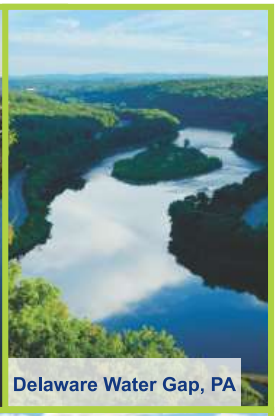
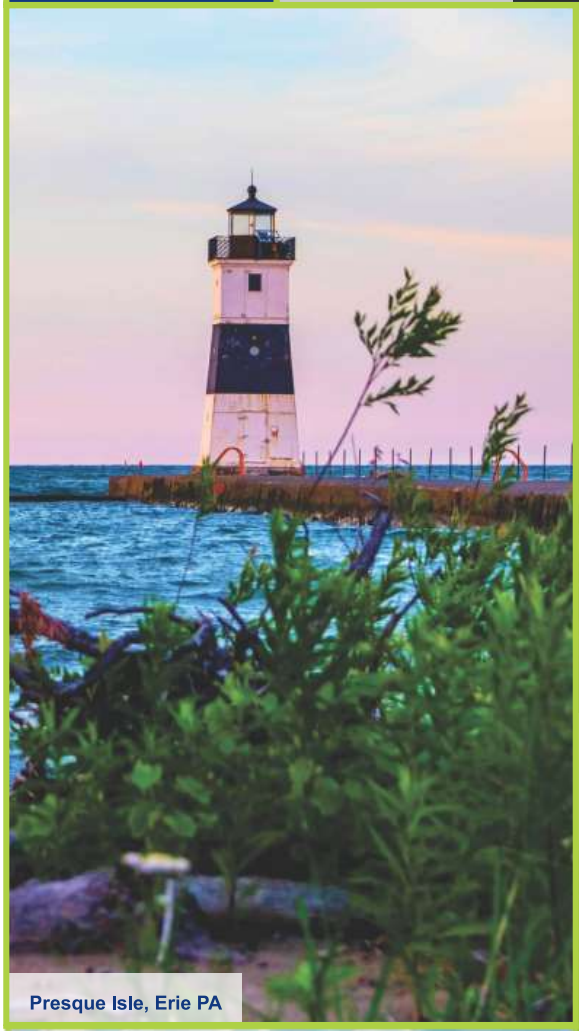

Update
2022
Pennsylvania
State Water Plan
pennsylvania
DEPARTMENT OF ENVIRONMENTAL
PROTECTION

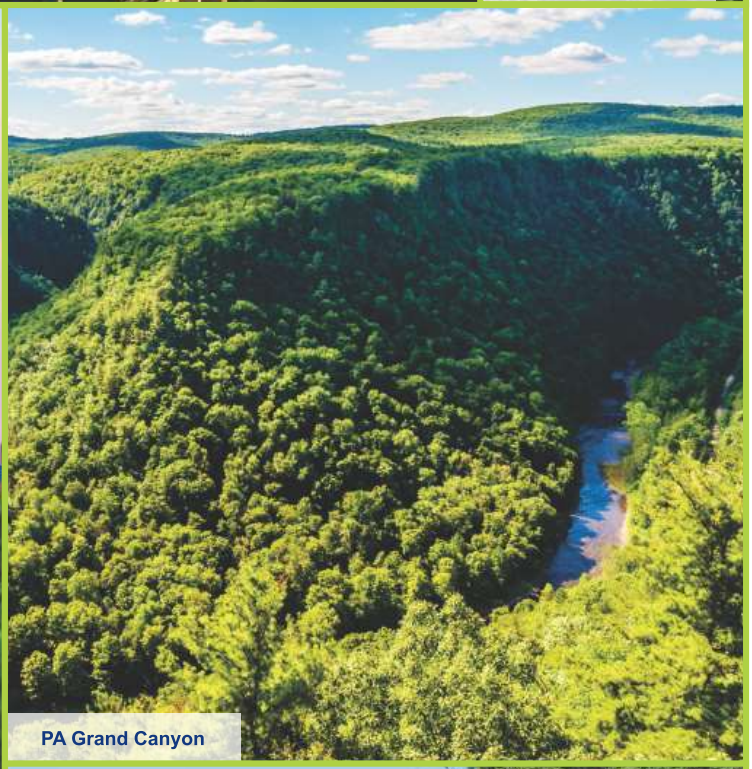
Harrisburg, PA



Delaware Water Gap, PA

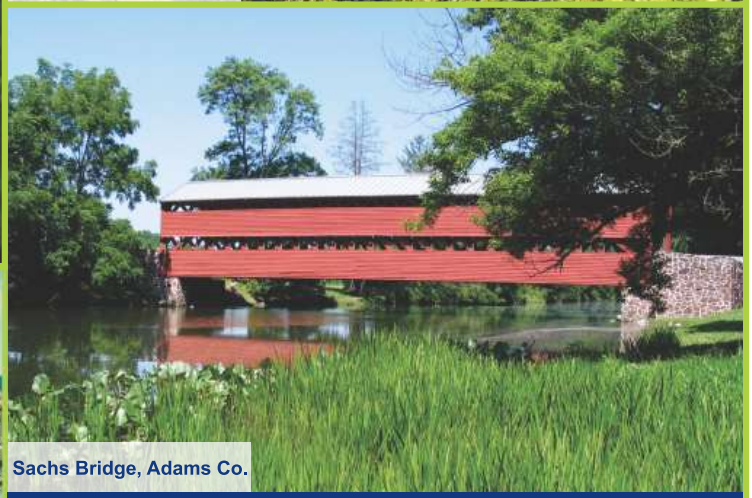


Presque Isle, Erie PA



PA Grand Canyon

Pittsburgh, PA



Sachs Bridge, Adams Co.

PENNSYLVANIA STATE WATER PLAN UPDATE 2022

An update of the State Water Plan under the Water Resources Planning Act, Act 220 of 2002

_____ _____, 2022

Message/Welcome

From Secretary, or

Secretary/Statewide Committee Chair

Placeholder

Examples:

MESSAGE FROM SECRETARY PATRICK MCDONNELL

Tools to Lead on Climate Action

Slowing down future climate change and adapting to changes that are already happening present a challenge on a scale that can seem overwhelming. Where to start?

Pennsylvania Climate Action Plan 2021 is where to start. Here you'll find statewide data on and trends in greenhouse gas emissions from every sector: electricity generation, transportation, industry, agriculture, residential and commercial buildings, and more.

A suite of 10 strategies is recommended that—if started now—will meet our statewide greenhouse gas emissions goals for 2025 and 2030. For each strategy, the emission reductions, costs, and benefits in jobs and economic growth are quantified, and health and social benefits are analyzed. Supplemental strategies are also recommended to bolster efforts toward greenhouse gas reductions.

In addition, Pennsylvania Climate Action Plan 2021 identifies priority areas to focus our preparation and adaptation: public health, overburdened and vulnerable populations, agriculture, recreation and tourism, infrastructure, and forests, ecosystems, and wildlife.

Pathways to adaptation are mapped out that will enable us to lessen negative impacts and capitalize on any potential opportunities created by climate change.

After getting an overview from this booklet, head to www.dep.pa.gov/climate. There you can review the complete Pennsylvania Climate Action Plan 2021 in depth to inform your policy, planning, and program decision making. You'll also find helpful related resources, including Pennsylvania Climate Impacts Assessment 2021, the Local Climate Action Program, statewide data on greenhouse gas emissions, as well as on job growth and workforce development needs in clean energy industries, and many more tools to lead on climate action in Pennsylvania.

September 22, 2021

Commonwealth of Pennsylvania

STATEWIDE WATER RESOURCES COMMITTEE

DEPARTMENT OF ENVIRONMENTAL PROTECTION

Dear Reader:

As Chairperson of the Statewide Water Resources Committee and Acting Secretary of the Department of Environmental Protection (DEP), we are pleased to present you with the Pennsylvania State Water Plan (Plan). The Plan is the culmination of more than five years of data gathering, analysis and research, and we believe that the Plan will prove to be a meaningful and useful tool that will benefit each and every Pennsylvanian.

We would like to take this opportunity to express our gratitude to the 169 members of the Statewide and Regional Water Resources Committees who graciously volunteered their time to oversee and participate in this process. Their input and expertise were invaluable to the development of the Plan, and we look forward to continuing working with them into the future.

Following is the State Water Plan Principles which highlights the State Water Plan Priorities and Recommendations for Action, key components of the Plan that will carry us into the next five years and lay the groundwork for future versions of the Plan. The Plan in its entirety is also available on DEP's worldwide Web site to further engage the public and provide the resources needed for anyone to make informed decisions about water resources management. By providing improved information to make more informed decisions, we can continue to make the commonwealth a great place to live, work and recreate, and still be surrounded by beautiful natural resources.

Sincerely,

Donald C. Rhodes II
Chair
Statewide Water Resources Committee

Sincerely,

John Hanger
Acting Secretary
Department of Environmental Protection

Preface

This 2022 State Water Plan Update (updated State Water Plan or 2022 Update) was prepared under the Water Resources Planning Act or the Act of December 16, 2002, P.L. 1776, No 220 (Act 220 of 2002)[1] which requires the Department of Environmental Protection (DEP) to conduct a periodic review of the State Water Plan.

The goal for the updated State Water Plan was to evaluate the outcomes from the extensive body of technical work performed for the 2009 State Water Plan Update (2009 Update) through the interim period to the beginning of the updated State Water Plan. This evaluation was used to form a policy-level report providing a fresh assessment of issues and revised recommendations, and an appraisal of new climate action strategies. Tasks included:

- Evaluations of previous regional and statewide water resources priorities
- Appraisals of the previous plan's goals
- Development of improved online public access to data
- Expansion of educational and outreach opportunities
- Evaluations of climate action strategies related to water resources
- Continuation of work with previously started Critical Area Resource Plans

Under the provisions of Act 220 of 2002, a collaborative approach was taken to the updated State Water Plan. A host of statewide and regional stakeholders serving on a statewide committee and six regional committees advised and guided DEP toward an understanding of today's evolving priorities and needs across each of Pennsylvania's six unique water resource planning regions.

This updated State Water Plan consists not only of this summary report, but also includes the following additional components to meet a wide range of water resource planning and educational needs:

- A collection of web-based tools for access to water withdrawals data

  Since the 2009 Update, several significant improvements in data management were developed. Funding assistance received since 2015 from the United States Geological Survey has improved the process of collecting, managing, and sharing water use data, a priority of state water planning efforts. DEP has developed several web-based products to readily share water use data and information with the public that are essential components of the 2022 Update. These products include water use report viewers and water use summary reports, which can be accessed on DEP's website[2].

[1] Act 220 of 2002
https://www.legis.state.pa.us/CFDOCS/LEGIS/LI/uconsCheck.cfm?txtType=HTM&yr=2002&sessInd=0&smthLwInd=0&act=0220.

[2] Department of Environmental Protection, Water Use Reports
https://www.dep.pa.gov/DataandTools/Reports/Pages/Water.aspx

- An updated digital water atlas

  Utilizing technologies that combine text with interactive maps and multimedia content, a new updated digital atlas complements the Pennsylvania Water Atlas from the 2009 Update with updated information and maps to educate the public and help water resource managers make informed decisions, avoid conflicts, and employ effective management practices to protect water resources.

- A platform for educational materials on water resources

The Pennsylvania Clean Water Academy[3] serves as a digital training library for DEP, conservation district staff, and sewage enforcement officers, with some limited training content available to the public. The Pennsylvania Clean Water Academy contains a wide range of water-related webinars, eLearning, and other resources including but not limited to stormwater, water quality, stream encroachments, and water quality data. DEP's State Water Plan Program will take advantage of this platform to expand outreach and educational opportunities by posting water resource-related content.

The State Water Plan is to be reviewed every five years as per the provisions of Act 220 of 2002. Although the Act calls for reviews every five years, ongoing planning work by DEP under the State Water Plan implementation known as "Path Forward" will continue with the guidance and advice of the statewide and regional committees who will meet periodically on an ongoing basis.

[3] Pennsylvania Department of Environmental Resources, Clean Water Academy https://pacleanwateracademy.remote-learner.net/

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Executive Summary

Introduction

The purpose of this report is to provide the results of a review of the Pennsylvania State Water Plan as required by the Water Resources Planning Act, Act 220 of 2002 (Act 220 of 2002)[4] that forms the basis for an updated State Water Plan. Periodic reviewing and updating is important to assure the State Water Plan reflects the vision, goals, and recommendations that will ensure sustainable water use over time.

The previous update of the State Water Plan was completed in 2009. During the years between 2009 and the beginning of this update, organizational restructuring and budget reductions directed the focus of state water planning efforts primarily toward improvements in data reporting, access, and collaboration. Streamlining processes and refining its data system have substantially improved compliance by public water suppliers in reporting water withdrawal and use reports, increased data accuracy, and extended access to the public. These improvements benefit those who rely on the water data to make informed water resources decisions. Background information on the State Water Plan is described in Chapter 1.

This review was a collaborative effort by DEP in consultation with one statewide and six regional water resources committees with diverse memberships representing various water use sectors, state and federal agencies, and river basin commissions. More information on the collaborative approach may be viewed in Chapter 1.6.2.

Assessments of the 2009 State Water Plan Update (2009 Update) identified those priorities and recommendations for action that would benefit from updating and also identified new or emerging priorities which may be added to the recommendations for action. Evaluation of state water planning activities will continue during the implementation of this updated State Water Plan. The assessment process, described as the "Path Forward," will continue to reevaluate topics discussed but not addressed during the 2009 Update and this current update, as well as assess new or emerging issues. The Path Forward provides accountability on work progress and adaptation in addressing emerging water resource needs.

Summary of Outcomes

Key outcomes from the collaborative assessment process yielded the following:

- Assessments of regional water resources priorities for each of six regions
- Assessment of statewide priorities, and redeveloped priority recommendations for action
- Recommended legislative priorities of the statewide water resources committee

See Chapters 2.1 through 2.4 for detailed information on the regional and statewide assessments and recommendations.

Assessment of Regional Water Resources Priorities

Table 1 summarizes the outcomes from each regional committee's assessment and updates of the regional water resources priorities developed under the 2009 Update to reflect ongoing and new challenges that have impacted Pennsylvania since the previous update of the State Water Plan.

[4] Pennsylvania General Assembly, 2002 Act 220 https://www.legis.state.pa.us/CFDOCS/LEGIS/LI/uconsCheck.cfm?txtType=HTM&yr=2002&sessInd=0&smthLwInd=0&act=0220.

Table 1. Summarization of Regional Priorities

Region	*Priorities*
Delaware	***Strengthen the Link Between Land Use and Water Resources Management*** • Develop and distribute water resources information and data • Preserve, protect, restore, and enhance the quality, quantity, and availability of clean, sustainable water supplies for the people, businesses, and ecological needs of the Commonwealth
	Regional Planning and Land Use Coordination and Collaboration • Think regionally and act locally • Conduct Integrated Water Resources Planning on a holistic watershed basis • Coordinate between local, state, and federal entities
Great Lakes	***Protect Water Quality and Quantity in the Basin*** • Take larger role in federal legislation and other measures that may impact Lake Erie and Lake Ontario • Have Northwestern Pennsylvania take larger role in state legislation impacting Lake Erie and Lake Ontario • Protect water quality throughout region's watersheds by assessing biology, analyzing contaminants, evaluating impact of stormwater management, and following agricultural best management practices
	Coordinate with Partners • Engage with other states, provinces, and stakeholders • Collaborate toward a regional approach with support of Department of Environmental Protection (DEP) for communication and incentivized cooperation through grant funding • Coordinate through education and outreach

Lower Susquehanna	***Identify and Target Solutions for Potential Protection Priority Water Resources to Reduce or Prevent Point and Nonpoint Source Pollution with a Focus on Currently Impaired Water Resources*** • Identify "protection priority" water resources • Identify targeted solutions • Reduce existing point and nonpoint source pollution • Prevent new water pollution from all sources • Broaden support and advocacy for water resources
	Enable Continued Responsible Economic Growth by Ensuring Adequate Water Resources • Prioritize resiliency solutions to address increased stormwater runoff and flooding, including restoration and expansion of green infrastructure • Include proactive management of land development and land expansion • Provide support to local governments and municipalities through training and model ordinance development, and enlisting non-governmental organizations, watershed groups and riverkeepers
Ohio	***Inter-Agency Water Resources Planning*** • Support holistic approaches to water quality, quantity, and availability • Develop plans that identify water resources needed to promote and facilitate economic development while maintaining watershed integrity and recreational benefits • Develop plans that evaluate impacts of resources extraction from the Marcellus Shale • Take initial step of inter-agency water resources planning through Act 167 stormwater planning
	Water Quality and Quantity • Institute integrated approach to quality and quantity challenges • Increase data collection to inform community input and watershed planning • Prioritize natural systems, man-made infrastructure, and water treatment • Prioritize multi-municipal planning and funding projects, including best management practices that use integrated approaches to maximize pollution reduction and mitigate flooding • Address acid mine drainage, orphaned wells, inter-basin transfers, agricultural activities, sanitary sewer overflows (SSOs), combined sewer overflows (CSOs), Municipal Separate Storm Sewer Systems (MS4s), unsustainable forest management and larger-scale industrial water users

Potomac	***Promote Programs and Practices that Protect Water Quality and Quantity and Preserve the Ecological Integrity of Groundwater and Surface Water*** • Encourage municipal programs to collaborate and plan regionally, address land use planning, provide domestic water well construction standards, and implement best management practices
	Climate Change Resiliency, Especially with Respect to Stormwater Management, Flooding, and Drought • Promote stormwater management with use of riparian buffers, rain gardens and stream restoration • Identify protection priority water resources trending toward impairment
Upper/Middle Susquehanna	***Protect Important Headwater Habitats, Enhance Recharge Areas, and Minimize Stormwater Runoff of the Upper/Middle Susquehanna Basin*** • Focus on forested land use practices by minimizing large-scale forest cutting, preservation of forested ecosystem services, and reduction of sedimentation • Address legacy infrastructure in acid mine drainage areas • Reuse degraded/abandoned industrial or commercial lands • Strive to protect forest lands, preserve recreation areas and greenways, and protect critical habitat areas in rural areas • Address stormwater in suburban and urban areas with green infrastructure through zoning ordinance changes • Promote municipal ordinances in public water supply recharge areas • Implement statewide water well construction standards
	Multi-Municipal Planning and Coordination • Expand land use planning with county-wide action plans and integrated water resources management • Take a regional approach of education and outreach to water resource stakeholders • Prioritize upgrading existing aging water infrastructure • Optimize use of funding dollars through multi-municipal planning

Assessment and Update of Statewide Priorities and Recommendations for Action

To begin their work in assessing the 2009 Update, the Statewide Water Resources Committee (statewide committee) utilized a questionnaire on integrated water resources management (IWRM) and an online survey to committee members. The responses helped gauge the current highest priority water resources problems and identify gaps, shortcomings, and deficiencies in the current water resources planning and management processes and programs. Engaging discussion resulted in the establishment of high priority topics for which eight work groups were formed to develop white papers for these priority topics.

- Stormwater and Flood Mitigation
- Water Supply
- Legacy Impacts
- Water Management and Land Use Management
- Drinking Water and Wastewater Infrastructure Sustainability
- Coordination among State Agencies
- Emerging Contaminants and Water Quality
- Agriculture

Table 2 summarizes each of the workgroup topics, relevant planning outcomes for priority topics and the approaches to reach the outcomes. Click on bookmarks linking to the white papers providing detailed subject backgrounds and specific recommendations under the general approaches.

Table 2. Statewide Committee Workgroups, Topics, Relevant Outcomes, and General Approaches

Workgroup/Topic	Relevant Outcomes	General Approaches
Stormwater and Flood Mitigation Workgroup Floodplain and Stormwater Management	• Assessment of increased flooding risk due to climate change • Protection of Pennsylvania floodplains • Enhanced community recovery assistance following flood events • Improved commonwealth and local capabilities in preparing for and reacting to flooding events	• Enhance commonwealth agency capabilities with revised policies, authorities, and permitting changes • Encourage financial opportunities for floodplain and stormwater projects • Direct support to local actions based on watershed approaches • Encourage legislative funding to support programs in meeting goals • Provide technical guidance and educational training • Support administrative changes to agencies and governments

Workgroup/Topic	Relevant Outcomes	General Approaches
Water Management and Land Use Management Workgroup Integrated Water Resources Management (IWRM)	• Discovery of new opportunities to improve coordination on water resources management within DEP • Improved coordination and data sharing across state agencies and throughout the federal, interstate, state, and local government levels • Solidified connection between land use and water resources management	• Perform a baseline assessment of what IWRM may entail for DEP and other commonwealth agencies • Establish an actionable workplan to identify programmatic, policy, or regulatory options and develop actions reflecting linkage of land use to water resources management • Improve water resources coordination across agency, basin, federal, and local levels • Assist in the adaptation and promotion of existing forms of county level integrated water resources planning
Water Supply Workgroup Water Withdrawal and Use	• Evaluation of a more consistent and secure statutory water rights arrangement than found under current common law • A better understanding of future water demands • Protection of existing and future uses of private wells and other groundwater resources	• Encourage enactment of legislation to require proficiency-based licensing and certification of well drillers and to establish statewide private water well construction standards • Improve utilization of reported water use data in projecting future demand trends and managing and accessing water supply and water availability on a watershed scale • Evaluate current effectiveness and shortcomings of Pennsylvania's existing water rights and water withdrawal arrangements • Evaluate and improve DEP drought monitoring practices • Recommend all community water systems as well as self-supplied users evaluate the vulnerabilities of their respective sources to the impacts from expected increases in frequency and intensity of flooding and droughts

Workgroup/Topic	Relevant Outcomes	General Approaches
Water Supply Workgroup Water Efficiency	• Dissemination of technical information on water efficiency technologies and practices • Evaluation of climate change adaptation initiatives • Management of public water supply assets • Improved efficiency by municipal and industrial water users	• Develop and incorporate information on water efficiency technologies into the Pennsylvania Clean Water Academy. • Asses expected need for increased irrigation in the face of climate change • Promote/adopt/support appropriate technologies, policies, and practices, research opportunities, rebates, and grants for water suppliers, water users, and other interested parties
Legacy Issues Workgroup Legacy Impacts	• Improvements in existing programs to address water resources impacts from abandoned coal mines and abandoned oil and gas wells	• Support efforts that provide additional funding for addressing abandoned mine lands (AML) sites • Continue grants for maintenance funding • Develop sustainable funding for long-term treatment of abandoned mine drainage (AMD) • Support legislation to protect Good Samaritans • Support efforts including legislation to provide additional funding for identification and addressing inactive, abandoned, and orphaned oil and gas wells • Generate revenues associated with decommissioning of legacy wells • Explore third parties for decommissioning of legacy wells
Drinking Water/Wastewater Infrastructure Sustainability Workgroup Drinking Water and Wastewater Sustainable Infrastructure	• Addressing Pennsylvania's infrastructure investment and renewal challenges	• Improve data on infrastructure capital needs • Encourage water and wastewater systems to plan for long term infrastructure needs • Support legislation to promote and support development of asset management planning • Evaluate alternatives for assuring systematic assessment of water system conditions • Promote PENNVEST Programmatic Financial Guidance • Encourage financially challenged systems to consider alternative arrangements to assure technical, managerial, and financial capability

Workgroup/Topic	Relevant Outcomes	General Approaches
Emerging Contaminants and Water Quality Workgroup Contaminants of Emerging Concern	• Stronger support to DEP in fulfilling its duties regarding emerging contaminants and encouraging the federal government to extend their responsibilities	• Support efforts to establish and fund a DEP emerging contaminants program including support expansion of DEP lab capabilities and liaison with the federal government on critical emerging contaminants issues
Internal DEP Assessment of Navigation Needs	• Restoration, development, and improvements to water transportation and assessments of environmental risks and impacts	• Support commonwealth agency efforts in addressing hydrological, structural, and qualitative aspects associated with commercial and recreational navigation on waterways. • Support commonwealth participation in navigation related arrangement involving international federal, interstate, and regional governments and institutions
Agriculture Workgroup Agriculture Nonpoint Source Pollution	• Evaluation of the impact of nonpoint source runoff from agricultural operations on the water quality of Pennsylvania's waterways through the support of commonwealth and federal agricultural programs	• Support legislative bills addressing agricultural nonpoint source pollution • Support federal United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) initiatives

Recommended Legislative Priorities of the Statewide Water Resources Committee

Following are statewide, funding, and regional legislative priority recommendations directed at the Pennsylvania General Assembly that were extracted from workgroup papers referenced in the previous section created by the Statewide Committee and from regional components of the plan. Details on the recommendations may be found in Chapter 2.3.

