Series Landsat data has been extremely helpful to relatively small scale land use and environmental studies. The long span of now available data (up to 25 years) potentially allows researchers to capture fine resolution changes in environmental conditions while factoring out natural year to year variability. CMI used Time Series of Landsat data covering over 20 years of leaf-on imagery to study changes across a multi-county area Northern Virginia.

By employing a trajectory-based change detection method using Landsat imagery, CMI identified areas of permanent disturbance as well as subtle disturbance events that occurred in wetlands within the study area. The overall accuracy of the change detection was determined to be 89.4 percent. This represents a significant improvement over what is possible using single year air photo imagery.

In addition to being able to effectively identify areas of complete wetland loss, other disturbance activities captured by the method included timber logging and thinning activities, farming, and conversion of wetlands to open water bodies. Further, while identifying specific areas of change in fine resolution, Landsat Time Series imagery also establishes firm temporal context (exact year of disturbance).

A full description of the study and its results appear under Appendix C *Investigating the Use of Landsat Time-Series for Monitoring Wetland Change Dynamics*.

Task 2.2. Conduct a feasibility study on the potential use of Light Detection and Ranging technology (LIDAR) in wetland mapping and assessment

CMI in collaboration with faculty at Virginia Tech initiated a feasibility study on the potential use of LIDAR in wetland mapping and assessment. The study looked at the use of LIDAR-derived digital elevation models, wetness indices derived from LIDAR, and the use of LIDAR datasets to identify anthropogenic changes within a wetland complex.

The study area consisted of the Cedar Run Watershed and surrounding landscape in Prince William and Fauquier counties, Virginia, including the Cedar Run Wetlands Mitigation Bank. This study area was selected for a number of reasons. First, the Cedar Run Wetlands Bank covers 715 acres of former cattle pasture and crop land now compensatory wetlands and buffer area. This provided additional research opportunities by way of evaluating the quality and effectiveness of the environmental mitigation efforts. The land and land uses surrounding the wetland mitigation area are highly typical of that portion of Northern Virginia. This part of the state is experiencing intense development pressure, adding value to its use as a case study.

The remote sensing study was limited to Palustrine wetland classes. Open water and areas of *Phragmites* were eliminated to factor out short term, natural variability not connected to anthropogenic impacts. Using time series (multi-year) data offered by LIDAR was a significant

benefit as it helped eliminate false change results associated with single event atmospheric conditions.

While preliminary, results of the LIDAR study were clearly promising. It was determined that LIDAR has the potential to capture finer changes within wetlands that would otherwise escape detection using other remote sensing or imaging methods. A full accounting of study methods and findings appear under Appendix D *Lidar Pilot Study*.

In contrast to Landsat imagery which is free and widely available, LIDAR remains prohibitively expensive for small scale studies such as assessing individual wetlands. As LIDAR costs decrease over time and the data become more widely available, its use in wetland permitting compliance will likely become feasible.

Task 3. Community Outreach

DEQ strives to maintain a robust community outreach program. The agency believes that keeping the public informed as to how and why state waters, including wetlands, are regulated is essential to success in protecting these resources. As part of our commitment to reach the public, DEQ has updated and expanded the *Public Guide to the Wetland Permitting Process in Virginia*, a publication last produced in 2002. This document will be available in electronic format and is designed to easily accommodate statutory and regulatory changes, newly developed program guidance, and updates to websites for additional resources.

Grant support by EPA has also allowed for a comprehensive reorganization and update of DEQ's VWP website (<http://www.deq.virginia.gov/Programs/Water/WetlandsStreams.aspx>). The new website includes basic wetland information intended for the general public, as well as detailed data to support professional watershed planning and management. Other changes include reorganizing the regulatory and compliance pages, the addition of summary metrics on the overall success of the wetland permitting and compliance programs, and the addition of a Wetland Monitoring and Assessment page.

The publically available Status and Trends [report](#) for our regulatory program will continue to inform the public on how Virginia is achieving its statutory goal of no net loss of wetland acreage and function. This electronically available document summarizes trends in permitting, compensation, and compliance activities carried out by the DEQ Water Division's Office of Wetlands and Stream Protection.