Statewide Legislative Priorities

- Secure sustainable funding of water resources programs
- Establish well construction standards
- Address legacy mining and well challenges and reduce barriers to private action
- Evaluate Pennsylvania's water rights
- Amend flood control act
- Establish sustainable public and private stormwater management infrastructure
- Enact water resources restoration policies
- Facilitate asset management planning
- Create program for agriculture conservation practices
- Reduce livestock access to streams

Funding Priorities

- Assist conservation districts in hiring more staff and expanding capacity
- Increase funding for available Resource Enhancement and Protection (REAP) tax credits
- Dedicate and increase funding for the Environmental Stewardship Fund (ESF)
- Secure additional funding for addressing inactive abandoned and orphan oil and gas wells
- Re-invigorate funding for Act 167 stormwater plans and Act 537 sewage facilities plans
- Provide outreach and assistance to public water suppliers
- Secure funding for establishment of an emerging contaminants program
- Fund enhanced flood forecasting and warning systems
- Increase efforts to enhance community preparedness and resiliency for flood events and recovery assistance following flood events
- Locate funding sources for Chapter 102 compliance
- Fund DEP to update for update of a stormwater management model ordinance

Major Regional Priorities

- Strengthen the link between land use and water resources management
- Coordinate integrated water resources planning and inter-agency and international coordination
- Engage in Act 167 stormwater management planning

Critical Water Planning Areas

Act 220 of 2002 established a process to designate Critical Water Planning Areas (CWPAs) – areas where existing or future water demands exceed or threaten to exceed water availability. Act 220 of 2002 also authorized the preparation of Critical Area Resource Plans (CARPs) for any watershed or watersheds within a CWPA. During the State Water Plan update in 2009, considerable work was done to "screen" the entire state for CWPAs.

All the following major components for the Marsh and Rock Creek, Laurel Hill Creek, and Back Creek CARPs have been drafted.

- Verification and Statement of Problems
- Existing and Future Reasonable and Beneficial uses
- Water Availability Evaluation
- Quantity of Water Available and Required for Future Water Uses
- Assessment of Water Quality Issues
- Stormwater and Floodplain Management
- Adverse Impacts and Conflicts
- Supply-side and Demand-side Alternatives
- Recommendations

After a process of screening and verification – with input from regional committees and recommendation from the statewide committee – four watersheds were officially designated CWPAs by the Secretary of DEP: Marsh and Rock Creeks, Adams County (Potomac Region); Back Creek, Fayette

County (Ohio Region); and Laurel Hill Creek, Fayette and Somerset Counties (Ohio Region). Interactive maps showing all these watersheds' locations are available in the Water Use and Planning section of the updated State Water Plan Atlas[5].

To view the status and actions of each process for draft CARPs, refer to DEP's State Water Plan[6] website.

Assessment of Climate Change Adaptation Strategies

Assessments of Pennsylvania's Climate Action Plan 2021 (CAP 2021) and the previous Climate Action Plan 2018 (CAP 2018) revealed where water-related strategies from both documents aligned with regional and statewide State Water Plan Priority Action Recommendations.

From the CAP 2018, the opportunities of using stormwater best management practices and promotion of IWRM and water conservation correlated closely with the State Water Plan priority action recommendations related to floodplain and stormwater management and IWRM. Therefore, implementation of priority actions from this updated State Water Plan may complement other strategies to support the implementation of those CAP strategies.

The assessment of the CAP 2021 for water resources related to significant impacts, approaches and strategies also revealed relationships with several priority action recommendations and, thus, offer potential opportunities to satisfy both climate change adaption needs and other State Water Plan priority needs.

For example, suggested climate adaptation approaches and strategies to reduce the impacts of flooding on built infrastructure may be supported by investing in enhanced flood forecast and warning systems and by updating floodplain and flood insurance rate maps – priority action recommendations from the updated State Water Plan.

Details on the assessment of climate adaptation strategies are included in Chapter 3.

Data Access and Collaboration

For several decades, Pennsylvania has had the benefit of a water use data system for collecting water reports. With ongoing improvements to the system and the institution of registration regulations during the previous update of the State Water Plan, DEP now annually receives over 8,000 reports related to individual withdrawal sources (sub-facility) and over 2,000 reports (primary facility) related to the business entity or system that owns and operates sub-facilities.

In 2017, DEP launched a series of six water use report viewers to readily share with the public users' registration and periodic reporting of water use information. The project was fully funded by a United States Geological Survey (USGS) Water Use Data and Research (WUDR) grant. The report viewers are a web-based program using an SQL Server for Report Services (SSRS) server-based reporting platform.

[5] Insert URL when completed

[6] Pennsylvania Department of Environmental Protection, State Water Plan https://www.dep.pa.gov/Business/Water/PlanningConservation/StateWaterPlan/Pages/default.aspx

In 2021, an additional viewer and data export tool was added to the DEP Water Reports webpage. The water use summary report[7] summarizes total withdrawals by categories and source types using charts, maps, and tables at state, county, and watershed scales for the past five reporting years. The report also displays the locations of reported sources. However, the water use summary report excludes showing and providing the coordinates of PWS sources due to DEP's sensitive locational policy prohibiting readily sharing coordinates of these sources.

Data acquisition has significantly improved since the initial Act 220 of 2002 registrations were submitted in 2003. With support from a USGS grants program, further refinement in the collection of water data increased the accuracy and quality of data through quality assurance and control and other system functionality.

In 2021, a secure centralized site for sharing water use data was set up to exchange large amounts of water data between DEP and partner agencies. The site was designed to automate transferring of data for integration in a partner agency's own applications. This eliminates the labor-intensive manual processes involved with sharing large datasets or the need for a user to manually query and download data from a web-based application, such as DEP's report viewers.

See more detailed information on this subject within Chapter 4. Data Access and Collaboration.

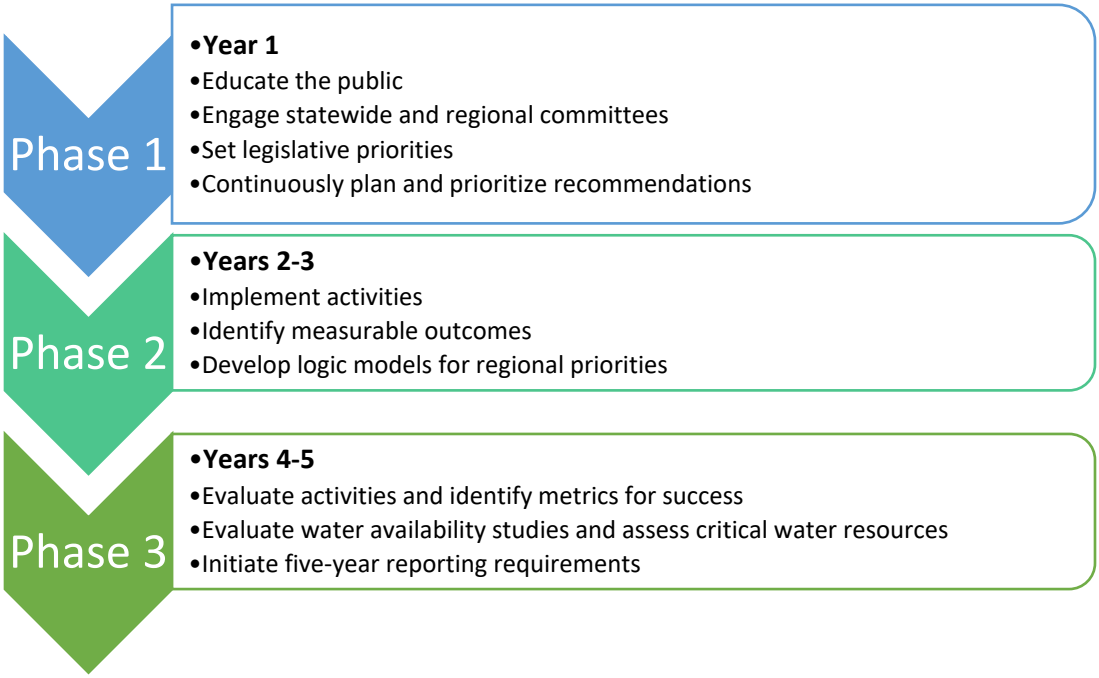
Path Forward

Throughout the state water planning process, discussions with regional and statewide committees often led to the same question: How will this plan be implemented? The particulars of this question were centered around integrated efforts of state programs and agencies as well as local governments and other stakeholders. It is felt that an integrated effort involving many levels of the government and private entities will be necessary to sustain existing water resources programs and establish a concrete linkage between water resources management and land use.

To achieve this, a phased or incremental implementation plan or "Path Forward" has been developed (as shown in Figure 1) that will: a) Provide a high level of awareness to water resources needs through public education and participation; b) prioritize and initiate work on the most important issues identified within priority recommendations; c) establish levels of accountability by measuring success in quantifiable ways; and d) institute the framework for a continuous planning process for effective administration of the State Water Plan Program.

[7] Water Use Summary Report

Figure 1. Path Forward Implementation



1.0 Introduction

1.1 How to Use the State Water Plan Update

The 2022 State Water Plan Update (update of the State Water Plan or 2022 Update) was developed for decision makers at all levels to help make informed decisions, avoid conflicts, and employ effective management practices to protect water resources. The update of the State Water Plan may be used as a source for extensive water resource data, the latest information, and policy recommendations. Additionally, the update of the State Water Plan may be a helpful guide for the development and implementation of policies, programs, and projects on water availability, infrastructure investment, water resource protection, health and safety, and access to climate change adaptation strategies. It further serves all Pennsylvanians by extending environmental educational opportunities on water resource topics.

1.2 History of the State Water Plan

State water planning has existed as a concept in Pennsylvania for over a hundred years in various forms, starting with several pieces of legislation in the early 20th century. These included the Purity of Waters Act of 1905 in response to outbreaks of typhoid and cholera. Additionally, the Controlling of Water Resources Act of 1913, which led to a large inventory to be taken of Pennsylvania's water resources, included records reaching as far back as the early 1800s.

Several laws were passed in Pennsylvania throughout the 1920s and 1930s that dealt with many concerns surrounding water quality, flooding, and water rights. In the 1960s, a severe drought in the northeastern United States led to broader federal water resources planning that allowed for the dispersal of grant monies to states to begin building their own water resource inventories and plans. Pennsylvania responded by forming an Inter-agency Water Resources Coordinating Committee that, in 1968, developed an outline of what would be the commonwealth's first water resources plan that was to be part of a broader statewide comprehensive plan. That 1968 document established plan components including objectives, what was to be inventoried, development needs, regional analyses of demands/needs, development solutions, and implementation actions.

Figure 2. 1970's and 1980's State Water Plan

It was not until the 1970s that the predecessor to the Pennsylvania Department of Environmental Protection (DEP), the Pennsylvania Department of Environmental Resources (DER), began a comprehensive state water plan based on the 1968 outline. The DER Division of Comprehensive Resources Programming collaborated with federal and other state agencies to produce what would be 20 sub-basin plan volumes (like that shown in Figure 2), completed periodically between 1975 and 1983. Each volume presented:

- Summary and recommendations
- Physical features and resources
- Socio-economic features
- Water resource problems and solutions/alternatives
- Impacts of structural alternatives

Beginning in 1997, several inquiries would be launched over a period of four years that would gauge the need for revised water resources legislation and planning. At that point, 14 years had passed since the completion of the last State Water Plan volume.

The 21st Century Environment Commission was launched by Governor Tom Ridge in 1997 to determine Pennsylvania's 21st century environmental priorities. As the 21st Century Environment Commission was underway, a drought during 1998 and 1999 further underscored the critical need for updating the commonwealth-wide water resources management planning. That commission produced recommendations that promoted responsible land use and conservation of natural resources; a healthy environment; and environmental education, training, and stewardship.

As a follow-up to the *Report of the Pennsylvania 21st Century Environment Commission*[8], Governor Ridge directed the establishment of a statewide sound land use outreach program. The *Sound Land Use Implementation Plan*[9] documented the high level of interest among Pennsylvania citizens in protecting the quality and quantity of water resources, including recognition of possible water shortages and advocacy of planning on a watershed basis through updating and implementing the State Water Plan. Of note in that plan was the critical need to understand groundwater resources.

A series of 15 water forums were convened across Pennsylvania in the spring of 2001, just months before initial county drought declarations were made later in August. During those meetings, agreement was reached on the need to manage water resources more effectively. With over 1,700 people participating in the water forums, citizens spoke to the need to update the State Water Plan (whose last volume was published then 18 years prior), and they offered other ideas on ways to address water resources needs through meaningful water resources legislation and administrative changes. The outcomes from those water forums highlighted the need for education on water resources and for the integration of water quantity with quality.

By December of 2001, the commonwealth was about six months into the drought, and with recent past water forums and studies calling for action, the conditions were right for initiation of new water resources legislation.

1.3 Legislative Foundation of the State Water Plan Update: Act 220 of 2002

Water resources legislation supported by Governor Mark Schweiker during the 2001-2002 Pennsylvania General Assembly session took the form of several bills – HB 2230 , HB 2302, and SB 1230 – that would require updating the State Water Plan, promoting water conservation, and identifying Critical Water Planning Areas (CWPAs). The major elements of these bills were based on the water forums held during the spring of 2001.

With bipartisan and broad stakeholder support, HB 2302 was enacted as the Act of December 16, 2002, P.L. 1776, No. 220 (Act 220 of 2002), also referred to as Pennsylvania's "Water Resources Planning Act."

[8] Pennsylvania Environmental Council (PEC), Report of the Pennsylvania 21st Century Environment Commission https://pecpa.org/wp-content/uploads/21st-Century-Environment-Commission-Report.pdf

[9] Pennsylvania Department of Transportation, PENNDOT Sound Land Use Implementation Plan https://www.dot.state.pa.us/public/bureaus/ProgCenter/REVISED_PennDOT%20Sound%20Land%20Use%20Implementation%20Plan%2011.pdf

1.4 2009 State Water Plan Update

Under Act 220 of 2002, the first State Water Plan was to be updated within five years to help answer the basic questions: How much water do we have? How is the water being used? Where will the demand for water exceed the supply? Between 2003 and 2009, the State Water Plan update workplan involved the registration and reporting of certain water withdrawals, identification of CWPAs, and initiation of Critical Area Resource Plans (CARPs) for several watersheds identified as CWPAs. DEP completed this work, with the input of 169 appointed people with a wide range of representation serving on six regional committees, a statewide committee, and subcommittees, as well as additional public input.

Figure 3. 2009 State Water Plan Principles Document

Early in the process of creating what became the 2009 State Water Plan Update (2009 Update), the planning team identified three principal priorities:

- The efforts initiated in the plan to collect, interpret, and disseminate water resources information should continue.
- An integrated approach to managing water resources should be encouraged and sustained.
- The commonwealth should adopt policies that encourage technological advances designed to conserve and enhance water resources.

The framework for the 2009 Update fell into four tiers: **data** (collection, consolidation, and analysis); **regional components** (key issues that reflected the priorities of each of the six planning regions); **marketing and engagement** of the plan; and an **action agenda** for the recommendations **(Shown in Figure 3 as State Water Plan Principles.)**

Notable accomplishments from the 2009 Update include:

- Water use registration and reporting
- United States Geological Survey GIS-based water availability screening
- Identification of CWPAs

The results of the 2009 Update were then distilled into four components:

- A principles document highlighting the plan priorities, recommendations for action, and key components of the plan
- A marketing document also known as the “Touchstone Document” explaining the basis for water resources planning
- A coffee table-sized Water Atlas as an educational aid that laid out the landscape of Pennsylvania’s water resources and how they are managed
- A web-based system for water use registration and reporting

For more information, visit DEP's webpage for the State Water Plan Update of 2009.

1.5 The Intervening Years

The previous update of the State Water Plan was completed in 2009. During the years between 2009 and the beginning of this update, organizational restructuring and budget reductions directed the focus of state water planning efforts primarily toward improvements in data reporting, access, and collaboration. Streamlining processes and refining its data system have substantially improved compliance by public water suppliers in creating water withdrawal and use reports, increasing data accuracy and extending its access to the public – all of which benefit those who rely on the water data to make informed water resources decisions.

Some other notable accomplishments for the State Water Plan Program during the intervening years include:

- **Development of Water Management Plans for Oil and Gas Operations.** The State Water Plan Program collaborated with the DEP Oil and Gas Management Deputate in the development and implementation of water management plans required under the 2012 Oil and Gas act (Act 13 of 2012)[10] for water sources to be withdrawn or utilized for drilling or hydraulic fracturing of unconventional gas wells. In 2016, Chapter 78a (Unconventional Wells) required all sources approved by a water management plan to submit daily water use to DEP. The GreenPort application (DEP's access to online applications) for submission of water use reports was revised in 2017 to collect these daily reports.
- **Launching of Water Use Data System Downloads and Viewers.** During this period, grants from USGS enabled the State Water Plan Program to develop six water report viewers to share registration and reporting of water use. As recently as 2021, an additional summary dashboard/viewer was added for public web access.

A full explanation of the data access and collaboration efforts of DEP's Water Use Data System (WUDS) is found in Chapter 4.

1.6 State Water Plan Update Process

1.6.1 Goals and Outcomes

Building on Pennsylvania's rich history of water resources planning from the 1970s into the 2000s, DEP began working under the provisions of Act 220 of 2002 to review and revise the 2009 Update, including revisions and updates to regional plan components as well as amendments and updates to the statewide components.

[10] Pennsylvania General Assembly, 2012 Act 13 https://www.legis.state.pa.us/CFDOCS/LEGIS/LI/uconsCheck.cfm?txtType=HTM&yr=2012&sessInd=0&smthLwInd=0&act=0013.

Figure 4. Regional Water Resources Committee Meeting

This update of the State Water Plan followed the requirements within Act 220 of 2002 for the periodic review, amendment, and updating of a State Water Plan, which necessitated a balancing of considerations. Deliberations took place within DEP and in consultation with the various State Water Plan committees on regional priorities, objectives, and recommendations of the regional committees to ensure that the regional and statewide components reflect federal, state, and interstate basin compact commission policies, plans, objectives, and priorities. Figure 4 depicts an early meeting of the Ohio Regional Water Resources Committee.

Components of this update of the State Water Plan include the following:

- A reviewed and updated State Water Plan resulting from the input, guidance, and advice of a repopulated and reinstated statewide committee, six regional committees, and the public
- Work toward completion of CARPs within the Potomac and the Ohio planning areas that were incomplete at the time of the 2009 Update
- Enhanced web-based applications and tools to deliver improved access to water resources information, data, and statistics for educational and water planning purposes
- Plan provisions to implement applicable water resources-related strategies outlined in both the 2018 and the 2021 Pennsylvania Climate Action Plans
- A phased implementation plan – or "Path Forward" – describing a continued planning process that helps ensure ongoing engagement and accountability of advisory committees in state water planning

1.6.2 Collaboration: Statewide and Regional Committees

Act 220 of 2002 calls for a collaborative approach that, in this 2022 Update, necessitated the reconstitution of the statewide committee and the six regional committees. More information on the geographic extent of regional committees may be found within the State Water Plan Digital Atlas.

Act 220 of 2002 is prescriptive as to the roles and responsibilities of various parties in preparing and updating the State Water Plan. DEP, having responsibility over developing and drafting the plan and regional components, received guidance, advice, and recommendations from six regional committees comprised of representatives of agriculture, public water supply, wastewater, industrial, commercial,

mining, and energy enterprises; environmental and conservation interests; and water resources management and local government agencies.

The statewide committee was primarily responsible for making recommendations to the DEP Secretary for approval and adoption of the entire plan update, including approving regional components, assisting with public participation, recommending policies and guidelines, and reviewing and commenting on proposed regulations and policies. Statewide committee participants included appointments from the regional committees, the same interest sectors of the regional committees, in addition to ex officio voting members such as secretaries, directors, chairs or designees of DEP, the Pennsylvania Department of Agriculture, the Pennsylvania Department of Conservation and Natural Resources, the Pennsylvania Fish and Boat Commission, and the Pennsylvania Emergency Management Agency.

Once reconstituted, the committees reviewed the 2009 Update's regional and statewide priorities and recommendations for action. These reviews, in conjunction with DEP program reviews, considered which of the priorities and recommendations for action had been addressed since the 2009 Update, and which should change with this update of the State Water Plan. Furthermore, these reviews evaluated whether to add any new or emerging issues to the lists of priorities and recommendations for action.

1.6.3 Public Process and Environmental Justice

Public Process

DEP believes public participation is an integral part of achieving its mission to protect Pennsylvania's air, land, and water from pollution and to provide for the health and safety of its citizens through a cleaner environment. As part of the public participation process, the 2022 Update utilized a wide range of opportunities and approaches to inform the public, solicit input, and respond to input during the development of the update.

Public outreach and participation efforts have included the following:

- Posting regional and statewide committee information on the DEP website, including meeting agendas, meeting dates, and meeting minutes
- Utilizing a hybrid model for conducting meetings with both online and in-person participation options for the public, committee members, and agency staff
- Publishing notices of meetings in the *Pennsylvania Bulletin*
- Welcoming input from the public at the beginning of the process, at a hearing held on January 6, 2021
- Providing public comment opportunities during each of the committee meetings
- Reaching out to the public for their comments on the regional priorities at a hearing held on March 11, 2022
- Inviting the public to review and submit written comments regarding the draft plan

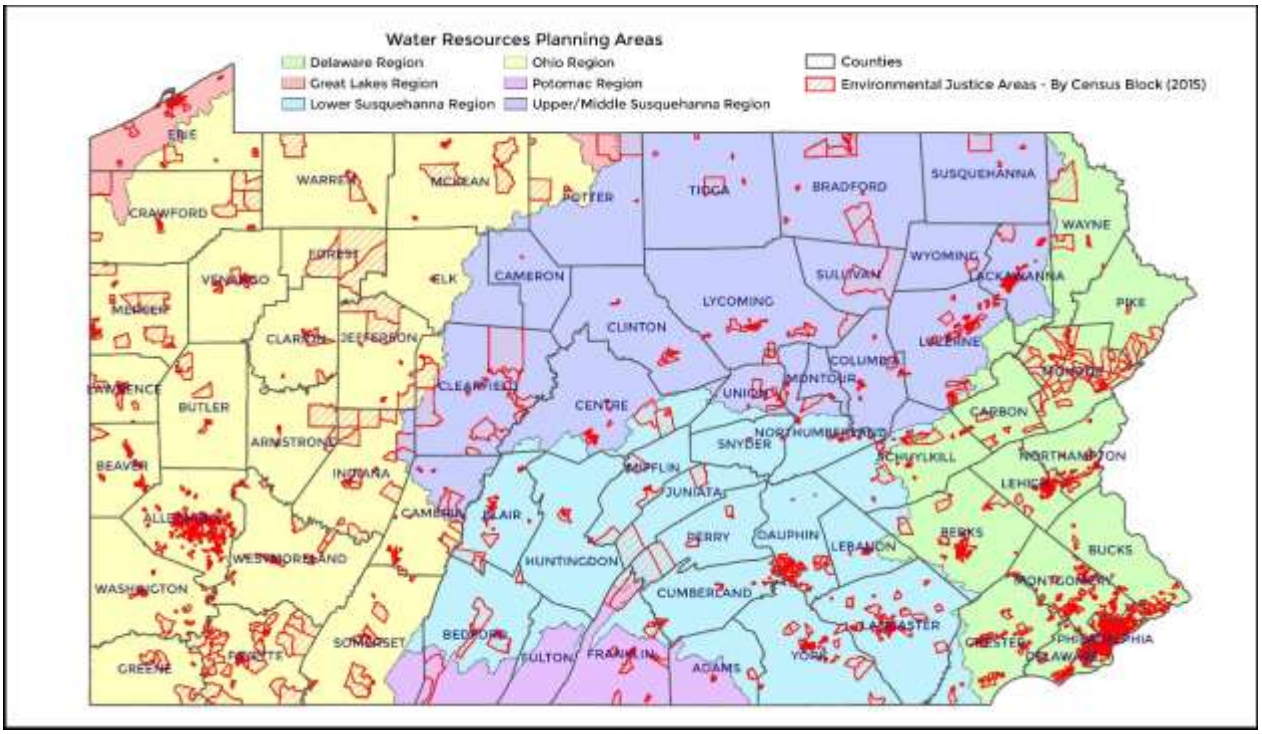
Environmental Justice

Simultaneously, the DEP has been committed to ensuring that Pennsylvanians in the most vulnerable communities have a voice in the development, implementation, and enforcement of environmental policies, regulations, and laws. To that end, implementation of this update to the State Water Plan will follow Environmental Justice (EJ) public participation policy approaches by:

- Providing educational opportunities and soliciting input and participation from EJ areas and regions throughout the state water planning processes.
- Implementing climate adaptation-related statewide and regional priority recommendations – consistent with the opportunities identified – to address the climate change impacts to overburdened and vulnerable populations found in the *Pennsylvania Climate Action Plan 2021*[11].

Figure 5 depicts environmental justice areas overlaying water resources planning areas used in the State Water Plan.

Figure 5. Environmental Justice Areas and Water Resources Planning Areas



[11] Pennsylvania Climate Action Plan 2021
https://www.dep.pa.gov/Citizens/climate/Pages/PA-Climate-Action-Plan.aspx

2.0 Assessment of Pennsylvania Water Resource Priorities

2.1 Assessment of Principal Priorities

The 2009 Update recognized the close relationships between land development, flooding, irrigation, water supply, and withdrawals and the need for deeper consideration of those relationships in all water resources management decisions. To that point, three principal priorities were identified that formed a foundation for the 2009 Update.

Priority: Continue collecting, interpreting, and disseminating water resources information.

The 2009 Update supported the need to maintain up-to-date information about the quantity, quality, and availability of water as well as the demands for water.

Status: Water resources data continues to be an important component for making water management decisions and remains an asset that should be available to the public and those making water resources decisions. To that end, DEP maintains a water use data program to collect water use reports on individual water withdrawal sources and the business entities or systems that own them. With decades of data behind it, the program remains an extensive resource of water use information for Pennsylvania. Ongoing development of new tools will continue to improve the access and utility of the information. Details on data access and collaborative use may be found in Chapter 4.

Extensive screening to assess water availability was performed during the 2009 Update planning period, resulting in a process for identification and designation of CWPAs. As needs are identified, similar work will be considered for future state water plan updates. Among other key components, future updating may include Act 220 of 2002 provisions involving inventories of surface and groundwater water resources, assessments and projections of water use needs and withdrawal demands. The data from such work will be collected, interpreted, and disseminated for decision making.

Priority: Encourage and sustain an integrated approach to managing water resources.

The 2009 Update established the need for the commonwealth and local government to consider withdrawals, wastewater discharges, flood control, and other water resources issues in conjunction rather than in isolation.

Status: Exploratory steps toward implementation of Integrated Water Resources Management (IWRM) were taken by DEP after the adoption of the 2009 Update. However, funding and regulatory structure, among other factors, made it difficult to adapt to a higher level of collaborative workflow. The statewide committee continues to believe that a framework of integration for water resources planning is imperative. As such, they have built upon the recommendations from the 2009 Update and offered a series of new recommendations within this 2022 Update for DEP to identify and understand related challenges and opportunities to address those challenges. See Chapter 2.4.2 to explore the full spectrum of IWRM recommendations, in combination with recommendations to improve inter-agency coordination.

Priority: Adopt policies that encourage technological advances designed to conserve and enhance water resources.

Under this priority, the 2009 Update made the case for advancing innovative water resources conservation, protection, and enhancement technologies for domestic use and for export to the international community. The concept was to encourage development of these technologies within Pennsylvania to not only benefit businesses within the commonwealth, but across the world.

Status: An important component of this priority related to the development of a "Water Resources Technical Assistance Center" as a statewide, nonprofit organization to promote voluntary water conservation and provide technical assistance on water use issues – including reducing demand on water, improving water use efficiency, reducing water leakage, and enhancing groundwater recharge. While the initial steps in establishing this center were successful, challenges in organizational structure and long-term funding halted its implementation.

DEP recognizes the importance of water resources conservation, protection, and efficiency. Chapter 2.4.4 on Water Efficiency provides recommendations developed by the statewide committee's Water Supply Workgroup to disseminate technical information, address adaptation to climate change, manage public water supply, and accomplish overall improvement in efficiency by municipal and industrial water users. In addition, DEP plans to utilize the Pennsylvania Clean Water Academy as a platform for future development and post educational content on water conservation and efficiency to meet related objectives.

2.2 Assessment of Regional Water Resources Priorities

Once reconstituted, the regional committees reviewed the 2009 Update regional components which consisted of regional Priorities and Recommendations for Action. These reviews, in conjunction with DEP program reviews, considered which, if any, of the priorities and recommendation for action had been addressed since the previous 2009 Update, and which may have changed. Furthermore, the reviews evaluated whether any new or emerging issues were added to the lists of priorities and recommendations for action.

Since the prior plan's submission in 2009, the commonwealth has undergone significant changes that have led to new priorities within each region. With higher-intensity storms occurring due to climate change, storm water and flooding have become a more central issue to each of the state water plan regions. The *Pennsylvania Climate Action Plan 2021*[12] contains various resiliency strategies which have been adapted to water planning priorities, as well as adopted and tailored to each region through specific tools like IWRM which has been a consistent theme.

Economic changes resulting from expanded access to online shopping have led to large areas of impervious ground being unused – particularly parking lots surrounding malls – and new logistics centers being constructed. This has led many regions to focus their attention on land usage and water linkages, riparian buffers, stormwater policy, runoff and aging infrastructure, and funding for projects addressing these concerns as the tide of land development shifts.

The various committees comprising the State Water Plan effort have adapted to the many changes that have impacted Pennsylvania in the last decade and have adjusted their planning efforts to meet these new challenges.

[12] Pennsylvania Climate Action Plan 2021
https://www.dep.pa.gov/Citizens/climate/Pages/PA-Climate-Action-Plan.aspx

2.2.1 Delaware

Specific Regional Priorities

The Delaware region is the most populous region with over 5.5 million (43% of Pennsylvania's population) people calling it home and contains the only estuary in the state, which runs alongside Philadelphia. The large and growing population is going to require holistic coordination between all users to ensure the availability and quality of water as well as addressing stormwater and flooding. These varying and complex needs are partly addressed by entities like the Delaware River Basin Commission and the National Estuaries program but a unified approach to land use and water management is a critical piece of the puzzle.

Strengthen the Link Between Land Use and Water Resources Management

Linking land use decisions and water resources management to sustain and enhance the quality of life in the Delaware River basin is a top priority of the committee. The development and distribution of water resource information and data will help strengthen the link between land use, soil, and water resources management among multiple stakeholders. Implementation of comprehensive educational initiatives would improve how water resources management, soil and vegetation conservation, flood controls, stormwater management, and sewage management relate to land use decisions, infrastructure funding, construction decisions, and grant decisions. The goal of these efforts is to preserve, protect, restore, and enhance the quality, quantity, and availability of clean, sustainable water supplies for the people, businesses, and ecological needs of the commonwealth.

Regional Planning and Land Use Coordination and Collaboration

"Think regionally and act locally" is a priority for the committee. The committee's solutions to the region's water issues focus on developing regional coordination and planning to address stormwater management, climate change, water quality, water availability, water diversion, aquifers, healthy soils and vegetation, protecting fish and wildlife habitats, and protecting recreation areas. Solutions are developed through regional planning efforts, education and outreach with policy makers and the community, along with adequate funding. Water planning should be considered on a holistic watershed basis considering both droughts and floods. A One Water concept can further educate the community and increase collaboration among stakeholders for integrated water resources planning. Growth in rural, urban, and suburban areas continues to place stress on water infrastructure; replacement and retrofitting of existing infrastructure and development of new infrastructure can be a challenge in both urban and suburban communities. Larger scale coordination efforts between local, state, and federal entities can help ensure more of the region's needs are being accounted for during the planning phase and available resources can be maximized.

Region's Uniqueness

What are the Delaware region's unique characteristics that are important considerations in the state's water planning?

- This is the most populated region in the commonwealth and features a diverse population living in urban, suburban, and rural locations.
- The Delaware region has a large amount of impervious surfaces, leading to both water quality and quantity problems including reduced groundwater recharge and excess runoff which can pollute waterways and cause excess flooding.

- The region boasts abundant and varied natural and recreational resources.
- The main stem of the Delaware River remains undammed.
- The tidal Delaware region is the second largest in the country in terms of power production.[13]
- The Delaware basin discharges into the Atlantic Ocean via the Delaware Estuary, which is comprised of a unique ecosystem and a variety of stakeholders, including federal programs like the National Estuary Program, water suppliers, and industrial users. This also means that tidal influences are a consideration in planning efforts for the basin.
- The basin is challenged by the demands of four states and multiple jurisdictions. In 1954, the United States Supreme Court entered a Decree that established certain rights and obligations for New York City and New Jersey concerning diversions of water out of the Delaware River Basin. Delaware, New Jersey, New York, Pennsylvania and New York City are all parties to the Decree.
- The Delaware River Basin Commission plays a significant role in the management of water resources in the basin.
- County planning commissions play a significant role in land use and should be part of the linkage between land use and water resources.
- Philadelphia's port complex is one of the largest freshwater ports and is an economic hub of great value to the region.

Stormwater and Flood Management

What are the region's concerns and recommendations for stormwater and flood management to preserve water quality?

- Increased flooding can occur when floodplains are saturated by repeated storms, as well as during acute high intensity events.
- Stormwater management infrastructure often lacks proper maintenance, especially aging infrastructure.
- Strengthen local efforts, regional planning, and watershed-scale planning of water resources to support and enhance recommendations and requirements laid out in the latest Department of Environmental Protection's Stormwater Best Management Practices Manual including an emphasis on nature-based stormwater control measures.
- State authorities should ensure adequate funding for Act 167 plans.
- Regional authorities should ensure that Act 167 plans and resulting model ordinances do not propose to alleviate flooding on tributaries at the expense of main-stem flooding in accordance with the act's provisions.
- Legacy combined sewer overflows (CSO) remain a significant stormwater issue primarily in the tidal urban portions of the Delaware region.

[13] Projections of power generation sector water withdrawals in the Delaware River Basin, DRBC (https://www.nj.gov/drbc/library/documents/WMAC/031621/thompson_DRB_PGprojections.pdf)

- Stakeholders should continue to actively support source water projects that minimize impacts downstream. It's vital that the connection between potential sources for pollution upstream and resultant water quality downstream are understood by the public.
- Water should be considered from a holistic perspective as with the "One Water" movement.
- Storm surge may become an issue in the lower Delaware River as winds and long fetches draw higher waters upstream into the Delaware Estuary Coastal Zone.
- Schuylkill headwaters have coal mine refuse piles that need to be properly managed or removed to minimize the potential for coal tailings runoff into the system.
- Encourage projects that enhance stormwater management on previously developed land.
- Educate the public about stormwater impacts, including the difference between localized flooding versus regional flooding.

Climate Change Adaptation for Water Resources

How are water resources within the region being impacted by climate change and what could we do to adapt?

- Encourage regional authorities to assess the ability of aging infrastructure to handle high-intensity storm events, which are increasingly likely to occur in face of a changing climate, and implement infrastructure maintenance, as necessary, to mitigate flooding impacts.
- There is an increased risk that changing rainfall patterns and increasing temperature will likely lower the water table; as a result, we must continue to promote healthy soil and groundwater infiltration to maintain aquifers and manage reservoir systems to abate these potential effects on water quality and quantity. Healthy soils absorb more water and are critical to reducing runoff and mitigating the effects of drought.
- Encourage stakeholders to mitigate impacts of sea-level rise, including the impact on port facilities' economic benefit provided to the region, and protect drinking water sources and infrastructure from salt front intrusion in the Delaware Estuary.
- Encourage development of additional scenario models so municipalities can proactively plan for potential outcomes of climate change, which is resulting in significant amounts of riverine and localized flooding. Promote data showing changes in rain frequency and intensity and focus on climate resiliency. Recognize that the increased precipitation and storm frequency will have effects on land use planning.
- Stakeholders should make use of all potential bodies of research and resources such as the DRBC Advisory Committee on Climate Change, which recently formed to develop ideas and tools.
- Climate change can have a number of water quality impacts including thermal impacts affecting dissolved oxygen and water use designations, an increase in both terrestrial and aquatic invasive species, increased erosion due to higher intensity storms resulting in higher turbidity, and changes in vegetation types affecting stream buffers.

2.2.2 Great Lakes

Specific Regional Priorities

Pennsylvania is fortunate to be a part of the Great Lakes region. The Great Lakes are the largest surface freshwater system in the world, contain the equivalent of 90% of North America's annual supply of freshwater, provide vital habitat to native species, and support diverse ecosystems and robust biodiversity. It provides drinking water to 40 million people in the U.S. and Canada and sustains a thriving $6 trillion regional economy. Lake Erie directly connects northwestern Pennsylvania to this resource, underpinning the social identity of the region and fueling the tourism, recreation, port, and maritime sectors of its economy. Also, the headwaters of the Genesee River flow through the forests and agricultural lands of northern Potter County into New York on their way to Lake Ontario. Many demands are placed upon the waters of the Great Lakes which require thoughtful protections to assure sustainability for future generations. Pennsylvania works diligently with the other U.S. states, Canadian provinces, and the two federal governments to eliminate the possibility of major diversions of water outside of the Great Lakes basin, improve water quality, enhance biodiversity and ecosystems, and provide cooperative, sturdy governance mechanisms for the resource.

Protect Water Quality and Quantity in the Basin

The Great Lakes are vitally important to the prosperity of northwestern Pennsylvania, serving regional domestic, commercial, agricultural, and industrial needs. They supply power, offer world-class recreational opportunities, and provide domestic and international transportation and trade access across the entire Great Lakes – St. Lawrence Seaway system. As a result, the committee believes that Pennsylvania should not only maintain current participation in interstate and international governance, but also play a larger role in federal legislation and other policy measures that may impact Lake Erie and Lake Ontario such as invasive species control, pollution reduction, agricultural practices, and stormwater management. In addition, northwestern Pennsylvania should have a larger role in state legislation that impacts Lake Erie and Lake Ontario.

One of the best ways to protect the water quantity of the Great Lakes is by coordinating with the other states and provinces to uphold the interstate compact and international agreement that prohibit the diversion of water out of the basin, regulate water withdrawals and consumptive use, and encourage increased conservation and efficiency measures across many jurisdictions.

Additionally, the committee recognizes that the region is not composed solely of Lake Erie and Lake Ontario, so efforts must be made to protect water quality throughout the larger regional watersheds. This can be accomplished by assessing biology, identifying potential sources of contaminants such as on-lot sewage treatment systems, evaluating the impacts of stormwater management, and assessing agricultural best management practices on a regional scale. This will also help inform how Pennsylvania and Great Lakes communities can build resiliency to the impacts of a changing climate in these unique watersheds.

Coordinate with Partners

One effective way to achieve the larger goals of the committee is for the commonwealth to actively engage with partners across multiple political strata. This includes other states, provinces, federal government agencies, and other stakeholders including governmental and non-governmental. The committee believes that bidirectional lines of communication between these diverse stakeholders, from locally focused to internationally focused agencies and interests, are critical. On a local level, counties and municipalities should collaborate toward regional approaches to water challenges with support

from the Pennsylvania Department of Environmental Protection (DEP), whose role would be to encourage open and continual communication and incentivize cooperation through grant funding. Coordination should begin with education and outreach to communicate the impacts of land use choices to property owners and implement best management practices to better maintain the hydrologic integrity of the region.

Region's Uniqueness

What are the Great Lakes region's unique characteristics that are important considerations in the state's water planning?

- Lake Erie and Lake Ontario have large, but not unlimited supplies of water.
- Despite their relatively small land areas, Pennsylvania's Lake Erie and Lake Ontario watersheds are vital assets to the commonwealth.
- The quality and quantity of water in Lake Erie and Lake Ontario are impacted by Canada and other U.S. states bordering the Great Lakes.
- The region's economy is reliant on tourism and recreation related to water-based activities.
- The Great Lakes are utilized as navigational waters by international business and industry.
- Ship traffic from other parts of the world can potentially lead to the introduction and distribution of invasive species, which can impact the health and viability of native species and the efficiency of nutrient cycle processes.
- Agriculture, especially vineyards, play an important role in the northwest Pennsylvania economy.
- Localized sources of nutrients and nonpoint source pollutants can negatively impact Great Lakes tributaries and open waters, and contribute to harmful algal blooms.

Stormwater and Flood Management

What are the region's concerns and recommendations for stormwater and flood management to preserve water quality?

- Municipal stormwater management is critical due to its beneficial impacts on water quality and the potential to reduce bluff recession and ravine erosion in the coastal zone. Best management practices will help control the volume, flow, and quality of stormwater coming from developed areas.
- Evaluate Act 167 stormwater management plans to determine their long-term feasibility. Consider potential funding sources for counties to update Act 167 plans, and for large and small municipalities to update stormwater management ordinances. These activities should include an evaluation of municipal subdivision and land development ordinances, hazard mitigation plans, and integrated water resources management.
- Encourage regional solutions such as incentivizing municipal authorities to assess and, where possible, repair/retrofit aging infrastructure for the increasing frequency of severe storm events and the need for increased water quality, erosion control, and infiltration measures.
- Develop asset management and capital improvement plans through digitizing municipal and private stormwater infrastructure and utilizing geographic information systems (GIS). DEP has

provided grant funding to Erie County to conduct a Municipal Separate Storm Sewer System (MS4) assistance program which could be leveraged to help digitize this data for both urban and rural communities and lead to more informed and sustainable management.

- Highlight the role of public education and outreach to achieve community support for stormwater management.
- Continue to work toward the elimination of remaining municipal combined sewer overflows (CSOs) as part of an overarching stormwater plan.

Climate Change Adaptation for Water Resources

How are water resources within the region being impacted by climate change and what could we do to adapt?

- Consider the implications of flash flooding and potential decreased groundwater recharge on waterway flow. With the risk of potentially severe droughts and flash flooding brought on by climate change, continuing to promote surface water infiltration to recharge groundwater aquifers should be a high priority, while also understanding the unique susceptibility of lake bluffs and ravine systems to groundwater inputs.
- Participate in efforts to identify regional climate stressors and plan for economic and environmental resiliency actions.
- Stakeholders should assess the implications of climate change on water supply vulnerability and availability to build resiliency.
- Stakeholders should investigate impacts of extreme Lake Erie and Lake Ontario water levels (higher or lower than normal) and the associated impact on tourism, recreational activities, navigational, commercial and industrial activities, bluff and beach erosion, and lakefront residential communities.
- Municipalities should take a regional approach to evaluate aging stormwater infrastructure and its current capacity in an effort to develop mitigation strategies for increased storm intensity and frequency due to climate change.
- Maintain focus on science and explicit data to follow demonstrable trends in climate change.

2.2.3 Lower Susquehanna

Specific Regional Priorities

The Lower Susquehanna basin is the hydrological gateway to Maryland where the mouth of the river system connects to the Chesapeake Bay. Rapid expansion of logistics centers and a quickly growing population in the region leads to increased risk to waterways. There is a need for the most critical areas to be identified and prioritized to minimize the potential for impact to these resources.

Identify and Target Solutions for Potential Protection Priority Water Resources to Reduce or Prevent Point and Nonpoint Source Pollution with a Focus on Currently Impaired Water Resources

Identify “protection priority” water resources that may be trending towards impairment for any use, through the collection and analysis of data. Priorities may be determined by looking specifically at emerging contaminants, declining water quality and/or quantity, evolving land use impacts, and flooding issues. Improve the region’s protection priority water resources through identified targeted solutions that may include education and outreach, asset management, resource improvement, and others.

Reduce existing point and nonpoint source pollution in the region's significant number of impaired water resources. Focus added attention on currently impaired water resources. Prevent new water pollution throughout the region from all sources. Implement active solutions to reduce pollution by forming public-private partnerships (P3), engaging willing landowners, targeting funding, and others. Broaden support and advocacy for our water resources through enlisting stakeholders, enhancing partnerships, and coordinating efforts. Improved water quality sustains drinking water supplies, preserves a healthy ecosystem that supports recreational use, and enables a viable economy.

Definition of "Protection Priority" - water resources prioritized for protection based on potential threats to water quality, for the purpose of setting long-term priorities for where focused efforts towards restoration, best management practices, and protection would provide the most benefit to the watershed.