DEQ staff also gives informational presentations to development interests, real-estate agents and community stakeholders on wetland issues and the regulatory process.

The *Public Guide to the Wetland Permitting Process in Virginia* publication is available on our website under the "Featured Topics" section of the Wetland and Stream Protection home page: <http://www.deq.virginia.gov/Programs/Water/WetlandsStreams.aspx>

D. Conclusions

CMI Recommendations

During the course of the CEDS review and related studies, CMI identified actions that could potentially impart efficiencies into the VWP permit process and related record keeping.

Based on these findings, CMI makes the following recommendations for DEQ to consider:

- The most significant recommendation would be for DEQ is to require electronic versions of permit applications and the related spatial data be submitted digitally along with the hardcopy versions.
- Given CMI's current understanding of the database and filing system, we believe the remaining permit data could be digitally recorded relatively quickly and inexpensively.
- Adding a field in CEDS indicating the status of the permit. This would be useful for users as an indication that the preservation is complete, in process, or never completed and would allow a user to know the status at a glance.
- A review of the wetland preservation areas should begin with the staff member most familiar with the permit to determine if there were unidentified changes that were not captured or removed in the spatial data.
- As a result of numerous conversations with DEQ staff members, CMI believes the DEQ has an enormous amount of institutional knowledge regarding preserved wetlands in Virginia that is not captured by CEDS. CMI recommends that DEQ capture as much of this as possible in the spatial database for the use of future DEQ employees.

DEQ Recommendations

Based on CMI's findings, DEQ concludes with the following responses and recommendations:

DEQ currently allows permittees to submit Joint Permit Applications (JPAs) electronically including submittal of shapefiles and other digitally formatted information. Even though this is an option available to the public, it is not a requirement due a variety of factors including the diversity of permittees, types of permits issued, and economics. Permittees not only include developers, consultants, institutional and non-profit organizations but also individual landowners who are unable to hire a surveyor/consultant or unable to access the resources and equipment needed to delineate wetlands.

In regards to CMI's observations of our filing system, a mandate was issued by Governor Kaine in 2010 for all state agencies to use ECM (Enterprise Content Management) with DEQ as the pilot agency to implement it. ECM is the method and tools for the capture, management, storage, preservation, and delivery of agency information stored in digital format. This digital information includes permits, spreadsheets, presentations, photos, PDF's, and other content. FileNet is a component to ECM. FileNet includes a Record Manager component that will be used to track retention schedules and affect record destruction. FileNet also has a powerful workflow engine that will enable the agency to automate many of its business processes making them more efficient. FileNet and CEDS are separate but complimentary applications. CEDS is a

database and FileNet is a digital document repository. When indexing a document into ECM, provided the facility is also in CEDS, some of the metadata is validated or verified with the CEDS database. Additionally, some metadata is mined from CEDS that saves the user keystrokes and can be used in searches. At the present time, ECM interacts with CEDS but CEDS does not interact with ECM. The Office of Wetland and Stream Protection (OWSP) is in the process of scanning all of our previously issued VWP permits to digital format.

Currently, our DEQ Northern Regional Office (NRO) is working on a GIS project that would map the polygons for all permitted preservation areas and maintain this information in future permitting actions. The project objectives were to develop a process to better ensure “No Net Loss of Wetlands” by creating easy access to 1) project boundaries, 2) wetland and stream “Permittee Responsible Mitigation (PRM) area boundaries, 3) riparian buffer PRM areas, and 4) other required PRM areas and finally to monitor PRM areas for encroachment using aerial imagery.