Enable Continued Responsible Economic Growth by Ensuring Adequate Water Resources

The challenges associated with this region are water availability, flooding, aging stormwater infrastructure, water quality, and drought. Prioritized resiliency solutions to address increased stormwater and flooding that include restoration and expansion of green infrastructure to capture runoff would be beneficial to the region. Strategies may also include proactively managing land development and land management by expanding programmatic and policy flexibility to watershed boundaries to maximize effectiveness of multi-benefit best management practices. Broad support can be provided to local governments and municipalities through training and model ordinances to manage stormwater and flooding and enlisting the cooperation of non-governmental organizations, watershed groups, and riverkeepers.

Region's Uniqueness

What are the Lower Susquehanna region's unique characteristics that are important considerations in the state's water planning?

- The Susquehanna River is a unique feature of the region, which is shared with the Upper/Middle Susquehanna region.
- The basin is home to one of the fastest growing populations in Pennsylvania.
- This region has the highest concentration of agricultural land uses in the state, particularly in York and Lancaster Counties. The plain sect communities in Lancaster and York Counties require unique communication strategies.
- Due to the intersection of highways running through the basin and additional cargo shipping coming by land from the recently dredged Delaware ports, the region has experienced much growth and development, resulting in an abundance of logistics centers. This growth and development has facilitated the need to preserve more open space and agricultural land.
- This region hosts a large concentration of manufacturing in Pennsylvania. Manufacturing industries tend to consume more water than logistics and warehousing industries.
- Three large run-of-river hydropower dams exist within the region, as the region is a center for power production. Listed from north to south along the Lower Susquehanna River are the Safe Harbor Dam (1931), Holtwood Dam (1910), and Conowingo Dam (1928).
- There are many historical impacts to the region such as legacy sediments, mill dams, and other water resource impairments linked to past land uses as well as collected sediment from more contemporary dam structures that impact water quality.

- There are National Heritage Areas in lower York and Lancaster Counties.
- The Susquehanna River contributes one-half of the freshwater flow to the Chesapeake Bay. Being a hydrological gateway into Maryland, the region faces the challenge of coordinating with multiple state entities, stakeholders, legal frameworks, and working to accommodate their differing objectives.

Stormwater and Flood Management

What are the region's concerns and recommendations for stormwater and flood management to preserve water quality?

- Improvements to stormwater management on a watershed scale could, via groundwater recharge and appropriate direction to surface water sources, increase access to fresh water in higher quantities throughout the region.
- Develop regional or watershed-scale planning of water resources, ensure management of stormwater at the source, enhance groundwater recharge, and work toward a more long-term strategic approach.
- There is a need for regional authorities to assess aging infrastructure for high-frequency storm events through monitoring and inspection. The first step would be to create an inventory of stormwater infrastructure including location and ownership.
- More floodplain restoration and removal of legacy sediment would be beneficial to the region.
- An enhanced water quality monitoring network could drive strategic investment in best management practices. Data sharing coordination could facilitate an enhanced water quality monitoring network throughout the watershed, targeting strategic locations for the most critical metrics.
- Stormwater compliance could be improved at the local level by providing education and outreach and increased financial resources.

Climate Change Adaptation for Water Resources

How are water resources within the region being impacted by climate change and what could we do to adapt?

- Flooding is the top hazard that municipalities are mitigating in the region. Municipal implementation of floodplain management ordinances along with providing education and outreach would be beneficial.
- With the potential for increased storm frequency and intensity, encourage enhancement of structural and non-structural strategies to reduce environmental impacts of these storm events.
- Engage stakeholders on the implications of intense rain events, degrading soil health, and increased temperatures and how these conditions not only cause flooding but can also lead to micro-droughts.
- Develop a map of areas most likely to be affected by climate change showing the nature and potential of those impacts.
- Stakeholders should develop a more effective approach to floodplain restoration projects by emphasizing the benefits of flood mitigation. Some of these strategies may include the removal

of obstructions and encroachments such as buildings, legacy sediment, or undersized bridges and culverts.

- Drought management for reservoir systems should be enhanced to account for a changing climate and plan for resiliency with an amplified drought of record to facilitate protection and conservation of water resources.
- Encourage continued coordination amongst agencies (state, federal, and local) and non-government organizations to help leverage resources to reduce the impacts of climate change.
- Continue to promote economic incentives to be more proactive than reactive, creating long-term resiliency. Climate change can cause increased surface water temperatures that can impact the ecosystem (e.g. harmful algal blooms) and destroy habitats, leading to treatment challenges for public water suppliers.

2.2.4 Ohio

Specific Regional Priorities

The Ohio region is geologically distinct from the other water planning regions. It is marked by varied elevations, cliffs, landslides, and high-relief areas. This watershed contributes to the larger Mississippi basin and, as such, requires the involvement of several stakeholders in order to maintain water quantity and quality.

Inter-Agency Water Resource Planning

The committee supports a holistic approach to water quality, quantity, and availability. They believe watershed implementation plans (WIPs) and interagency water resources planning can address many water priorities. Organizations that should be involved in interagency water planning include federal, interstate, and state agencies, local municipalities, conservation districts, watershed districts, watershed authorities, nonprofit environmental organizations, and the U.S. Army Corp of Engineers. Plans should identify water resources needed to promote and facilitate economic development including source water protection while maintaining watershed integrity and recreation benefits. They should also evaluate impacts of shale gas resource extraction on water quality, emerging contaminants in water systems, reclaiming of water resources impaired by abandoned mines, and inter-basin transfers of water. Act 167 stormwater planning at the county level is an initial step toward interagency water resource planning.

Water Quality and Quantity

Regional solutions depend upon an integrated approach to water quality and quantity challenges. Water quantity can be defined as a spectrum from too much to too little. Quantity can also vary over time and location. There are critical area resource plans for two watersheds (Back Creek and Laurel Hill Creek) within the region approaching final recommendation in their process. Quality, which is defined by water usage, can be impacted by quantity - either too high or too low. Increased data collection can inform community input and watershed planning. Planning will help to prioritize natural systems, man-made infrastructure, and water treatment to include creative, diverse, and strategic solutions that can maximize water supply and the quality of our drinking water.

Hazards to communities in the watershed originate from multiple sources:

Excessive amounts of stormwater runoff can cause flooding and damage the quality of the waterways through agricultural runoff, combined sewer overflows (CSOs), sanitary sewer overflows (SSOs), and

Municipal Separate Storm Sewer System (MS4) overflows. Stormwater is significantly impacted by climate change and aging infrastructure. Priority should be given to multi-municipal planning and funding projects that include best management practices referenced in the Pennsylvania Stormwater Best Management Practices Manual, and updates thereto, that use integrated approaches to maximize pollution reduction and mitigate flooding.

Additionally, legacy issues can produce significant contaminants. These issues include the historical coal mining and oil and gas extraction industries that played a key role in the region's development. Abandoned mine lands and drainage can dramatically change the ecology and dynamics of the stream, causing it to not meet its designated uses, harm drinking water and well water systems, and can destroy the economic vitality of the waterways. Orphaned wells that go unplugged may cause long-term seeps of petroleum byproducts into the region's river systems, that cause additional ecological degradation. As well as the above issues, byproducts of prior industrial development can include soil and groundwater contamination and disposal of wastes. Land use plans that address these brownfield sites should be developed so they do not impact water resources and the land can be restored and gainfully reused.

Farms are vital to the region. The Ohio River valley is home to significant agricultural activities that sustain communities and provide food to the region. However, some agricultural activities come with environmental impacts, therefore conservation measures should be prioritized in a farm plan and through state regulations. Stakeholders within the region are working hard to promote conservation approaches which work alongside agricultural practitioners to create sustainable farming and a sustainable food cycle. The committee encourages the implementation of such practices.

In addition to stormwater management, legacy, and agricultural issues, planning efforts need to address, inter-basin transfers, unsustainable forest management, and the introduction of larger-scale industrial water users, all of which have implications on both quality and quantity.

Region's Uniqueness

What are the Ohio region's unique characteristics that are important considerations in the state's water planning?

- The basin contains the headwaters of the Ohio River, having an impact on 1,000 miles of river downstream through multiple states. Water drains north from West Virginia and south through Ohio and New York before contributing to the larger Ohio River basin.
- The Ohio River basin contains organizations that are unique to the region with a focus on water quality: The Ohio River Basin Alliance (ORBA) and The Ohio River Valley Water Sanitation Commission (ORSANCO).
- Universities, colleges, municipalities, and local foundations within the basin often work together towards solutions to water resource related issues.
- Industry has played a significant economic role throughout the region including steel, coal, and glass and was a nationally significant source for all three resources, especially in the early 1900s[14].
- The Ohio region's French Creek plays host to the most diverse mussel population in the state.

[14] A Very Short History of Pittsburgh https://pittsburghquarterly.com/articles/a-very-brief-history-of-pittsburgh/ and The Glass City: Pittsburgh's History as the Center of the U.S. Glass Business https://www.wesa.fm/arts-sports-culture/2013-07-16/the-glass-city-pittsburghs-history-as-the-center-of-the-u-s-glass-business

- Clean water is vital for recreational activities in many watersheds of the basin15 and are major economic drivers.
- The Ohio River basin is a municipally dense region which can lead to difficulties in coordinating zoning and planning activities.
- The region contains the tribal lands of the Seneca Nation of Indians.
- The Allegheny National Forest is in the basin; these protected lands provide conservation and recreation.
- There are many locks and dams within the region including 16 multipurpose flood control dams and 23 navigable locks and dams.
- Rivers are extensively used for recreation and transportation with inland ports for sand, gravel, coal, and other commodities. The Port of Pittsburgh is the fourth largest inland port in the United States.
- The region is geographically distinct from the rest of the state due to the Appalachian Mountains. Geologically the Appalachian Mountains are an incised plateau which leads to the appearance of synclines and anticlines from glacial activities. Varying elevations, such as cliffs and high relief areas can be prone to landslides. This necessitates different planning and treatment requirements based on location.
- Hydraulic fracking and coal fired power plants in the region create additional water demands.

Stormwater and Flood Management

What are the region's concerns and recommendations for stormwater and flood management to preserve water quality?

- Stormwater management infrastructure often lacks proper maintenance, partly due to confusion about ownership and the associated responsible parties. Some agreements have been in place since the 1960s, but these can be difficult to enforce, especially as facilities change ownership, leaving some older facilities without maintenance for decades.
- Education and outreach is needed to tie the concept of stormwater management more closely to flooding, as poor stormwater management can lead to downstream flooding.
- Aging stormwater infrastructure should be assessed by regional authorities for high-frequency, as opposed to high intensity storm events. Retrofitting aging best management practices and providing groundwater recharge areas for large impervious areas such as parking lots from vacant shopping malls would be beneficial.
- Contaminants from large impervious areas can be transported by stormwater, which can contribute to water quality issues.
- Planning should be completed on a watershed basis and priority should be given to planning upstream and/or at the headwaters.
- CSOs are common in the Ohio basin and their removals are ongoing. Impacts occur only during rain events, which makes CSOs both a stormwater concern and a water quality problem.

[15] Freshwater Mussels https://www.frenchcreekconservancy.org/freshwater-mussels/#:~:text=The%20French%20Creek%20Watershed%20contains,and%20east%20in%20the%20nation

- Rivers, with their proximity to raw materials (lumber, coal etc.) and easy transportation served as an ideal location for development. This not only obstructed the flood plain but constrained the gradual geomorphic development of the waterway. Therefore, the redevelopment of older structures on floodplains, which were built prior to local ordinances that would have prevented their original construction, are a concern for the region.
- State guidance on flood plain development is released whenever a new Flood Insurance Rate Map (FIRM) is provided by the Federal Emergency Management Agency (FEMA). FIRMs are then enacted via municipalities (through floodplain ordinances and collaboration with neighboring communities) and could benefit from regional planning.

Climate Change Adaptation for Water Resources

How are water resources within the region being impacted by climate change and what could we do to adapt?

- Flooding due to large amounts of impervious surfaces will continue to cause problems as precipitation intensity increases.
- Stakeholders should investigate climate change implications on water supply vulnerability, availability, and reliability.
- Climate change will likely increase the intensity of storms in Pennsylvania but could also extend dry periods. Stakeholders should investigate the implications of flash flooding and potential decreased groundwater recharge.
- Capturing water during high-intensity storm events and continuing to promote ground water recharge will help reduce drought events. Regional authorities should provide incentives for homeowners to utilize rain barrels or route downspouts to swales.
- The Army Corps of Engineers owns and operates locks and dams within the region which may help with resiliency, provided they are properly maintained. This will require additional infrastructure planning to enhance resiliency.
- There is a need to maintain riparian buffers, particularly in communities at the headwaters of the basin.

2.2.5 Potomac

Specific Regional Priorities

The Potomac region is comparatively small and each county in the region is split with at least one other watershed. Being composed of mostly smaller watersheds, the region is at risk from changing precipitation patterns due to climate change and groundwater recharge issues related to land use practices; these issues represent a primary focus of the regional committee.

Promote Programs and Practices that Protect Water Quality and Quantity and Preserve the Ecological Integrity of Groundwater and Surface Water

A major priority of the regional committee is to develop land use programs that protect water quality and quantity while preserving the ecological integrity of groundwater and surface water, including springs, streams, lakes, and wetlands. To ensure adequate water resources for present and future generations in the Potomac basin, the committee recommends an approach that encourages municipal programs to collaborate and plan regionally, address land use planning and growth, provide domestic water well construction standards, and implement best management practices to protect water quality and quantity. Completing Countywide Action Plans to support Pennsylvania's Phase 3 Watershed Implementation Plan is also a high priority under this objective.

Climate Change Resiliency Especially with Regard to Stormwater Management, Flooding, and Drought

From a water resources perspective, climate change impacts stormwater management, flooding, and drought. Large intense precipitation events and longer duration storms are increasing stormwater runoff and creating or exacerbating erosion issues. Areas in this region have low infiltration rates, leading to less groundwater recharge and increased flooding. Varied storm frequencies may also lead to an increase in droughts. Promoting stormwater management with the use of riparian buffers, rain gardens, and stream restoration will reduce erosion and improve groundwater recharge.

As they would specifically relate to documented climate change, identify protection priority water resources that may be trending towards impairment for any use, through the collection and analysis of data. Priorities may be determined by looking specifically at declining water quality and/or quantity, and flooding issues. Improve the potential protection priority water resources through identified targeted solutions that may include education and outreach, asset management, resource improvement, and others.

Region's Uniqueness

What are the Potomac region's unique characteristics that are important considerations in the state's water planning?

- This region forms the headwaters to the Potomac River, which makes interstate coordination crucial, as the majority of the basin is located within Maryland.
- This region borders the Susquehanna and Delaware River basins. Each county in this region is split between at least two planning regions.
- Local geology and topography limits groundwater storage and recharge; water does not infiltrate into the soil well and may lead to flooding.
- Unique location along the I-81 corridor with a high amount of development, particularly warehouse expansion.

- The geography is unique in that it is predominantly farmland that is densely populated, but also has rugged mountains that are more sparsely populated.
- There has been increased residential growth throughout the basin as a result of urban sprawl from the Baltimore, Harrisburg, and Washington DC metropolitan areas, which will change the dynamics of water needs.
- Adams County within the region has, in conjunction with local well drilling contractors, developed a set of standards for well construction. They are the only county in the region to have accomplished this thus far.

Stormwater and Flood Management

What are the region's concerns and recommendations for stormwater and flood management to preserve water quality?

- Promote Countywide Action Plans which are beneficial for facilitating coordination and addressing stormwater.
- Consider water quantity and quality when performing cost/benefit analysis for land development and infrastructure.
- Regional authorities should assess aging stormwater infrastructure for high-frequency, as opposed to high intensity storm events. Retrofitting aging best management practices and providing groundwater recharge areas for large impervious areas such as parking lots from vacant shopping malls would be beneficial.
- The region's unique geology that limits groundwater recharge and storage should be taken into account for regional planning of stormwater and flooding events.

Climate Change Adaptation for Water Resources

How are water resources within the region being impacted by climate change and what could we do to adapt?

- With the potential for increased storm frequency and storm intensity, stakeholders should find ways to reduce safety risks, environmental impacts, and generally be more prepared for these types of storm events.
- Increasing resiliency for flash flooding events should be considered in regional planning. Riparian buffers and conveyance structures can help reduce the effects of flash flooding and promote groundwater recharge.
- Extremes in water availability requires regional authorities to plan for both flooding and drought, which creates difficulty in planning and coordination. Integrated water resource planning (IWRP) can help coordinate these efforts.
- Since there is increased risk of more severe droughts brought on by climate change, there needs to be greater resilience of water resources. Protection and conservation of groundwater sources can be accomplished through increased infiltration and aquifer maintenance.
- Stakeholders should investigate climate change implications on water supply and water quality. This can be accomplished by collecting data on both the high and low precipitation events.
- Stakeholders should explore ways to communicate climate change that won't alienate potential allies.

- Where possible, use “on the ground” data collection, science, and regional data as opposed to global datasets. This data will provide more accurate forecasting, attract more stakeholders, and help with localized decisions. Additional types of data and sources would be beneficial in finding the best way to analyze and track local changes (CoCoRaHS network).

2.2.6 Upper/Middle Susquehanna

Specific Regional Priorities

The Upper/Middle Susquehanna operates as a headwaters region for the Susquehanna basin and contains the West Branch watershed. The region’s challenges include a history of legacy mining, aging infrastructure, and a relatively low population making broad regional coordination and ecosystem protection critical.

Protect Important Headwater Habitats, Enhance Recharge Areas, and Minimize Stormwater Runoff of the Upper/Middle Susquehanna Basin

To care for the water resources in the Upper/Middle Susquehanna basin and ensure a sustainable supply of quality water, important headwater habitats and groundwater recharge areas must be protected. Because much of the basin is forested, the approach should focus on forested land use practices and their effect on area water supplies. Minimizing large scale forest cutting is a priority to mitigate downstream flooding, preserve forested ecosystem services, and reduce sedimentation. Addressing legacy infrastructure, including point source outfalls, in acid mine drainage areas is also critical to protecting important headwaters and streams. We strongly encourage reuse of degraded/abandoned land such as available industrial or commercial lands.

Marcellus shale is a large resource for natural gas in the basin that can require large quantities of water for hydraulic fracturing and has potential impacts to the headwaters, wetlands, and the overall groundwater and surface water quality and quantity of the region. Committee members recognize a different approach must be taken to address water quantity and quality issues between rural and urban/suburban areas within the region. Rural areas strive to protect forest lands, preserve recreation areas and greenways, and protect critical habitat areas. Stormwater quality and quantity concerns in suburban and urban areas may be addressed with green infrastructure through zoning ordinance changes for underutilized and/or vacant commercial property, as well as their associated parking and paved areas.

Working collaboratively with stakeholders including state, county, and municipal government, municipal authorities, conservation districts, and watershed associations through education and outreach efforts is essential to advancing sound land use practices that are protective of these headwater areas. As part of a strategy to accomplish this, local governments can promote appropriate municipal ordinances in public water supply recharge areas, which is particularly important in areas with limited availability of quality water. The committee also recommends that statewide water well construction standards be implemented, particularly related to residential well drilling and geothermal bore holes, which will protect and sustain groundwater quality and availability.

Multi-Municipal Planning and Coordination

Land use planning and development are critical to protect headwater habitats, enhance recharge areas, and minimize stormwater runoff. Planning needs to expand with county-wide action plans and integrated water resources management throughout a watershed. A regional approach of education and outreach to water resource stakeholders, emphasizing the value of coordinated water quality and

quantity planning among municipalities, is critical to protecting all communities. Continue to prioritize upgrading existing aging water and sewer infrastructure to maintain water quality and quantity, recognizing that parts of the region have experienced a decline in population and as a result many communities are challenged economically. Multi-municipal planning coordination enhances success in preserving water quality and quantity and optimizes the use of funding dollars.

Region's Uniqueness

What are the Upper/Middle Susquehanna region's unique characteristics that are important considerati ons in the state's water planning?

- This region encompasses a large portion of the headwaters for the Susquehanna River.
- The Upper/Middle Susquehanna has complex geology and substantial topographical variation.
- Legacy mining in the region presents water quality problems such as source water contamination but also provides opportunities through mineral recapture and recycling.
- There is a vast number of diverse hydrologic features in the basin including wetlands, streams, lakes, and ponds as well as peatlands.
- The Upper/Middle Susquehanna basin is densely forested, which helps to filter groundwater.
- With a large number of state forests, state game lands, and public lands, recreation plays a big role in this region's economy.
- Marcellus shale is a large resource for natural gas in the basin.

Stormwater and Flood Management

What are the region's concerns and recommendations for stormwater and flood management to preserve water quality?

- Good forestry practices should be continued in order to support headwaters, as healthy forests help mitigate flooding downstream.
- Incorporate green measures, such as green streets and green roofs into municipal plans to better capture precipitation in urbanized areas.
- Retrofitting existing stormwater facilities, promoting groundwater infiltration and recharge areas with a focus on smaller-scale granular solutions instead of large basins would be beneficial. With consideration of climate projections and future changes in the regional climate, local authorities should assess aging infrastructure for high-frequency storm events, erosion control, and filtration.
- Vacant shopping malls and corporate properties designed parking lots for maximum occupancy, which can lead to excessive runoff. Since the advent of virtual workspaces and online shopping, there is less demand for such large parking lots. Methods to modify or reuse these parking lots by retrofitting them with new stormwater best management practices should be investigated first by accurately determining responsibility. Transferring development rights might be a tool to achieve stormwater improvements on these properties.
- Stakeholders should provide education and outreach to homeowners on the impacts of stormwater, including the differences between pervious and impervious surfaces and various mitigation techniques, such as rain gutters and rain barrels, etc.

- Stormwater best management practices should be properly maintained; pervious pavements vacuumed regularly, streets swept, and algae controlled. Maintenance provisions in Municipal Separate Storm Sewer System (MS4) requirements and credits can help ensure continued functionality of best management practices.
- Connecting multiple municipalities within counties to create MS4 or stormwater consortiums so communities can discuss how best to apply the regulations would be beneficial.
- Stormwater ordinances need to be kept up-to-date with stormwater infrastructure improvements considered alongside redevelopment projects.

Climate Change Adaptation for Water Resources

How are water resources within the region being impacted by climate change and what could we do to adapt?

- Increased storm frequency and high intensity events will create issues with groundwater recharge and flash flooding. With droughts having a more severe impact on groundwater, continue to promote groundwater recharge to increase water availability.
- An in-depth study of climate change implications on water supply, vulnerability, availability, and reliability would be beneficial.
- Stakeholders should promote flexibility and incremental practical steps in response to the changing climate, especially in smaller communities that may lack the necessary budgets.
- Stakeholders should provide education and outreach focusing on resiliency and scientific data to help guide climate change discussions.
- Emphasizing the benefits and co-benefits of climate adaptation projects to the public and stakeholders would be beneficial, such as general resiliency and health of the ecosystem.

2.3 Recommended Legislative Priorities of the Statewide Water Resources Committee

These recommendations are directed at the Pennsylvania General Assembly. They are extracted from the various workgroup papers created by the statewide committee and from regional components of the 2022 Update. Below is a table (Table 3) that briefly summarizes these recommendations. Additional context for these can be found by clicking the priority's title, which hyperlinks to the place in this report that explores the concept in more detail.

Top Statewide Legislative Priorities

Table 3. Legislative Priorities for Pennsylvania General Assembly

Priority	Rationale	Recommendation
Sustainable Funding of Water Resources Programs	Water is a critical resource and, though generally plentiful in Pennsylvania, requires ongoing care, protection, and sustainable management to assure its continuing availability and quality. Programs that support the stewardship of this valuable resource should be given sufficient and consistent funding.	See section on Funding Priorities. Listed are a series of specific recommendations concerning sustainable funding priorities identified by the State Water Plan committees and workgroups.
Well Construction Standards	Pennsylvania has the second highest number of private wells in the country. In the absence of well construction standards and in some cases installer training and proficiency, many wells are not adequately constructed to prevent contamination of the well and groundwater, thereby putting Pennsylvanians at risk.	Enact legislation to require proficiency-based licensing and certification of water well drillers and establish statewide water well construction standards. To avoid landowner concerns, legislation should make clear that the legislation applies to those who install wells, and that no tax, fee, or restriction on water use will be applied to homeowner wells. Proposed legislation should be preceded by a strategic public educational outreach.
Legacy Mining and Well Challenges - Reducing Barriers to Private Action	A "Good Samaritan" law at the federal level and clarification of National Pollutant Discharge Elimination System (NPDES) Permit requirements would help remove barriers to nonprofit organizations and other private parties from undertaking remediation efforts, by providing immunity from legal liability for mine and abandoned well discharges they did not cause.	Encourage Congress and the United States Environmental Protection Agency (EPA) to enact Good Samaritan laws and other reforms that would release entities from being legally liable for discharges they did not cause while they attempt to treat said discharges and remediate abandoned mines and wells. Examples of similar laws include the Pennsylvania Good Samaritan Act and Community Relations Partnership Act.
Evaluating Pennsylvania's Water Rights	Pennsylvania's common law water rights are not well defined; they are unquantifiable, insecure, and difficult to enforce. Adoption of a more consistent and secure statutory water rights arrangement, like that enacted by other eastern states, could provide more predictable and better-defined water rights that would protect existing users and provide a more secure foundation for future economic investments.	The Statewide Water Resources Committee should work with DEP, a broad spectrum of stakeholders, and the General Assembly to evaluate the effectiveness of current water rights and withdrawal arrangements, evaluate options for improvements and develop recommendations for a more consistent, secure, and holistic approach to water rights.

Priority	Rationale	Recommendation
Amend Flood Control Act	Rainfall intensity is trending higher, putting more Pennsylvanians at risk of flooding. A mitigation approach that considers both non-structural and structural measures will be needed to protect lives and reduce flood damage.	Provide DEP and other state agencies authority to consider and implement all potential flood control solutions and provide funding through the capital budget process and other means for such structural and non-structural projects.
Sustainable Public and Private Stormwater Management Infrastructure	With increasing rainfall intensity, stormwater becomes a key issue in urban centers. Therefore, having a plan to sustainably support that infrastructure is critical.	Authorize the creation and operation of local authorities, utilities, or management districts and/or other entities that can collect reasonable fees and generate sustainable revenues dedicated to improving, planning, constructing, monitoring, maintaining, expanding, and managing stormwater management infrastructure.
Water Resource Restoration	A holistic view of stormwater and flooding that considers the downstream impacts of such events is critical in addressing stormwater.	Fund, promote, and support water resource restoration projects, particularly projects that reestablish natural processes that support a broader aim of flood mitigation and stormwater control.
Facilitate Asset Management Planning	The most recent EPA Infrastructure Needs Survey projected a capital need for Pennsylvania drinking water systems of $16.8 billion over the next 20 years; and with the legacy challenges of combined sewer systems and aging wastewater infrastructure, the projected needs for wastewater systems are comparable. Development and implementation of a sustainable asset management approach is needed to assure ongoing investment, maintenance, and renewal of this essential infrastructure.	Maximize access to and utilization of funds made available from the 2021 Bipartisan Infrastructure and Jobs Act, in combination with state and system level investments. Pennsylvania Infrastructure Investment Authority (PENNVEST) funding for asset management plans should be increased from $25,000 to $50,000 with conditions and timeframes attached. Consider amendments to 25 Pa. Code Chapter 71 to require Act 537 plans to include periodic reviews and reporting on the sustainable management of wastewater systems. Reinvigorate an Act 537 process to help address sustainable infrastructure goals and reestablish and fund the Act 537 planning and enforcement reimbursement program.
Create Program for Agricultural Conservation Practices	There are many agricultural facilities which can contribute nutrient and pathogen runoff, soil erosion, and unrestricted livestock access to streams and surface waters. Though farmers and the agricultural community are ready and willing to do their part to reduce runoff while improving farm practices, they cannot do it without technical support.	Agricultural Conservation Assistance Program (ACAP) (currently SB 465, SB 837 and HB 1901) that could complement the existing Conservation Excellence Grant (CEG) program.

Priority	Rationale	Recommendation
Reduce Livestock Access to Streams	Keeping animals and their waste out of streams reduces bacteria, nitrogen, and phosphorus that pollute waterways and helps prevent erosion by protecting stream banks.	Eliminate prohibitions on restricting livestock access to streams through applicable legislation.

Funding Priorities

Sustainable funding of water resources programs, and sustainable investment in the management and maintenance of water, wastewater, and stormwater infrastructure, is essential to ensuring that Pennsylvanians have adequate, safe, and reliable water supplies and that the quantity and quality of Pennsylvania's water resources are protected for the long-term. Unfortunately, over the past decade or more, funding of water management programs and infrastructure at the federal and state levels have diminished even as challenges have increased.

With the recent passage of the Bipartisan Infrastructure Law, there has been renewed interest in funding critical water resources projects. The regional and statewide committees have considered and developed proposals for how some of that funding can be allocated to have the greatest possible impact on Pennsylvania's water resources and supporting infrastructure.

Below is a list of specific capital investments that could be made to protect and enhance Pennsylvania's water resources:

- **Assist conservation districts in hiring more staff and expanding capacity** by funding the following:
    - Chesapeake Bay Agricultural Source Abatement Fund
    - The Conservation District Fund Allocation Program
    - The Nutrient Management Fund, to provide additional funding for conservation district staff. More funds per Full Time Equivalent (FTE) as well as additional funds for expanding capacity are needed.
- **Increase funding for available Resource Enhancement and Protection (REAP)** (under the Pennsylvania Farm Bill) tax credits.
- **Identify dedicated and increased funding sources for the Environmental Stewardship Fund (ESF).** The ESF provides funding for Pennsylvania's Growing Greener Plus grants as well as Pennsylvania's Chesapeake Bay Clean Water Coordinator and Countywide Action Plan Implementation block grant programs. These two grant programs invest in agricultural conservation practices as well as riparian corridor practices like stream restoration and riparian forested buffers as well as stormwater best management practices. ESF also funds Conservation District Watershed Specialists who help to administer and oversee project implementation.
- **Provide additional Funding for Abandoned Mine Land (AML) Sites.** To ensure long-term funding for continued operation of AML water treatment projects, the state needs to facilitate use of "set aside" accounts under which a portion of funds received from federal AML program grants are placed and held to underwrite future operation and maintenance of those projects.
- **Provide additional Funding for Addressing Inactive Abandoned and Orphan Oil and Gas Wells.** In addition to funding received from the Bipartisan Infrastructure Law, federal and state funding to

address inactive, abandoned, and orphan oil and gas wells will be needed. One option meriting serious consideration would be a proposal to the voters for a state bond issuance similar to the Project 500 / Land and Water Reclamation Act, to help underwrite expanded efforts to tackle these legacy situations in a prioritized manner, thereby restoring Pennsylvania's impacted water resources to usable and sustainable condition.

- **Reinvigorate funding for Act 167 Stormwater Plans and Act 537 Sewage Facilities Plans.** Providing funding for both programs concurrently would help establish a coordinated, holistic way of relating land use and water resources management to meet program goals through Integrated Water Resources Management, or IWRM. There is broad support and demand for reinvigorating funding of these programs. For example, as part of Pennsylvania's Phase 3 Chesapeake Bay Watershed Implementation Plan, 20 Countywide Action Plans identified the Act 167 plan as a priority for urban/suburban stormwater. Revitalizing Act 167 program funding was also recently identified by the State Planning Board as a key recommendation for storm preparedness, flood hazard mitigation and community resiliency.
- **Reach Out and Assist Public Water Suppliers** by funding programs involved with outreach and assistance (technical, managerial, or financial) to water suppliers, especially smaller operations.
- **Provide Funding for the Establishment of an Emerging Contaminants Program**. Establish a contaminants of emerging concern program for collaborative engagement across DEP organizational structure and partnering organizations.
- **Fund Enhanced Flood Forecasting and Warning Systems.** Enhance the Flood Forecasting and Warning Systems Mesonet (or other applicable method) for all major river basins.
- **Increase Efforts to Enhance Community Preparedness and Resiliency for Flood Events and Recovery Assistance Following Flood Events:**
    - The Governor, General Assembly, and all state agencies should evaluate and adjust state funding programs to ensure they offer a preference for locating or relocating structures outside the floodplain.
    - Provide adequate budget funding for agency efforts – i.e., DEP, Commonwealth Flood Coordinator, Pennsylvania Emergency Management Agency (PEMA) – and for project funding and grants needed to meet the above floodplain goals and recommendations.
    - Provide adequate budget funding for DEP to provide grants to meet annually required structural improvements to existing flood control project infrastructure.
- **Provide funding for Chapter 102 Compliance** to encourage proper operation and maintenance of existing stormwater infrastructure to bring it in line with Chapter 102 compliance.
- **Fund DEP for Update of a Stormwater Management Model Ordinance.** Increase consideration to provisions for county and watershed special protection initiatives and watershed-based stormwater management technical reviews.

Regional Priorities

As reflected above, the statewide committee and workgroups weighed and considered the regional priorities in the creation of the statewide priorities.

Act 220 of 2002 subdivides the state water planning effort into six major drainage basins with regional committees representing them. This highlights the unique nature and needs of these geographical regions. Some core themes emerged throughout these committee meetings, such as strengthening the link between land use and water resources management, particularly as it pertains to land development and stormwater control measures. The Delaware regional committee and several other committees felt that an integrated planning approach (considering all aspects of water resources together, in conjunction with land use considerations both within the appropriate state agencies and at the municipal level where most land use decisions are made) was an appropriate solution, with a focus on inter-agency coordination and sharing information with local governments and planning agencies. This was especially true in the Great Lakes region, where international coordination is critical. Act 167 stormwater management plans were also frequently referenced as a potentially valuable tool, if expanded to include consideration of other water issues and if adequate funding to the Act 167 program is restored, to facilitate such holistic planning. In response to this discussion, a workgroup dealing specifically with IWRM was established and the recommendations from that group are discussed in detail in Chapter 2.4.2 Integrated Water Resources Management. Though these were expressed in the context of statewide considerations, it is important to note that these needs are acutely felt locally.

2.4 Assessment and Update of Statewide Priorities and Recommendations for Action

A major outcome of the previous update of the State Water Plan was a set of recommendations to DEP from the statewide committee that would improve water resources in the commonwealth. During the preparation of this update of the State Water Plan, the statewide committee examined whether the previous recommendations for action were still relevant to current discussions and considered what changes or new priorities would be recommended.

Surveys of members were utilized by the statewide committee to help understand what the current highest priority water resources problems may be and to help identify gaps, shortcomings or deficiencies in current water resource planning and management processes and programs.

From these surveys and subsequent discussions, the list of priorities was ranked, and work groups were established for each of the highest ranked priorities to develop "white papers," as shown in Figure 6, with background information and recommendations for action.

Figure 6. Workgroup White Paper Topics

- Floodplain and Stormwater Management
- Integrated Water Resources Management (IWRM)
- Water Withdrawal and Use
- Water Efficiency
- Legacy Impacts
- Drinking Water and Wastewater Infrastructure Sustainability
- Contaminants of Emerging Concern
- Assessment of Navigation Needs
- Agriculture Nonpoint Source Pollution

2.4.1 Floodplain and Stormwater Management

Stormwater and Flood Mitigation Workgroup

The 2009 State Water Plan Principles[16] provided an in-depth assessment of floodplain and stormwater management in Pennsylvania as it stood during that time. The 2009 Principles presented a detailed examination of issues framing problems, programs addressing the problems, identification of gaps and roadblocks, and recommendations in addressing flood control and stormwater management, much of which remains valid today. While many of the challenges previously reported in the 2009 Principles report remain today, significant accomplishments were made during the interim years that have helped meet the life-threatening, environmental, and economic effects of flooding. Some examples include:

- Development of an update in 2018 to the All-Hazard Mitigation Plan[17] by PEMA
- Construction of Flood Mitigation Projects provided through grants from the Department of Community and Economic Development (DCED) under Act 13 of 2012[18]

[16] Department of Environmental Protection, State Water Plan Principles
https://www.dep.pa.gov/Business/Water/PlanningConservation/StateWaterPlan/Pages/2009-Update.aspx
[17] Commonwealth of Pennsylvania, 2018 State Hazard Mitigation Plan, Annual Update: October 2019
https://pahmp.com/wp-content/uploads/2020/01/PA-2019-SHMP-Update-October-2019-Update.pdf
[18] Department of Community and Economic Development, Act 13 Programs
https://dced.pa.gov/programs-funding/commonwealth-financing-authority-cfa/act-13-programs/

- Initiation of eleven flood control projects by DEP since 2009, valued more than $39.5 million, with seven of the projects completed
- Transfer in 2019 of responsibilities for coordination of the National Flood Insurance Program from DCED to PEMA
- Completion in early 2020 by DEP of a statewide Probable Maximum Precipitation (PMP) study that updated the methodology for determining theoretical maximum rainfall amounts for dam design criteria

For the 2022 Update, the Stormwater Management and Floodplain Management Workgroup of the statewide committee examined the prior background and action items from the 2009 Update as part of their understanding of the past, the present, and the future issues of floodplains and stormwater management. A primary part of this workgroup's responsibility was to determine which prior recommendations were already accomplished, identify those that have yet to be addressed, and present new recommendations whenever appropriate. Solutions formulated by the Stormwater Management and Floodplain Management Workgroup generally fell into categories such as:

- Enhancing commonwealth agency capabilities with revised policies, authorities, and permitting changes
- Encouraging financial opportunities for floodplain and stormwater projects
- Directing support to local actions based on watershed approaches
- Encouraging legislative funding to support programs in meeting goals
- Providing technical guidance and educational training
- Recommending administrative changes to agencies and governments to achieve a higher level of cooperation, and to refine the authorities, responsibilities, reviews, and enforcement of existing regulations

While the workgroup recognized and appreciated the valuable steps achieved since the last State Water Plan, the workgroup also emphasized that evolving effects of climate change on water resources have significantly added to ongoing problems.

The Need for Climate Adaptation

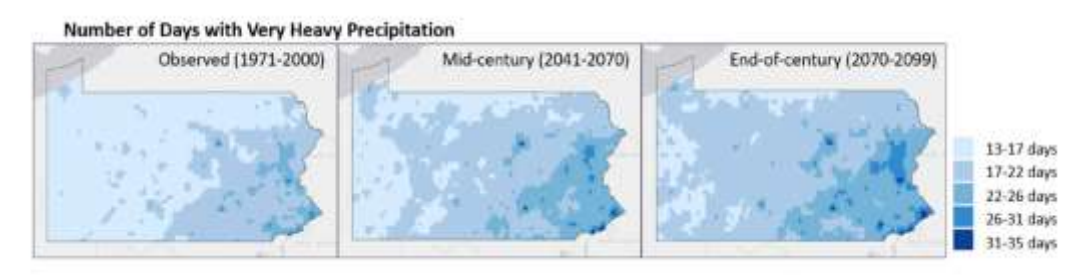
The Pennsylvania Climate Impacts Assessment 2021[19] provides valuable information about changes that have already occurred as well as those projected into the future.

[19] Pennsylvania Department of Environmental Protection, Pennsylvania Climate Impacts Assessment 2021 http://www.depgreenport.state.pa.us/elibrary/GetDocument?docId=3667348&DocName=PENNSYLVANIA%20CLIMATE%20IMPACTS%20ASSESSMENT%202021.PDF%20%20%3cspan%20style%3D%22color:green%3b%22%3e%3c/span%3e%20%3cspan%20style%3D%22color:blue%3b%22%3e%28NEW%29%3c/span%3e%204/30/2023

Increased flood risks

As illustrated in Figure 7, by this mid-century, compared with a 1971-2000 baseline, Pennsylvania could experience more total average rainfall, occurring in less frequent but heavier rain events. It is estimated there could be a 24% increase in the number of days with more rainfall than currently occurs on 95th percentile or "very heavy" rainfall days, with an estimated 12% increase in precipitation on those days. Under this 2021 assessment, flooding is the highest risk hazard facing Pennsylvania, and flood risks are projected to increase.

Figure 7. The Pennsylvania Climate Impacts Assessment 2021



The workgroup recommends embracing a coalescence of approaches, such as IWRM, implementation of climate adaptation strategies, and use of green infrastructure. These combined strategies will ensure that stormwater management, floodplain management, and flood protection programs will be of sufficient strength and resilience to meet the challenges the commonwealth faces now and into the future.

It is for these reasons that the statewide committee offers the following recommendations.

Flood Control Recommendations

1. Request that PEMA, with consultation of other state agencies, review and update elements of the Pennsylvania Enhanced All-Hazard Mitigation Plan that address flooding.
2. Encourage the General Assembly to fund an enhanced Flood Forecasting and Warning Systems Mesonet, (or other applicable method) for all major river basins, utilizing a partnership of federal, state, and local governments.
3. Request PEMA, with consultation of other state agencies, to support the Federal Emergency Management Agency's (FEMA) efforts to update Flood Insurance Rate Maps and encourage FEMA to improve the process for communicating with affected property owners in the updating of floodplain maps.
4. Through executive action, appoint a Commonwealth Flood Coordinator (CFC) charged with coordinating flood prevention and recovery activities among state agencies. The CFC would also serve as the primary point of contact for federal, interstate, commonwealth, and local officials on flood-related matters. This coordinator should be autonomous from DEP and other agencies, and report directly to the Governor's office.

5. Increase efforts to protect Pennsylvania's floodplains.

    - The General Assembly should enact amendments to the Flood Control Act to provide authority to DEP and other appropriate state agencies to consider and implement all potential flood control solutions, including non-structural alternatives and preventive approaches to reduce the risk of flooding; and allow all types of flood control solutions to be funded through the capital budget process.

    - Pennsylvania should encourage Congress and FEMA to review and evaluate the Federal Flood Insurance Program to identify policies, such as the buy-out option, which can be enhanced with floodplain restoration to decrease the likelihood of future damage to communities.

    - DEP, in consultation with PEMA, should evaluate and provide recommendations to the General Assembly to enact amendments to Section 301(a) of the Flood Plain Management Act to consider expanding the list of floodplain obstructions that present a special hazard to public health and safety, that may cause significant pollution or that may endanger life and property. Additionally, such legislation should address rebuilding within the floodplain and should provide provisions for restoration and remediation of the floodplain to minimize future flood losses.

6. Increase efforts to enhance community recovery assistance following flood events.

    - All involved state agencies should ensure that existing programs are coordinated and provide incentives for floodplain protection and restoration. Public funds used for flood recovery and rebuilding should target floodplain and carrying capacity restoration and obstruction removal. Retrofitting existing development with facilities designed to minimize flood losses should be considered where appropriate.

    - To the maximum extent allowable under applicable law, FEMA, PEMA and other involved state agencies should prioritize flood recovery funds for activities that protect the flood carrying capacity of the floodplain, including stream, floodplain, and wetland restoration projects, inclusive of restoring riparian corridor herbaceous and forested cover and other green infrastructure. Invest funds effectively and reasonably to restore the floodplain and to reduce future losses.

    - FEMA and PEMA should cooperate in revising existing post-flood recovery funding programs to require post-disaster assessments and mitigation investigations and emphasize increased efforts on floodplain restoration and restoration of flood carrying capacity (trees/vegetation within restorations).

    - The Governor, General Assembly and all state agencies should evaluate and adjust state funding programs to assure they offer a preference for locating or relocating structures outside the floodplain. Where this approach is not feasible, approval to build or rebuild within the floodplain should include provisions for restoration and remediation of the floodplain to minimize future flood losses.

7. Request PEMA, DEP, and DCED to establish an information center/clearinghouse providing education and training to local government officials, municipal solicitors, municipal engineers, and the design community that emphasizes the importance of embedding integrated stormwater and floodplain management considerations into related municipal decisions.

8. In connection with integrated water resources planning, local governments should be encouraged to include floodplain management and floodplain regulation into local integrated water resources

planning. During their planning processes, county and local governments should consider provisions with preferences toward achieving floodplain restoration and relocations, where practicable.

9. Request DEP to seek advisory (non-regulatory) comments from PEMA and the CFC for all Joint Permit (404/105) applications which have floodplain-limiting components, within the established review timelines. Request that DEP provide notice of all Chapter 105 General Permit authorizations to the same for inventory and mapping.
10. Request DEP, in coordination with the Pennsylvania Fish and Boat Commission (PFBC), to establish technical design guidance for new encroachments and obstructions including:
    - Aquatic Organism Passage (AOP) design standards
    - Construction materials and standards
    - Design storm sizing – including recommendations for the Department of Transportation, (PennDOT) and Municipal road crossings
    - Stream simulation design standards
    - Other items deemed necessary for resilient safe conveyance of flood waters
11. Encourage county planning commissions, in consultation with local municipalities, county conservation districts, and DEP, to establish floodplain studies for surface waters with drainage areas greater than 100 acres, which are zoned for non-agricultural uses and not part of an existing detailed FEMA study. Additionally, enact local ordinances which require those engaged in development to provide such studies.

    Provide adequate grant opportunities based on regional need and hazard potential for these studies.
12. Encourage county planning commissions, in consultation with local municipalities, county conservation districts, and DEP, to map existing floodplain obstructions and encroachments within the statutory floodway of surface waters. Provide adequate grant opportunities based on regional need and hazard potential for these studies.
13. Encourage county planning commissions, in consultation with DEP and PEMA, to incorporate existing floodplains, proposed floodplain management areas, stream restoration priorities, and riparian buffer corridors into overall comprehensive planning efforts and adopted plans at both county and municipal levels.
    - Consider density and use variances for projects which incorporate significant regional floodplain management/restoration within the subject tracts of land to incentivize public-private partnerships.
    - Consider ways of addressing the “loss of tax base” for the municipality associated with floodplain restoration and relocations.
14. Encourage county planning commissions, in consultation with DEP and PEMA, to require all municipalities to enact and enforce a floodplain ordinance consistent with DEP, PEMA, and FEMA standards.
15. Encourage the General Assembly to provide adequate budget funding for DEP and PEMA efforts and project funding and grants needed to meet the above floodplain goals and recommendations.