By using GIS and various layer files available from the Virginia Environmental Geographic Information Systems (VEGIS), a robust GIS mapping application that provides several mapping services created expressly for DEQ, a base map was created for NRO to geo-locate VWP permits. Refer to the following links to access the VEGIS data viewer and available datasets: <http://www.deq.virginia.gov/ConnectWithDEQ/VEGIS.aspx>, http://www.deq.virginia.gov/mapper_ext/default.aspx?service=public/wimby

Using base map components from the DEQ and VEGIS server, the latitude and longitude of all NRO VWP permits in CEDS were used to plot points on an ArcMap of the region. Permit data was then stored in County specific geodatabases. Project polygons were created to identify the location and boundaries of the compensation areas (identified by type – preservation, creation, or restoration.) Survey accurate polygons, wetland delineation boundaries, and impact area location, or the type of resource preserved (i.e. stream, wetland, buffer, etc.) were not provided in this project.

Attempts were made to acquire survey accurate shapefiles of PRM areas from project agents but in the end, due to myriad issues, it was determined that NRO would need to create the PRM area boundaries from the information located in the hardcopy files. Consequently the NRO VWP GIS project develops PRM area boundaries by using the ArcMap Editor’s draw tool. While this does not create a survey accurate boundary it does create a geo-spatially consistent “frame” which can be overlaid on chronologically sequential aerial photography to screen for land use changes in PRM areas. Screening is performed to monitor for encroachments and to screen JPA’s for potential project conflicts with existing PRM areas. Given the agency’s “due diligence” responsibility for PRM areas and potential repercussions with permitting impacts to existing PRM areas, the creation and periodic monitoring of PRM area boundaries is also considered a fundamental goal and objective of the NRO VWP GIS project. Researching and creating all the region’s PRM areas is a resource intensive task and requires designated staff (e.g. intern, wage, etc.) to complete in a reasonable time frame.

The NRO GIS project is in the beginning stages of development. Without accuracy and precision, the usefulness of entire project becomes debatable. Obviously the most up to date

approved final compensation is a requirement for accuracy. In addition, aerial images and high resolution imagery are required for accurate analysis to determine the exact location of preservation boundaries.

The DEQ NRO now requires new permittees to submit conservation polygon shape files if the capability to submit the information exists.

Environmental Outcomes & Improvements

The EPA-grant funded studies and initiatives commissioned by the DEQ Office of Wetlands and Stream Protection have resulted in clear and tangible environmental benefits. The CMI study provided DEQ with the framework for a digital database for permit condition preserved in Virginia. The evaluation of the CEDS system was of clear utility to VWP program and the agency as a whole. DEQ is moving forward implementing recommendations provided by CMI to incorporate more digital media and technologies into the wetlands permitting process. This is anticipated to result in significant efficiencies.

The feasibility studies on using satellite data to detect and monitor wetland changes demonstrated that these technologies and processes hold great promise. The CMI authors of the Landstat Time-Series data study on monitoring wetland change dynamics are preparing a submission to the *Journal of Wetlands*. Publication of the article will bring evaluation of this cutting edge technological advancement in the field of wetland monitoring and assessment before a nationwide audience of natural resource management professionals.

Support from EPA has also aided the DEQ Office of Wetlands and Stream Protection to enhance its outreach program. These enhancements are helping foster a better understanding in both the regulated community and the general public as to the importance of the natural resources the agency is charged with protecting. Further, DEQ will increase the overall awareness of our regulatory and compliance programs. The overall outcome of this continued focus on wetland permit compliance and community outreach will be better protection of wetlands and more definitive and defensible information on wetland protection efforts integrated with other water programs over time, incorporation of wetland issues into broader watershed planning and management goals, and documentation of how we are achieving no net loss of wetland acreage and function in Virginia.

The result of this grant has provided DEQ the capability to improve wetland tracking therefore providing better protection of wetlands. This project goal directly supported Goal 4 of EPA's Strategic Plan to "*protect, sustain, or restore...ecosystems using integrated and comprehensive approaches and partnerships*" and the National Priority of "*regulation for enhancing wetland protection*".

Appendix A

CMI's Executive Summary Report

Appendix B

*CMI's Geolocation of Preserve Wetland
in the State of Virginia and
Analysis of Wetland Permit Records*

Appendix C

*Investigating the use of Landsat Time-Series for
Monitoring Wetland Change Dynamics*

Appendix D

Lidar Pilot Study