16. Encourage the General Assembly to provide adequate budget funding for DEP to provide grants to meet annually required structural improvements to existing flood control project infrastructure.

Stormwater Management Recommendations

1. Through appropriate administrative and structural changes within DEP, provide a streamlined and more efficient stormwater management program for the regulated community.
2. Request that DEP establish an information center/clearinghouse (Pennsylvania Clean Water Academy or other as deemed appropriate) providing education and training to local government officials, municipal solicitors, engineers/designers, and the regulated community on related permitting, design, maintenance, reporting of stormwater infrastructure, and planning.
3. Encourage the General Assembly to authorize by legislation the creation and operation of local authorities, utilities, or management districts and/or other entities that are able to collect reasonable fees and generate sustainable revenues dedicated to planning, constructing, monitoring, maintaining, improving, expanding, operating, inspecting and repairing public and private stormwater management infrastructure. Fee arrangements should be structured to avoid being classified as a "tax" and should provide appropriate exemptions or credits to entities who have implemented appropriate and effective stormwater control and management methods that address the impact of their lands and activities. Currently, Section 2705 of Act 62 of 2016[20] provides some specificity as to the assessment of such fees for second-class townships. Recent bills seek to amend the statutes governing other types/classes of local governments (e.g., first-class townships, boroughs, third-class cities) to authorize specifically/explicitly "stormwater fees."
4. Encourage the General Assembly to fund, promote, and support water resource restoration projects through appropriate legislation. Water resource restoration projects to fund, promote, and support include, but are not limited to, the following:

    - Projects that reconnect streams to an active floodplain
    - Projects that remove anthropogenic impairments such as legacy sediments along streams
    - Projects that reestablish wetlands and restore degraded wetlands, especially in floodplains and in headwater areas
    - Projects that remediate actively eroding streambanks and use native woody and herbaceous vegetation best management practices to stabilize soils and trap sediments
    - Projects that restore riverine forms and processes while providing geomorphic stability, prevent head-cuts, bed scour, and other forms of channel degradation

    Support for these types of projects should consider, but not be limited to, the following:

    - Increased funding to support DEP's in-lieu fee program, including funds to establish initial credit-generating projects and for additional staff needed to administer the program
    - Expedited/prioritized review and permit authorization by county and state agencies
    - Increased density or Land Use zoning considerations at a local level

[20] Pennsylvania General Assembly, 2016 Act 62, Second Class Township Code- Storm Water Management Ordinances and Fees
https://www.legis.state.pa.us/cfdocs/legis/li/uconsCheck.cfm?yr=2016&sessInd=0&act=62

- Longer-term tax incentives or grant opportunities

5. Request DEP to regularly evaluate permitting fees for Chapter 102 and 105 programs as they relate to the actual effort spent by staff for review authorization. Adjust permitting fees as needed to fund adequate staffing and infrastructure for efficient standard.
6. Adequately fund regular updates and addenda to the Pennsylvania Stormwater Best Management Practices Manual[21] to reflect changes to computational methodologies/processes, design/construction practices, proprietary products, maintenance needs, and the best available and current technologies. Technical design guidance should include, but not be limited to:
    - Resilient structural practices to accommodate changing precipitation patterns within the commonwealth
    - Guidance on special projects such as large-scale energy projects, brownfields, oil and gas, mining, timber harvesting
7. Encourage the General Assembly to adequately fund DEP to continue to maintain and update the Stormwater Management Model Ordinance to reflect Stormwater Best Management Practices Manual revisions and statutory amendments
    - Provide provisions for county and watershed level special protection initiatives, as deemed appropriate by the county's commissioners
    - Promote watershed-based stormwater management technical reviews for consistency with watershed planning efforts
8. Encourage the General Assembly to fund DEP to enable adequate auditing and enforcement of municipalities such that proper operation and maintenance of existing and newly constructed post-construction stormwater management practices are assured for Municipal Separate Storm Sewer System (MS4) documentation and Chapter 102 compliance.
9. Through appropriate structural and administrative changes within DEP and county administrations, to the greatest extent practical, continue opportunities for delegated county conservation districts to implement Chapter 102 and Chapter 105 permitting and to support watershed-based local technical reviews, authorizations, and enforcement. DEP through its regional offices should continue to provide technical assistance, oversight, and training for the county conservation districts to assure statewide standardization of Chapter 102/105 regulatory compliance.
10. Encourage DEP through appropriate regulatory action to adopt technical safety standards for embankments of applicable stormwater facilities, not otherwise subject to Chapter 105 Dam Safety regulatory criteria, in accordance with technical recommendations outlined by the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS).
11. Encourage the General Assembly to provide adequate budget funding for DEP efforts, project funding, and grants needed to address stormwater management goals and recommendations through Integrated Water Resource Planning by way of the Act 167 program.

[21] Department of Environmental Protection, Pennsylvania Stormwater Best Management Practices Manual 363-0300-002
http://www.depgreenport.state.pa.us/elibrary/GetFolder?FolderID=4673

2.4.2 Integrated Water Resources Management

Water Management and Land Use Management Workgroup

For the commonwealth, nothing could be more important than ensuring that there is an adequate supply of clean water for all Pennsylvanians, sufficient in quantity and quality to supply its many needs and uses. Fortunately, the commonwealth is rich in water resources, with about 85,500 miles of streams; nearly 4,000 lakes, reservoirs, and ponds; 80 trillion gallons of groundwater; and 404,000 acres of wetlands. In addition, the commonwealth has 56 miles of coast along the Delaware Estuary and 77 miles along Lake Erie.

Water is essential to virtually all aspects of our economy and life and an equally essential foundation to Pennsylvania's environment. In addition to residential drinking water for its 13 million people, water in the commonwealth is used for thermoelectric power generation, agriculture, industries, mining, and recreation.

Under the Pennsylvania Clean Streams Law, 35 P.S. §691.1[22], the commonwealth's official policy is to recognize that "clean, unpolluted streams are absolutely essential if Pennsylvania is to attract new manufacturing industries and to develop Pennsylvania's full share of the tourist industry," and DEP has the primary responsibility to "prevent further pollution of the waters of the commonwealth, but also to reclaim and restore to a clean, unpolluted condition every stream in Pennsylvania that is presently polluted." Concurrently, Act 220 of 2002, 27 Pa. C.S. §§3101-3136[23], provides for water planning that considers both quality and quantity, the assessment and projection of current and future uses, consideration of stormwater and floodplain management issues, and other important aspects of water management.

Within DEP, the Office of Water Programs coordinates policies, procedures, and regulations which influence public water supply withdrawals and quantity, sewage facilities planning, point source municipal and industrial discharges, encroachments upon waterways and wetlands, dam safety, earth disturbance activities, and control of stormwater and nonpoint source pollution. In addition, the Office of Water Programs coordinates the planning, design and construction of flood protection and stream improvement projects.

Pennsylvania is a party to the Delaware River Basin Compact, Susquehanna River Basin Compact, Interstate Commission on the Potomac River Basin Compact, Ohio River Valley Water Sanitation Compact, and the Great Lakes-St. Lawrence River Basin Water Resources Compact – interstate agreements that share the responsibility for the management of Pennsylvania's water resources in parts of the state. Within DEP, the Office of Compacts and Commissions coordinates with interstate commissions, state governments, and interstate organizations in advancing partnerships and promoting multi-state cooperation to address shared issues.

[22] Pennsylvania General Assembly, Clean Streams Law, 1937 Act 394 https://www.legis.state.pa.us/cfdocs/Legis/LI/uconsCheck.cfm?txtType=HTM&yr=1937&sessInd=0&smthLwInd=0&act=0394.

[23] Pennsylvania General Assembly, 2002 Act 220 https://www.legis.state.pa.us/cfdocs/legis/li/uconsCheck.cfm?yr=2002&sessInd=0&act=220

Linkage of Land Use to Water Management

At the same time, how land is used, developed, redeveloped, or conserved also has a great effect on the availability and quality of the water in the commonwealth's creeks, rivers, lakes, ponds, and groundwater for all of water's uses in Pennsylvania. Under the Pennsylvania Municipalities Planning Code, 53 P.S. §10101[24], (MPC), most issues involved in regulating land use and development are delegated to Pennsylvania's more than 2,500 local governments (cities, townships, and boroughs), and counties. While the MPC requires local zoning as well as subdivision and land development ordinances to consider the availability of water for various uses and access to water, integrating land use planning and water resources management would be beneficial to both managing the commonwealth's water resources while enhancing efforts aimed to support wise land use and smart development.

As one example, the regulation, design, operation, and management of proposed stormwater management systems can have a dramatic effect on the quantity and quality of the water in nearby waterways and groundwater and as well as impact downstream neighbors. Similarly, the planning, siting, and functioning of sewage facilities to serve existing or new development can significantly impact both water quality in surface and groundwaters and the way water is returned to streams or recharged to aquifers. An integrated approach brings surface water, groundwater, stormwater, wastewater, and water supply issues into the land planning decision-making process.

Importance of Coordination

Water resources management becomes incredibly complex when basins, watersheds, and geographic regions of interest are overlapped by multiple municipal, county, or state boundaries – each having varying governance and priorities. The multivariate nature of this problem means that success of a project could correlate directly with the level of coordination between involved parties, which becomes especially evident when work is done on a watershed scale in comparison with an individual permit site or small stream segment. Coordination is a commitment to bring different stakeholders together to work effectively.

Education, outreach, and data sharing with the local government regarding land use planning and land use decisions are coordination elements that help to effectively integrate water resources management into land use planning and decision-making, but they will require local acceptance by local governments.

An important example of coordination would be DEP continuing to lead in coordinating regular updates and addenda to the *Pennsylvania Stormwater Best Management Practices Manual*[25] to reflect changes to computational methodologies/processes, design/construction practices, proprietary products, maintenance needs, and the best current technologies available. This technical design guidance should include but not be limited to design criteria for resilient structural practices to accommodate changing precipitation patterns within the commonwealth, special guidance on certain projects with potentially significant impacts, such as large-scale energy projects, and brownfields redevelopment. Local governments should be encouraged to consider and adopt these guidelines in local land use ordinances.

With state incentives, technical resources, and encouragement, the commonwealth can lead the way by aligning its regulatory responsibilities within state agencies and then by working together with local

[24] Pennsylvania General Assembly, Municipalities Planning Code
https://www.legis.state.pa.us/WU01/LI/LI/US/HTM/1968/0/0247..HTM

[25] Department of Environmental Protection, Pennsylvania Stormwater Best Management Practices Manual 363-0300-002
http://www.depgreenport.state.pa.us/elibrary/GetFolder?FolderID=4673

governments and planning commissions to integrate water resource planning and projects into land use planning and decisions.

Strategic Direction

IWRM is a holistic, coordinated approach to managing water, land, and related resources that offers a framework to identify and understand water-related challenges and obligations and the opportunities to address those challenges efficiently and in consideration of watershed needs. Integration helps make practical and science-based decisions while considering water availability data, water resiliency (including considerations related to climate change), and water quality in the context of land use decisions.

Essential strategies for Pennsylvania may include but are not limited to:

- Looking for opportunities to improve coordination on water resources management within DEP.
- Improving coordination and data sharing across state agencies and throughout the federal, interstate, state, and local government hierarchy, including but not limited to Pennsylvania Emergency Management Agency (PEMA) and Federal Emergency Management Agency (FEMA).
- Solidifying the connection between land use and water resources management by looking for more opportunities to actively involve local governments, county planning commissions, conservancies and watershed groups, private companies, and citizens within the watershed, in integrated water resource planning education and land planning projects and decisions.

Comprehensive planning at all levels should consider the entirety of the river basin as well as more granular watershed level management, including regional planning; water quality regulation and enforcement; water allocation; low flow protection; drought preparedness; water use planning and regulation;, flood mitigation and stormwater management; groundwater recharge; consumptive use management and mitigation; monitoring and data management (baseline and impact assessment); addressing climate change impacts; mining; land use/land cover issues (including supporting the protection of existing forest cover and appropriate use of floodplains/active river areas); education and outreach; and the development of tools, including model ordinances, county and regional plans, funding, and incentives. Environmentally effective and cost-efficient planning is best done on a watershed basis.

DEP should continue to administer its water resources management, watershed restoration and protection, and water quality management programs in a consolidated and coordinated fashion, seeking opportunities for improvement both when performing planning and during the process of reviewing individual development projects. The strong relationships among these programs should continue to be encouraged and used in guiding DEP's strategic policy choices and daily decision-making.

DEP should continually strive to improve coordination among state agencies as well as throughout the hierarchy of governance in Pennsylvania. State agencies have an obligation to work toward common objectives so that statutes, regulations, and policies are mutually supportive, efficiencies are gained, and conflict and duplication are avoided. A great example is DEP's coordination on floodplain management and planning in cooperation with FEMA and PEMA.

DEP and PEMA should engage with Pennsylvania Fish and Boat Commission (PFBC) and Pennsylvania Department of Transportation (PennDOT) to establish technical design guidance for new encroachments and obstructions, including Aquatic Organism Passage (AOP) design standards, construction materials, and standards for design storm sizing. Such guidance for incorporation into local land use ordinances

should include recommendations for PennDOT and municipal road crossings, along with stream simulation design standards and other items deemed necessary for resilient safe conveyance of flood waters.

Similarly, DEP should further collaborate with federal, state, interstate, international, and local governments within a watershed to align their collective efforts to ensure consistency among water resources management initiatives and to take advantage of their combined wisdom, data, and capital. This will entail outreach and education to the private sector and non-profit organizations to build awareness and support for following a united course.

Land use has a profound influence on water resources planning and management. While federal, interstate, and state governments have broad mandates to manage and regulate water resources, Pennsylvania municipalities have authority to adopt comprehensive plans, zoning regulations, and subdivision and land development ordinances. Local land use decisions should integrate water resources management objectives in their watershed to sustain economic growth while also achieving environmental protection and water resources management goals. To the extent that local governments lack the resources to integrate their land use decisions with current science and available data and up-to-date water resource planning and development, the commonwealth – through grant incentives and support to county planning agencies and conservation districts – can encourage the development of model land use ordinances and offer the technical assistance to help them accomplish this.

Recommendations

Set Agency Groundwork for IWRM

1. **Perform a baseline assessment**. DEP, with assistance from the statewide committee, should develop a baseline assessment of what IWRM means under the current commonwealth governance and formulate a roadmap that establishes the roles that DEP and other agencies may have in IWRM. Applicable bureaus and offices within DEP include: Clean Water, Safe Drinking Water, Waterways Engineering and Wetlands, Chesapeake Bay, Compacts and Commissions, Mining Programs, and Abandoned Mine Reclamation. The scope will include, but not be limited to:

    a. Facilitate discussions to educate statewide committee members on program functions and current coordination among DEP programs and agencies. This will help provide a better understanding of current coordination that will lead to more defined and applicable IWRM concepts for statewide committee recommendation to DEP and partnering agencies.

    b. Identify specific current or emerging issues, opportunities for improved coordination and problems that may be addressed by IWRM. This can include areas where lack of coordination is leading to missed opportunities for existing programs or newer programs that address emerging environmental concerns and initiatives.

    c. Explore case studies and assessments of projects that are IWRM related.

2. **Establish an actionable workplan.** With the baseline assessment completed, DEP, with assistance from the statewide committee, should then begin to establish and take discrete, actionable steps that:

    a. Identify potential programmatic, policy or regulatory options along with their impacts and benefits.

    b. Assess options in developing specific implementable management actions that would reflect the linkage of land use to water resources management.

Improve Coordination

1. **Inter-agency coordination**. Consideration should be given to making the State Water Plan section of DEP the single point of contact (SPOC) in DEP's Central Office, charged with championing consistent planning, operations, and application of regulations and policies across programs and coordination across state agencies including DEP, DCNR, PENNVEST, Department of Transportation (PennDOT), Pennsylvania Energy Management Agency (PEMA) and the Public Utility Commission (PUC), as well as the Game Commission, Fish and Boat Commission, Department of Agriculture, and county conservation districts. Additionally, DEP should evaluate existing inter-agency teams established under National Environmental Policy Act (NEPA)[26] requirements to determine whether these requirements may be used for other planning/implementation issues.
2. **Inter-basin coordination**. DEP should continue to support basin commissions leading coordination efforts on issues affecting basin-wide water planning and management, understanding that land use management lies largely at the local level. Existing basin commission committees are very helpful tools. In parts of the commonwealth without a basin commission or other authorized agency, DEP should continue to be actively involved.
3. **State-federal coordination**. A concentrated effort should be taken by DEP to maintain and strengthen the relationships with key federal agencies, including USGS, FEMA, United States Army Corps of Engineers, EPA, United States Fish and Wildlife Service (USFWS), United States Forest Service, Natural Resources Conservation Service, and Office of Surface Mining Reclamation and Enforcement.
4. **Local government coordination**. Where the need and opportunities exist, DEP is encouraged to coordinate IWRM planning and education/outreach efforts with local governmental resources such as the Pennsylvania State Association of Township Supervisors (PSATS), Pennsylvania State Association of Boroughs, Pennsylvania Municipal League; professional organizations including the Pennsylvania Planning Association, and Consulting Engineers Council; and local organizations including county conservation districts, planning departments, and watershed associations.

[26] The Council on Environmental Quality, NEPA.gov https://ceq.doe.gov/index.html

Initiate County IWRM Plans

1. Efforts should be made by DEP to identify and assess completed countywide, online integrated water resource plans which serve developers by allowing them to classify their projects and determine which permits or state resources are applicable to their projects. These specific plans could be assessed for effectiveness by the State Water Plan section and proliferated using existing tools.
2. DEP should update current county integrated water resource plan templates as necessary for voluntary implementation and explore providing outreach and assistance to encourage widespread implementation of county wide plans.

2.4.3 Water Withdrawal and Use

Water Supply Workgroup

The 2009 Update included a comprehensive treatise on Water Withdrawal and Use Management in Pennsylvania that described the common law and statutory basis for water allocations and the roles of the federal, state, and local governments and compact commissions on water withdrawals and use. From this, the 2009 Update provided three primary recommendations centered on the:

- Advancement of water use registration and reporting
- Development of water use projections and water use trends
- Development of recommendations as to whether and how Pennsylvania's water rights system might be improved

For the 2022 Update, the Water Supply Workgroup of the statewide committee looked at the 2009 Update to ascertain which of the recommendations may be appropriately updated, to consider how water supply needs and priorities have evolved since 2009, and to offer new recommendations.

Of the three 2009 recommendations, DEP accomplished the development and implementation of water use registration regulations and an implementation program. From these registrations and subsequent periodic reporting, DEP created a comprehensive database and statistical information on water use in Pennsylvania[27] that is accessible to the public and other agencies for water planning purposes. This data is important in serving to inform the development of trends in water use over time.

With the benefit of water use data collected since the 2009 Update, total water use within the state has most likely peaked, primarily due to the declining trend in withdrawals from thermoelectric power-generating facilities. Water withdrawn for cooling of thermoelectric facilities is the commonwealth's largest water use sector, accounting for over 60 percent of all withdrawals at 3.1 billion gallons per day (BGD) in 2020. This sector, specifically coal-burning electricity-generating facilities, has been driving the overall decline in Pennsylvania. The next two largest water use sectors are public water supply and industrial, representing an additional 38 percent; together, these three water use sectors account for 98 percent of all reported withdrawals in the commonwealth. Public water supply use has been relatively steady, at 1.3 BGD, while industrial use has been declining since 2008. This information is further summarized in the Water Use and Planning section of the updated State Water Plan Atlas[28].

[27] DEP Water Use Reports webpage
www.dep.pa.gov/DataandTools/Reports/Pages/Water.aspx
[28] DEP State Water Plan Digital Water Atlas
[link to be inserted]

The Susquehanna River Basin Commission (SRBC) and Delaware River Basin Commission (DRBC) had completed reports within their respective basins, including projected water needs. SRBC, in its *Cumulative Water Use and Availability Study*[29], projected a 10% increase in reported consumed water by 2030 from 2014. Specifically, the report identified two subbasins – the Juniata River basin (in the Lower Susquehanna region) and the West Branch Susquehanna River basin (in the Upper/Middle Susquehanna region) – to increase the most, with a projected increase in reported consumed use at 27% and 16%, respectively. The SRBC report states that the primary driver for the increased water use is the natural gas industry.

Recent water use observations shared with the statewide committee from SRBC include the following:

- Water use for existing power plants has been declining
- Public water supply requests for water use reduction at time of renewal
- Decrease in the number of natural gas wells developed, but the amount of water use per well has increased
- Slight increase in water use for agriculture but is projected to decrease in the future
- Relatively stable to slight increases in manufacturing water use
- Ski facilities asking for increased withdrawal rates to take advantage of shorter periods of snowmaking conditions

In the Delaware River region of Pennsylvania, peak water use has likely already occurred. According to a recent DRBC report titled *Water Withdrawal and Consumptive Use Estimates for the Delaware River Basin (1990-2017) with Projections through 2060*[30], water use trends are projected to continue to decrease by 2060, led by declines in withdrawals from thermoelectric facilities utilizing once-through cooling. However, the DRBC report identifies projected increases in two subbasins (eight-digit hydrologic unit codes[31]):

- Crosswicks-Neshaminy (Bucks County) for thermoelectric power, industrial and public water supply
- Lehigh (east-central Pennsylvania) for primarily public water supply

The Water Supply Workgroup recognized that, going forward into the next planning phase of the State Water Plan, the legacy issues from the previous update should be completed. The workgroup also identified potential future activities, such as evaluating potential changes to the current common law system for a more consistent and secure statutory arrangement. The workgroup envisioned that such changes in law would consider DEP's water data system to achieve a better understanding of future water demands. Additionally, the workgroup envisioned that supporting legislation would be designed to protect existing and future uses of private wells and other groundwater resources. Finally, the workgroup believed it will be important to consider the effects of climate change and to plan for more resilient water supplies and improved drought and flood monitoring.

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[29] SRBC Cumulative Water Use and Availability Study
ww.srbc.net/our-work/reports-library/technical-reports/303-cumulative-water-use-availability/

[30]DRBC Water Withdrawal & Consumptive Use Estimates (1990-2017) & Projections Through 2060
www.nj.gov/drbc/programs/supply/use-demand-projections2060.html

[31] For explanation of hydrologic unit codes (HUCs), see the USGS Hydrologic Unit Maps webpage
https://water.usgs.gov/GIS/huc.html

These considerations are the basis for the following 2022 State Water Plan Update recommendations:

Water Withdrawal and Use Recommendations

1. Encourage the General Assembly to protect existing and future uses of private wells and the groundwater resources upon which they rely, by enacting legislation to require proficiency-based licensing and certification of water well drillers, and to establish statewide private water well construction standards. Considering past significant adverse reactions to similar proposals, any proposed legislation should be preceded by a strategic campaign of educational outreach.
2. DEP should work with the river basin commissions, United States Geological Survey, and other partners to improve the utilization of reported water use data in projecting future demand trends and to aid in managing and accessing water supply and water availability on a watershed scale. Such efforts should include the following actions:
    - Maintain efforts to register and report withdrawals under the provisions of Pennsylvania's Water Resources Planning Act (Act 220 of 2002) and counterpart basin commission programs, and to encourage compliance with withdrawal and consumptive use reporting programs
    - Expand the current data analytic tools (e.g., water use summaries, report viewers) to focus on consumptive use/depletions on a watershed scale
    - Prior to and during the next iteration of the State Water Plan, develop projections and trends in water withdrawal and consumptive uses by watershed
    - Prior to and during the next iteration of the State Water Plan, develop projections of the impacts of climate change on water availability by watershed
    - Explore opportunities for outreach to water supply purveyors and other self-supplied water users to focus on improved water supply planning to assure long-term, reliable supplies, including considerations of water resiliency, and to maintain accurate flow metering and data reporting
    - Reevaluate the processes for using reported data and projections to identify critical and potentially stressed or challenged watersheds and assign appropriate priority for focus on watersheds based on the degree of stress or challenge
3. The statewide committee should work with DEP, the broad spectrum of stakeholders, and the General Assembly to evaluate the current effectiveness and shortcomings of Pennsylvania's existing water rights and water withdrawal arrangements, and to develop recommendations for evolving those arrangements to a more consistent, secure, and holistic approach. Once shortcomings have been identified, an evaluation of programs used in other states and compact commissions should be conducted to determine if those practices may serve as recommendations for a secure and sustainable water supply statewide. Based on that process, a report developed by the statewide committee in consultation with DEP on the relative merits of the identified options should be developed, and appropriate recommendations should be made to the General Assembly as to whether and how Pennsylvania's water rights system might be improved and made more efficient, effective, predicable, and secure.
4. DEP should evaluate and continue to improve its drought monitoring practices and encourage proactive monitoring among public water suppliers.
    - Add targeted groundwater wells with 20-year records to the monitoring network to increase county representation

- Seek an alternative to the Palmer Drought Severity Index, which proved unreliable for Pennsylvania in recent droughts
- Encourage the monitoring of groundwater well water level monitoring by public water suppliers and industrial facilities that are not already required to do so and consider incorporating data into statewide drought monitoring

5. Considering the anticipated effects of climate change, all community water systems (as well as self-supplied users) should evaluate the vulnerabilities of their respective sources to the impacts from expected increases in both the frequency and intensity of flooding and droughts. These systems and users should follow their Uninterrupted System Service Plan to promote resiliency and redundancy and, where needed, seek: (i) diversification of sources (e.g., avoiding reliance on a single surface source or well field tapping the same resource); (ii) interconnection with neighboring systems; (iii) raw or finished water storage; (iv) development and implementation of conjunctive management plans for coordinated use of surface and groundwater sources; and (v) focused monitoring of source conditions, with contingency plans for implementing conservation measures and adjustment of water withdrawals in order to preserve the ability to meet essential needs through drought conditions.

2.4.4 Water Efficiency

Water Supply Workgroup

While the 2009 State Water Plan Principles[32] provided a comprehensive overview of water conservation and efficiency issues pertinent to Pennsylvania, the water conservation and efficiency recommendations in the 2009 Update focused primarily on the establishment, funding, and operations of a Technical Assistance Center as required by Act 220 of 2002. Early phases of a contractor-organized, nonprofit-based center were completed. However, significant challenges related to the organizational structure and long-term funding to maintain and carry out its functions halted its implementation.

As an alternative, the State Water Plan will now be utilizing the existing Pennsylvania Clean Water Academy[33] as a digital training library to house educational and outreach resources on a wide range of water resources topics, including water efficiency.

For the 2022 Update, the Water Supply Workgroup of the statewide committee met to review the 2009 Update recommendations and to formulate suggestions focused primarily on meeting today's priorities and challenges related to water efficiency. The following recommendations recognize the opportunities under the State Water Plan to disseminate technical information, address adaptation of climate change, manage public water supply assets, and accomplish overall improvement in efficiency by municipal and industrial water users.

Water Efficiency Recommendations

1. Information and materials on water efficiency technologies and practices should be developed and incorporated into the Pennsylvania Clean Water Academy (and other state information

[32] Department of Environmental Protection, Pennsylvania State Water Plan of 2009
https://www.dep.pa.gov/Business/Water/PlanningConservation/StateWaterPlan/Pages/2009-Update.aspx
[33] Department of Environmental Protection, Clean Water Academy
https://pacleanwateracademy.remote-learner.net/

dissemination vehicles) to promote their adoption. Recommendations for administration and operation of these forums are:

- Secure consistent funding and technical resources needed to effectively promote water use efficiency through the dissemination vehicles
- Improve marketing and expand the audience of the Pennsylvania Clean Water Academy and other vehicles while avoiding duplication with others offering technical assistance
- Develop materials related to water audits, leakage management, and retrofits
- Document and disseminate goals for water use efficiency

2. The expected need for increased irrigation in the face of climate change should be assessed. Best practices for irrigation, including minimizing impact to small watersheds, should be developed by the Pennsylvania Department of Agriculture with assistance from DEP, Penn State, and agricultural stakeholder groups, and disseminated via county conservation districts and other agricultural liaison entities.
3. Additional aspirations for improved water efficiency associated with Pennsylvania's municipal and industrial water users are summarized below.
    - Water suppliers:
        - Adopt technology and use policies that cut water resources use and demand at peak times of drought or resource constraints
        - Incorporate time-of-use rates that encourage using water at times of less demand
    - Water users:
        - Implement technologies that reduce overall base demand
        - Install "smart meters" that enable detailed measurement of water use in buildings to detect water leaks and other wasteful water use practices
    - Interested Parties:
        - Conduct research and promote innovative practices through marketing incentives, outreach, and educational efforts
        - Provide support and resources to entities that have implemented or wish to implement innovative water use efficiency practices
        - Offer rebates to encourage replacing open-loop systems with closed- loop systems
        - Link water use efficiency to the strong existing interest in energy efficiency and expand eligibility for energy efficiency grants to water use efficiency efforts

2.4.5 Legacy Impacts

Legacy Issues Workgroup

Two significant legacy issues for Pennsylvania are abandoned mine lands (AMLs) and abandoned oil and gas wells. For hundreds of years, coal was mined in Pennsylvania with little thought of environmental consequences and without robust regulation of environmental impacts. It is estimated that hundreds of thousands of oil and gas wells have been drilled in Pennsylvania since 1859. Both legacy activities have left Pennsylvania with environmental damage as well as health and safety risks as pollutants continue to enter the air, land, and water.

Pennsylvania's history of addressing abandoned coal mine issues extends back into the 1960s through legislation and programs to eliminate stream pollution from abandoned as well as active coal mining operations. DEP's Well Plugging Program[34] was established under the authority of Pennsylvania's Oil and Gas Act (1984) which was succeeded by the Pennsylvania Oil and Gas Act (Act 13 of 2012)[35]. Further information may be found on the DEP webpage entitled Laws, Regulations and Guidelines[36].

Although neither abandoned mines nor abandoned oil and gas wells were addressed as specific statewide priorities in the 2009 Update, the implications of these problems, among other legacy issues, spurred the 2022 Update statewide committee to form a Legacy Issues Workgroup to investigate the subjects.

During this 2022 Update, the Legacy Issues Workgroup narrowed their focus to these two legacy issues with a goal to offer recommendations to improve upon the efforts already underway at the federal and commonwealth levels. The workgroup examined Pennsylvania's legacy of mining and oil/gas well development and considered past and current approaches in addressing the myriad of environmental problems these legacies continue to pose today. After reflecting on the status of programs and decades of cleanup efforts, the Legacy Issues Workgroup offers the following recommendations for DEP's consideration in support of federal and commonwealth efforts to sustain, extend, and improve abandoned mine drainage (AMD) treatment, other AML programs, as well as identify and plug abandoned and orphaned oil and gas wells.

Full treatises on these subjects are available in Appendix D under the documents entitled "Overview of Pennsylvania's Coal Mining Legacy" and "Overview of the Oil and Gas Industry – the Legacy Well."

Consider the following sources for more information on Pennsylvania's mining legacy/AML and abandoned and orphan wells:

- PA's Mining Legacy and AML[37]
- Rewriting Pennsylvania's Legacy – Abandoned and Orphan Well Program[34]

[34] Department of Environmental Protection, Abandoned and Orphan Well Program https://www.dep.pa.gov/Business/Energy/OilandGasPrograms/OilandGasMgmt/LegacyWells/Pages/default.aspx
[35] Department of Environmental Protection, Oil and Gas, Title 58, Oil and Gas https://files.dep.state.pa.us/OilGas/BOGM/BOGMPortalFiles/OilGasReports/2012/act13.pdf
[36] Department of Environmental Protection, Office of Oil and Gas Management, Laws, Regulations and Guidelines https://www.dep.pa.gov/Business/Energy/OilandGasPrograms/OilandGasMgmt/Pages/Laws,-Regulations-and-Guidelines.aspx
[37] Department of Environmental Protection, PA's Mining Legacy and AML https://www.dep.pa.gov/Business/Land/Mining/AbandonedMineReclamation/AMLProgramInformation/Pages/PA's-Mining-Legacy-and-AML.aspx

Legacy Coal Mining Recommendations

The water quality impacts from coal mining are primarily attributable to mine drainage associated with abandoned mines and coal refuse sites. Long-term treatment of mine drainage through active and passive systems is essential to improve water quality in AMD-affected streams, and sustainable funding is needed to maintain such treatment. Additionally, it is important to recognize the role nonprofit organizations play in the operation of treatment facilities and to continue to push for federal Good Samaritan legislation to prevent these organizations from becoming liable under law for mine discharges they are not responsible for causing.

1. DEP should continue to support efforts, including federal legislation, that provide additional funding, in a set-aside account, for addressing AML sites. It should be noted that DEP has been actively preparing for a prospective influx of funding from the federal level to support a set-aside account.
2. DEP should continue to issue grants and develop maintenance funding for small treatment systems.
3. To the fullest extent possible, DEP should consider regionalization and consolidation of treatment systems, if economically feasible.
4. To the fullest extent possible, DEP should consider ways to develop sustainable funding for long-term treatment of AMD from any abandoned source.
5. DEP should support efforts to pass a Community Relations Partnership Act at the federal level, to protect Good Samaritans.
6. DEP should ensure that adequate moneys are in the AMD set-aside account. These moneys need to be:
    - Encumbered to provide for long-term water treatment for the mine drainage treatment facilities built.
    - Tied to interest or investment-earning accounts where the revenues are equal to or more than the funds needed to provide the treatment requirements.

Legacy Well Recommendations

1. DEP should continue to support efforts, including federal legislation, that provide additional funding for identifying and addressing oil and gas wells (inactive, abandoned, and orphan) to expand the magnitude and scope of the work the agency is currently conducting. Examples of such legislation include bills that amend “Section 349 of the Energy Policy Act of 2005 (42 6 U.S.C. 15907)” by providing funding for the states for the following purposes:
    - To identify and characterize undocumented orphan wells on state and private land
    - To rank orphan wells based on factors including: (I) public health and safety; (II) potential environmental harm; and (III) other land use priorities
    - To decommission orphan wells located on state-owned or privately owned land
    - To make information regarding the use of funds received under the proposed federal bill available on a public website
    - To measure and track: (i) emissions of methane and other gases associated with orphan wells; and (ii) contamination of ground water or surface water associated with orphan wells

- To remediate soil and restore native species habitat that has been degraded due to the presence of orphan wells and associated pipelines, facilities, and infrastructure
- To remediate land adjacent to orphan wells and decommission or remove associated pipelines, facilities, and infrastructure
- To identify and address any disproportionate burden of adverse human health or environmental effects of orphan wells on communities of color, low-income communities, and tribal and indigenous communities

It should be noted that DEP has been actively preparing for a prospective influx of funding from federal agencies or other sources to take advantage of these potential opportunities.

2. DEP, as part of its Climate Change Program efforts, should look to generate revenues associated with the decommissioning of legacy wells by acquiring and selling carbon credits. Pound for pound, the comparative impact off methane (CH_4) is 25 times greater than carbon dioxide (CO_2) over a 100-year period[38] which should provide a means of generating carbon credits that can be sold in the marketplace.
3. In addition, DEP should continue to explore opportunities for third parties to decommission legacy wells and obtain carbon offsets for sale in the open carbon market.
4. DEP should continue to coordinate with third parties to decommission legacy wells and evaluate efficiencies that will lower costs for decommissioning without affecting long-term plug performance.

2.4.6 Drinking Water and Wastewater Sustainable Infrastructure

Drinking Water/Wastewater Infrastructure Sustainability Workgroup

At the time of the last iteration of the Pennsylvania State Water Plan, the Governor's Sustainable Infrastructure Task Force (Task Force)[39] was engaged in a broad and comprehensive review of the state of the commonwealth's drinking water and wastewater systems, and the plan provided for subsequent review of the Task Force's final report prior to making specific recommendations related to ensuring the long-term sustainability of Pennsylvania's water infrastructure. The issues evaluated by the Task Force, detailed more than a decade ago, remain concerns today for the long-term viability and sustainability of our drinking water and wastewater systems to ensure clean, potable drinking water to all Pennsylvanians and to provide for adequate sewage disposal in clean efficient ways to protect water quality and the environment.

[38] U.S. Environmental Protection Agency, Overview of Greenhouse Gases https://www.epa.gov/ghgemissions/overview-greenhouse-gases
[39] Created by Executive Order 2008-02.

The Task Force's final report, entitled Creating a Sustainable Solution for Pennsylvania, was issued in November 2008, providing a sober assessment of the many challenges facing our water and wastewater infrastructure. As the Task Force aptly observed:

> "Pennsylvania's drinking water and wastewater systems are critical to protecting public health, the environment, and the continuing economic vitality of the commonwealth; yet, many of these systems have been allowed to deteriorate, resulting in an urgent need for repairs and replacements. Leaking collection and distribution systems, poorly maintained treatment facilities, and combined sewer overflows (CSOs) are common throughout the state."

In 2008, the Task Force projected the then existing infrastructure capital needs to address drinking water system deficiencies and needed improvements, CSOs, costs of nutrient removal, total maximum daily loads, and other challenges, to be approximately $11.5 billion for drinking water and $25 billion for wastewater systems, respectively (stated in 2007 dollars). With regard to drinking water systems, the long-term funding challenge (capital plus operation and maintenance and debt retirement for the next 20 years) was projected at more than $38.9 billion, with the greatest needs concentrated in the smallest systems (those serving a population of less than 3,300) and in the largest systems serving populations more than 50,000. As evaluated by the Task Force, wastewater systems faced even more daunting long-term financial challenges, with a projected 20-year total of $74.4 billion, with the vast majority of that challenge facing the larger systems with flows exceeding 5 million gallons per day (MGD).

To address these challenges, the final Task Force report reviewed a number of options and offered cogent conclusions and recommendations on a variety of topics. Among those conclusions and recommendations were the following:

- Water and wastewater systems need to be maintained and managed, both fiscally and physically, to ensure the long-term efficacy of their plants, systems, and equipment to ensure clean water and safe and efficient disposal of wastewater in the future.
- The public, consumers, and operators need to understand the true value and cost of the water and wastewater service and the true cost of providing a safe, adequate, and reliable water supply and a wastewater collection and treatment system protective of public health.
- Water and wastewater systems should be encouraged to regularly analyze the short- and long-term costs of running their systems and establish rates and efficient management strategies based upon the full cost of service to ensure long-term stability, clean and reliable drinking water supplies, and proper wastewater management.
- To assure that funds are available when upgrades or replacement are needed, all systems should be required to establish a repair and replacement fund.
- Where appropriate, regionalization and rightsizing of systems should be encouraged to consider interconnections for redundancy, as well as regional management and planning, shared purchasing, and potentially shared staffing, as well as encouragement of public-private partnerships and incentives for projects promoting regional cooperation.

These findings and recommendations provide a useful framing of challenges that have faced Pennsylvania's water infrastructure. National trends and economic strains have led to further challenges, although the data on which they were based is somewhat dated.

Among Pennsylvania's challenges are the following:

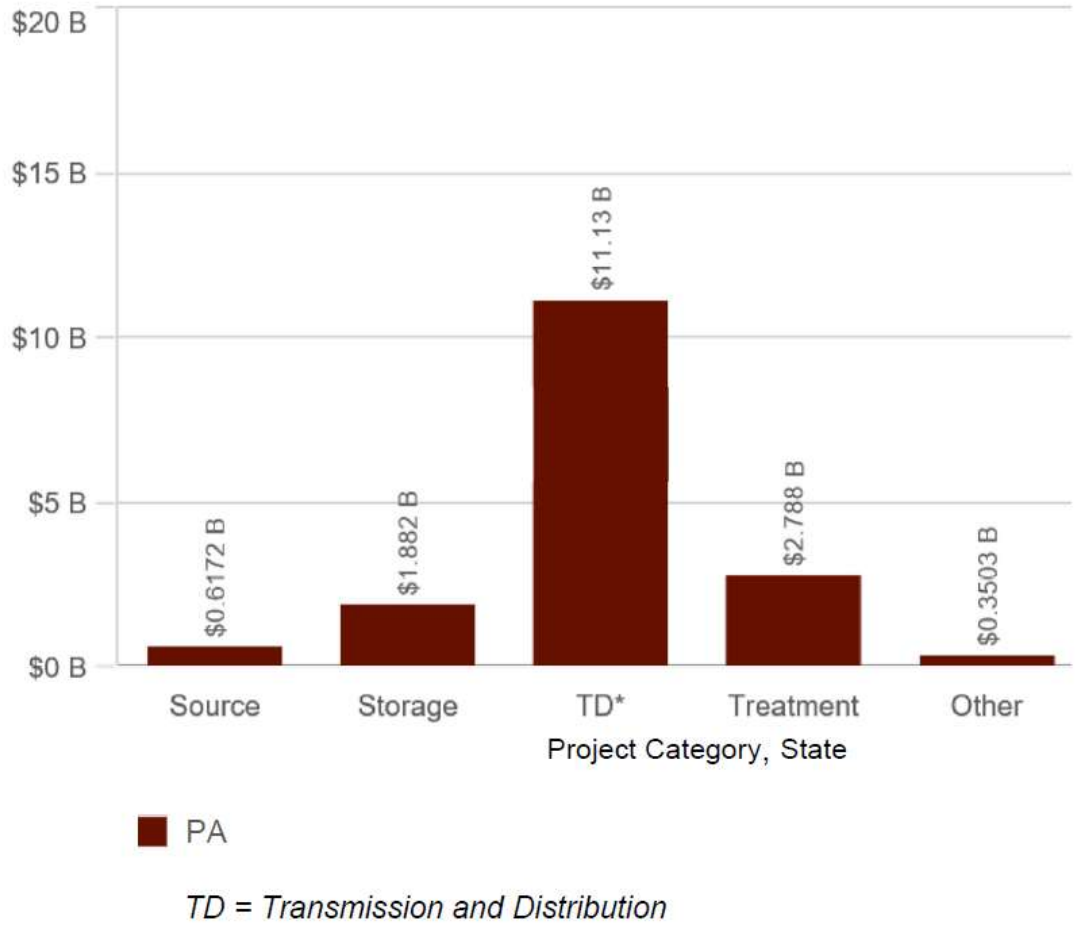
- The ongoing need for updated information concerning the physical and economic condition of our water and wastewater systems
- A number of older water and wastewater systems in financially stressed communities (both large and small) need significant renewal and improvements
- Challenges in encouraging and supporting smaller systems in their incorporation of long-term planning for improvements, maintenance, upgrades and new technology in their management and budget processes
- Concerns about identifying and implementing solutions that are affordable to communities and consumers (particularly in systems with lower income populations)

The economic downturn resulting from the Great Recession of 2007-2009, coupled with reduced tax revenues, competing needs, and rising municipal pension costs have strained the finances of many Pennsylvania communities, leading in some cases to deferral of maintenance and infrastructure renewal and upgrades. In addition, major new issues have come to the fore, including the public realization after the Flint Michigan crisis of the need to address lead in drinking water, including replacement of lead containing service lines, and recognition of risks associated with emerging contaminants including "forever chemicals" in drinking water, such as PFOS and PFOA.

By law, the EPA with DEP's assistance conducts "needs assessments" of drinking water systems and wastewater systems every four years, utilizing surveys to obtain information from individual system operators. For drinking water systems, the Drinking Water Infrastructure Needs Survey and Assessment Sixth Report to Congress, issued in March 2018 but based on 2015 data, is the latest available. The Sixth Report estimated a 20-year capital need for Pennsylvania drinking water systems of $16.772 billion, broken down as depicted in Figure 8.

Figure 8. Estimated 20-year capital needs for Pennsylvania drinking water systems by project category.

Source: EPA[40]



With respect to wastewater systems, the latest available survey information is provided in EPA's Clean Watersheds Needs Survey 2012 Report to Congress issued in January 2016. Based on the 2012 survey, EPA projected a total documented wastewater need for Pennsylvania of only $6.950 billion (which represented a substantial reduction from the estimate derived from the 2008 survey of $13.542 billion in 2012 dollars) but had no projection as to capital needs for Pennsylvania with respect to stormwater.

A notable point is that the EPA projections are based on data that is six to nine years old, from surveys that were conducted before some of the latest challenges came to be recognized. Updated needs surveys are underway and are expected to provide a more recent picture of projected requirements. However, it should be recognized that those surveys are inherently dependent upon the candor and completeness of the individual system operators filling out the survey forms. This highlights the need for more granular and objective data collection.

[40] EPA's 6th Drinking Water Infrastructure Needs Survey and Assessment
https://www.epa.gov/dwsrf/epas-6th-drinking-water-infrastructure-needs-survey-and-assessment

One thing that is clear is that Pennsylvania has a very high infrastructure investment and renewal challenge, a large part of which is derived from three key factors:

- The relative age of Pennsylvania's systems
- The relatively large number of small water and wastewater systems across the commonwealth
- The number of water and wastewater systems located in financially strapped and distressed communities.

Partly because of historic growth patterns, the large number of municipalities, and other factors, Pennsylvania has a very high number of drinking water and wastewater systems. DEP's most current data indicates a total of 8,085 public water supply systems in the state, of which approximately 1,900 are community water systems. Approximately 84 percent of the community drinking water systems are classified as being small and some have shortcomings in technical, managerial, and financial capacity.

Likewise, the commonwealth has a total of 1,994 sewage facilities having NPDES permits. Of those, 309 are considered "major" (having design flows equal to or greater than 1 MGD) and 1,685 are considered "minor" (having design flows less than 1 MGD). As observed by the Task Force in 2008, small systems can have some of the greatest management, financial, and capital investment hurdles to achieving sustainability and meeting regulatory requirements.

To encourage both long-term planning and fiscal responsibility, existing DEP programs provide technical assistance to drinking water systems.

The DEP Bureau of Safe Drinking Water (BSDW) includes a Technical Assistance Section, which is made up of seven Water Program Specialists who are highly trained and experienced staff that implement a variety of technical assistance programs for drinking water systems statewide. The primary goal is violation prevention and compliance assistance. EPA provides funding for some of these programs which are also referred to on a national level as "capacity development activities." The primary technical assistance programs offered by BSDW include:

- Capability Enhancement – Reviews technical, managerial, and financial capabilities with recommendations for improvement to small drinking water systems.
- Distribution System Optimization – Assists community drinking water systems in evaluating and better understanding water quality and water age throughout their distribution system.
- Operator Outreach – Employs wage payroll staff who are experienced operators capable of providing peer-to-peer technical assistance focused on enhancing routine operational procedures.
- Partnership for Safe Water – Through an agreement with the Pennsylvania Section of the American Water Works Association, this national program is implemented at the state level to encourage voluntary self-assessment of all portions of treatment and voluntary development of action plans to improve performance.
- Professional Engineering Services – Assists small drinking water systems with feasibility studies and permit preparation for projects which are considered critical to maintain or return to compliance.

The above information is a short summary of the primary technical assistance programs. A full list of technical assistance programs that are offered by BSDW, along with a detailed explanation for each, may be found on the DEP Safe Drinking Water website.[41]

A yearly report on progress at Pennsylvania's public drinking water systems in achieving and enhancing their technical, managerial, and financial capability may be found on the DEP Capability Enhancement webpage.[42]

The DEP Bureau of Clean Water also offers an Enhanced Technical Assistance Evaluation (ETAE) with the goal of assisting operators and permittees in reducing nutrients in their plant discharges while maintaining and/or surpassing the requirements of effluent limits established in NPDES permits.

DEP representatives utilize in-line process monitoring equipment and various bench-top laboratory equipment to assist operators in gathering process control and performance information.

1. The equipment is capable of monitoring the waste treatment process for ammonia, nitrates, dissolved oxygen, pH, mixed liquor suspended solids (MLSS), oxidation-reduction potential (ORP), biological oxygen demand (BOD) (equivalent), and clarifier solids blanket levels.
2. Equipment provides operators with instantaneous visual monitoring of the waste treatment process, allowing them to monitor process modifications firsthand and document positive or negative impacts.
3. DEP representatives managing the program and operating the equipment are fully trained and maintain current Pennsylvania Wastewater Operator Certification Licensing.
4. Projects occurring to date include working with facilities to accomplish nitrate reduction, nitrification optimization, energy conservation, microscopic evaluation of biomass, and solids management.
5. DEP representatives will work with operators to review process control testing and learn the value of using data trending to control and possibly predict plant operations.
6. The in-line process monitoring equipment provides operators with 24/7 access to their process monitoring data. Additionally, DEP representatives have the capability of providing graphical outputs to readily identify trends and optimum set points.

Results of ETAEs are summarized in reports. To learn more about what ETAEs have done for facilities across the commonwealth, visit our Helping Facilities Succeed page[43]. Requests for assistance can be made through regional DEP offices or by contacting the program directly:

Department of Environmental Protection
Bureau of Clean Water, Division of Operations
RCSOB, P.O. Box 8774
Harrisburg, PA 17105
(717) 787-6744

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[41] Department of Environmental Protection, Bureau of Safe Drinking Water https://www.dep.pa.gov/Business/Water/BureauSafeDrinkingWater/Pages/default.aspx

[42] Department of Environmental Protection, Governor's Report on the Capability Enhancement Program https://www.dep.pa.gov/Business/Water/BureauSafeDrinkingWater/CapabilityEnhancement/Pages/Governor%27s-Report.aspx

[43] Department of Environmental Protection, Helping Facilities Succeed https://www.dep.pa.gov/Business/Water/CleanWater/WastewaterOps/Pages/Helping-Facilities-Succeed.aspx

Both DEP and PUC have encouraged existing water and wastewater systems under their jurisdictions to develop system assessments and business plans to forecast and plan for infrastructure renewal and investment. The PUC's regulations are most far reaching. Investor-owned utilities that wish to utilize the distribution and collection system improvement charge ("DISC") option are subject to regulatory mandates to develop and submit to the PUC a Long-Term Infrastructure Improvement Plan at minimum five-year intervals, supplemented by annual reporting in what are referred to as Annual Asset Optimization Plans. DEP drinking water regulations require the submission of business plans for any new public water systems being permitted after 1996, but as per limitations in the federal Safe Drinking Water Act (SDWA), that mandate does not apply to the multitude of pre-existing water systems.

Regarding wastewater systems, the Pennsylvania Sewage Facilities Act (Act 537) requires municipalities to evaluate and address, in conjunction with land use and planning, long-term sewage needs within their jurisdictions to ensure the safe and effective disposal of sewage wastes. Act 537 plans are to provide comprehensive programs for disposal of sewage, including programs for decentralized, on-lot, sewage facilities permitting, operation, and maintenance and the management of centralized collection and treatment of sewage. Although Act 537 does not specifically refer to asset management as a requirement, it does require that plans include an evaluation of financing methods to implement the proposed sewage service alternative, and an assessment of the ability to implement the proposed sewage service approach, including a designation of the institutional arrangements necessary for implementation of the plan.

In reviewing proposed Act 537 plans, DEP is required to consider whether the plan or plan revision is implementable. This planning function is a good first step, but at the same time, after adoption of an Act 537 plan, the critical follow-up issue is whether and how those plans are ultimately implemented. The Act 537 planning program alone cannot ensure that systems are operated on a sustainable basis. Municipalities responsible for 537 Plan adoption do not typically monitor the financial status and administrative performance of non-municipal systems; and apart from Ch. 94 wastewater reports focused on identifying potential overload issues, wastewater system operators are not required to submit information on their assessment of and methods of addressing infrastructure maintenance, repair, and replacement needs.

Over the past decade, a number of municipal water and wastewater systems have been purchased by investor-owned public utilities regulated by the PUC. In part, this trend has arisen as municipalities have sought to sell their water or wastewater system assets to investor-owned utilities, a process which has been encouraged by Act 12 of 2016, which allows utilities to establish rates based on the appraised "fair market value" of the water and wastewater systems they have acquired.

Asset management plans help systems manage and sustain their systems and services by better understanding near- and long-term operational and capital needs. So, having all systems develop and implement sustainable asset management plans is a laudable long-term objective. At the same time, careful consideration needs to be given to the resources needed by systems (particularly smaller systems) to prepare such plans, identifying who will review them, and establishing mechanisms to ensure that they are in fact implemented.

PENNVEST supports the development and implementation of asset management plans. PENNVEST currently will provide up to $25,000 for development of an asset management plan for project funding recipients. A question to be resolved is whether that amount is adequate. PENNVEST Programmatic Financing provides for funding multi-year cash flow needs of a utility, rather than the traditional project-by-project funding approach. A Programmatic funding package funds a Capital Improvement Plan (in entirety or in part) for a group of drinking water or wastewater projects if each individual project or phase of projects is eligible and prepared in compliance with the PENNVEST program requirements.

Shifting from short-term project financing to long-term program financing ensures long-term funding is available to facilitate timely replacement of deteriorating infrastructure and incentivizes funding to utilities that develop and implement asset management through long-term capital improvement plans.

Recommendations

1. DEP, under its State Water Plan Program, with the assistance of the Statewide Water Resources Committee and water programs, is encouraged to investigate the feasibility of coordinating with PUC and other agencies in collecting and periodically updating data related to infrastructure capital needs. This first step will facilitate the preparation needed for re-establishing a Sustainable Infrastructure Task Force to review the data and provide recommendations for the long-term sustainability of Pennsylvania's water infrastructure.
2. Water and wastewater systems (public and private) should be encouraged to evaluate and plan for their future and long-term infrastructure needs, including the inventory and assessment of the condition of their infrastructure assets and a plan to pay for needed maintenance, replacements, upgrades, and meet new regulatory requirements. Such efforts are essential to ensure that all Pennsylvanians are assured of their ability to share clean streams, obtain clean, potable water, have efficient, environmentally-safe sewage disposal, and be confident in their provider's ability to sustain their water and wastewater systems in the future. Regarding sewage facilities, Municipal Sewage Facilities Plans required by Act 537 should periodically review the sustainable management and ongoing financially viable operation of systems within their jurisdiction. These reports should be shared with the affected local governments to coordinate their land use planning and zoning with the water and wastewater planning and to engage them in comprehensive planning for the future as well.
3. The General Assembly and Executive Branch should consider and adopt appropriate legislation and policies that promote the preparation and implementation of water and wastewater system asset management plans – where feasible with adequate planning and lead time and taking into consideration affordability criteria – and which provide assistance to smaller systems to facilitate the development of such plans.
    a. As noted above, PENNVEST currently supports the development and implementation of asset management plans through the provision of up to $25,000 for development of asset management plans by project funding recipients. Consideration should be given to increasing the maximum assistance for such plans to $50,000. To the extent it is not already the case, as a condition of obtaining grant or loan funding for water and wastewater infrastructure projects, funding recipients should be required to develop such asset plans within a prescribed time frame, so that there is reasonable assurance that the infrastructure being assisted will be maintained in a sustainable manner in the future.
    b. To assist smaller systems, BSDW contracts with experienced operators to provide technical assistance and asset management strategies. Additional funding and resources to expand this program, as well as education and outreach efforts to promote it. could make this effort even more effective.
    c. DEP should evaluate whether the Act 537 planning program can be adjusted to provide a more effective method for monitoring and assuring that wastewater systems are being properly managed and sustainably operated. Consideration should be given to amendments to 25 Pa. Code Ch. 71 to require municipalities as part of their Act 537 planning obligations to conduct periodic reviews of the sustainable management of systems within their jurisdiction, and to

submit reports indicating findings and recommendations for improvements to assure ongoing viability of system operations. Concurrently, to reinvigorate the Act 537 process to include ongoing evaluation of system sustainable management, the Governor and General Assembly should reestablish and fund the sewage facilities planning and enforcement reimbursement program to assist communities in more effectively performing this important function.

   d. The Governor and General Assembly should consider strengthening the Professional Engineering Services program with state general funds and/or increased DEP staffing levels to manage contracts and programs that work with public water supply systems and to expand their capability in outreach – particularly to smaller water systems needing help in assessing technical, managerial, and financial challenges. Utilizing funds provided through the recently adopted federal infrastructure legislation, a similarly focused Professional Engineering Services program and outreach and assistance effort should be established to address the challenges faced by small wastewater systems.

4. Federal and state drinking water regulations provide for the preparation and publication of "consumer confidence reports" on the quality of water distributed by drinking water systems, and DEP's existing Chapter 109 rules governing community water systems require the submission of business plans for new community systems. However, currently there is no ongoing generally applicable process for evaluating and providing to the public information on the physical condition and sustainable management of public water supply systems. The Statewide Committee, DEP, and PUC should work together, in consultation with concerned stakeholders, to consider and evaluate potential alternative methods (through appropriate regulatory or program changes and/or legislative proposals) for assuring performance of systematic assessments of water system conditions and improvement needs and providing the public with information about implementation of sustainable management programs.

5. PENNVEST is encouraged to promote its Programmatic Financing Guidance (ProFi)[44] which provides for funding multi-year cash flow needs of a utility, rather than the traditional project-by-project funding approach. A programmatic funding package funds a Capital Improvement Plan (in entirety or in part) for a group of drinking water or wastewater projects if each individual project or phase of projects is eligible and prepared in compliance with the PENNVEST program requirements. Shifting from short-term project financing to long-term program financing ensures long-term funding is available to facilitate timely replacement of deteriorating infrastructure and incentivizes funding to utilities that develop and implement asset management through long-term capital improvement plans.

6. Financially challenged systems should be encouraged to examine and consider alternative arrangements for assuring technical, managerial, and financial capability. Such arrangements may include, where appropriate, consideration of contracting for management services, shared management service arrangements, or public-public or public-private partnerships.

2.4.7 Contaminants of Emerging Concern

Emerging Contaminants and Water Quality Workgroup

Not addressed in the 2009 Update but of increasing concern for water quality today are "emerging contaminants" or "contaminants of emerging concern" (CECs). CEC compounds are typically unregulated

[44] PENNVEST programmatic Financing (ProFi) Guidance
https://www.pennvest.pa.gov/Information/Funding-Programs/Pages/ProFi.aspx

substances for which there is an emerging or evolving scientific understanding of the risk they pose to human health, aquatic life, or the environment. They are found in a wide range of products, including pharmaceuticals and personal care products as well as industrial, household, agricultural, and manufactured goods.

Because CECs are typically unregulated substances, they usually do not have any associated ambient water quality criteria or enforceable drinking water standards controlling or regulating the substances. However, continued research into CECs and development of regulations will help reduce adverse impacts on human and aquatic life.

The process to reduce or control a source of a new CEC is to:

- Develop a data-based process/methodology for naming a new CEC
- Create a pathway to analyze potential severity of impact, then develop a strategy to address
- Define a process for containment

In the recent past, DEP has taken steps to address a particular subset of CECs known as perfluoroalkyl and polyfluoroalkyl substances (PFAS). These actions include participation with other commonwealth agencies in a PFAS Action Team to assess the potential environmental and health effects of PFAS and recommend strategies to reduce or eliminate the impacts.

DEP collaborated with the United States Geological Survey and the Susquehanna River Basin Commission on a sampling study of PFAS at surface water quality network stations. Other DEP involvement in addressing CECs includes toxic contaminants research, policy, and prevention efforts under the Chesapeake Bay Program. Background information on CECs – including PFAS, endocrine disrupting compounds, and DEP sampling studies involving sediment and neonicotinoid insecticides – may be found at:

- the DEP Water Quality Division's webpage on Contaminants of Emerging Concern[45]
- the DEP Safe Drinking Water Program's Emerging Contaminants Frequently Asked Questions[46] webpage

On November 16, 2021, Pennsylvania's Environmental Quality Board (EQB) adopted a proposed rulemaking[47] that would set PFAS standards for public water systems. The EQB will have a 60-day public comment period and five public hearings on the proposed rulemaking.

On the federal level, EPA is increasing its commitment to addressing CECs, especially for PFAS, through the development of a PFAS Strategic Roadmap[48].

From the 2021 Bipartisan Infrastructure Investment and Jobs Act, the EPA will be investing $4 billion to address emerging contaminants through the Drinking Water State Revolving Funds, $5 billion to address

[45] Department of Environmental Protection, Contaminants of Emerging Concern (CECs) https://www.dep.pa.gov/Business/Water/CleanWater/WaterQuality/Pages/CECs.aspx

[46] Department of Environmental Protection, Emerging Contaminants, Frequently Asked Questions https://www.dep.pa.gov/Citizens/My-Water/PublicDrinkingWater/Pages/Emerging-Contaminants.aspx

[47] Department of Environmental Protection, DEP Proposal To Set Stricter PFAS Limits Approved by Environmental Quality Board, https://www.media.pa.gov/pages/DEP_details.aspx?newsid=1512

[48] United States Environmental Protection Agency, PFAS Strategic Roadmap: EPA's Commitments to Action 2021-2024 https://www.epa.gov/pfas/pfas-strategic-roadmap-epas-commitments-action-2021-2024

emerging contaminants in disadvantaged communities through Water Infrastructure Improvements for the Nation (WIIN) Grants and under Clean Water for Communities, and $1 billion to address emerging contaminants through Clean Water State Revolving Funds[49].

DEP collaborates with EPA, shares data, and utilizes EPA funding for DEP water quality monitoring work generally, including CEC monitoring. Under certain circumstances, DEP may take the initiative in conducting research, assessing the relevance of emerging contaminants, and developing regulatory proposals.

Leadership at the federal, state, and local levels will continue to make the biggest impacts toward regulating, cleaning up, and preventing contamination from CECs. With this in mind, for the 2022 Update, the Emerging Contaminants and Water Quality Workgroup under the statewide committee has developed the following recommendations to be implemented through the establishment of a statewide CEC program, to strengthen the support to DEP in fulfilling its duties regarding emerging contaminants and to encourage the federal government to extend their responsibilities.

General recommendations to expand the statewide Contaminants of Emerging Concern (CEC) program

DEP should expand and further coordinate its CEC program to include relevant program leads with a CEC nexus. DEP's CEC program should also be expanded by identifying and engaging partner organizations that are examining CECs, including sister commonwealth agencies and river basin commissions. The envisioned purpose of the expanded and further coordinated DEP CEC program is to establish collaborative engagement; this program would evaluate occurrence monitoring data/trends and apply screening criteria to prioritize and assess CEC for state action. Through this screening process, the program would:

- Develop a list of candidate CECs including their source, routes, and effects
- Maintain a publicly accessible website that summarizes the status of each candidate CEC

Finally, DEP would develop strategies for monitoring, managing, and addressing specific CECs as well as developing a process for identifying next contaminants of concern.

[49] United States Environmental Protection Agency, FACT SHEET: EPA & The Bipartisan Infrastructure Law https://www.epa.gov/infrastructure/fact-sheet-epa-bipartisan-infrastructure-law

Specific recommendations

1. The General Assembly should consider providing additional funding support for financing and establishment of an Emerging Contaminates program.
2. DEP labs should receive support for testing an expanding list of analytes. Additional dedicated funding would provide for needed staff and analytical equipment and would address any needed accreditation to assure data is defensible.
3. DEP should establish the impact and risk to the environment and human health in conjunction with having an in-house toxicologist to assist with risk assessments.
4. DEP should encourage the federal government to develop data and reports establishing the risk to the environment and human health, followed by development of national Maximum Contaminant Levels and Water Quality Criteria for CECs.

2.4.8 Assessment of Navigation Needs and the Means for Restoration, Development, and Improvement of Transportation by Water

Pennsylvania's commercial and recreational navigation assets provide significant economic benefit to the commonwealth. Navigational commerce offers direct employment and supports thriving businesses that depend on the availability of commercial ports and accessible waterways. Because commercial port activities on the Delaware Estuary, Lake Erie, and on the Allegheny, Monongahela and Ohio Rivers are vital to the economy of surrounding regions, recommendations are focused on these corridors.

Many Pennsylvanians and visitors to the commonwealth enjoy a diversity of recreational boating, fishing opportunities, and other water sports that further contribute to the economic strength and quality of life in Pennsylvania.

Commercial shipping offers advantages of larger bulk load capacities for the movement of goods. While improvements can be made to an aging fleet, it should be noted that within the Great Lakes System a seaway vessel loaded at 30,000 tons carries the equivalent of 301 rail cars or 963 trucks. A 1,000-foot laker carrying 62,000 tons of cargo carries in that one vessel what would take 564 railcars or 2,340 trucks.

The commonwealth has a legal obligation to preserve public rights in submerged lands of the commonwealth and navigation. Pennsylvania's water resources management decisions should support both commercial and recreational navigation opportunities but must also carefully consider public trust responsibilities as well as economic benefits, the needs of water-dependent uses, wetland and aquatic resources preservation, and private property rights.

Institutionally, there are numerous public and private organizations and programs that collectively manage and support commercial and recreational navigation. Examples include:

- Port authorities
- Private sector interests in shipping and support services
- U.S. Army Corps of Engineers' divisions and districts – dredging, infrastructure construction related to reservoir management, locks and dams and port facilities, and public access areas
- U.S. Department of Homeland Security

- Coast Guard districts and sectors, aids to navigation, ice breaking, and recreational boating safety program funding to states
- Water quality monitoring, ballast water management, and emergency response systems
- Interstate compact commissions and international treaty organizations
- State agencies, including the Departments of Environmental Protection, Conservation and Natural Resources, Transportation, and the Fish and Boat Commission
- U.S. and Pennsylvania Geological Surveys, EPA, and the National Park Service
- Marina and other access owners and operators
- U.S. Department of Commerce and the National Oceanic and Atmospheric Administration – charting, weather services and planning support, coastal resources management, and Sea Grant programs through state partnerships
- Pennsylvania Water Trail Partnership

Challenges

The environmental risks and impacts of commercial and recreational navigation differ by region in the commonwealth. Infrastructure needs also vary widely, including locks and dams, flood protection and flow management, navigational aids, and reservoir operations. Additional challenges are presented by dredging equipment and dredged material disposal facilities; applied technological solutions for preventing the introduction and spread of invasive species (including ballast water discharge controls); short sea shipping, ferry boat support facilities, and special structures related to tidal estuary; and marine shipping requirements. Vessel types capable of operating globally and using regional infrastructure vary broadly, as do sanitation needs for marine or freshwater environments. In addition, flow management, flooding, water quantity protection, and monitoring strategies are not regionally or internationally consistent.

Commercial shipping, international trade, and maintenance of federal navigation channels and recreational boating harbors raise multifaceted management issues related to aquatic habitats and dredged material disposal.

Because of the importance of commercial and recreational navigation to the commonwealth, specific steps are needed to address these challenges.

Recommendations

1. Hydrology and channel configuration create the fundamental conditions for navigation in Pennsylvania's waters. Where appropriate, the commonwealth should build on prior efforts related to infrastructure construction, shipping channel maintenance, security, adequate flow management, and water quality protection to support commercial and recreational navigation. Also crucial are related mapping and dredging activities to allow safe passage. The commonwealth should work closely with the United States Army Corps of Engineers and other operators of dams and impoundments to maximize the benefits of multiple-use management. The commonwealth should support bathymetric mapping of waterways used for navigation currently being conducted by the United States Geological Survey and the Pennsylvania Department of Conservation and Natural Resources. The federal Water Resources Development Act of 2020 provides special budgetary treatment for amounts appropriated from the Harbor Maintenance Trust Fund – up to a cap defined in law. This provision is meant to eliminate budget constraints and allow full use of Harbor Maintenance Tax revenue.

2. Safe and effective management of dredged material is important to navigation on rivers and lakes. The commonwealth and other resource regulators and operators should manage dredging and dredged material for multiple purposes, such as enhanced navigation, beneficial uses, protection of watercourses and wetlands, and beach formation.
3. The commonwealth should support the Pennsylvania Department of Transportation's Bureau of Rail, Freight, Ports, and Waterways in its work with federal agencies to help regional port authorities develop strategic plans for the management of commercial navigation in Pennsylvania. The commonwealth should continue to promote the competitive position of the Ports of Philadelphia, Pittsburgh, and Erie.
4. The commonwealth should continue to address navigation-related water quality and quantity issues, including ballast water management, wastewater and trash disposal from commercial and recreational vessels, monitoring systems, emergency response, and security management.
5. The commonwealth should continue to manage public natural resources in the beds of navigable waterways, subject to the permitting and submerged lands license, the legislative lease process provided under the Dam Safety and Encroachments Act and the requirements of the Fish and Boat Code.
6. The commonwealth should continuously evaluate infrastructure needs for locks and dams, dockwalls, shore power, reservoirs, and intermodal transportation facilities. Where appropriate, the Pennsylvania Fish and Boat Commission should continue to fund or endorse dam removals where the dams no longer serve a useful purpose, thereby improving migratory fish passage and eliminating obstructions to recreational navigation. The commonwealth should periodically re-examine its institutional arrangements for evaluating infrastructure needs and their adequacy for achieving the commonwealth's goals.
7. The commonwealth should continue to participate in regional institutional efforts to manage water quantities, flows, and flooding, which all affect navigation. Institutional arrangements and agencies that support Pennsylvania's navigation interests – such as the Great Lakes Water Management Agreements, the interstate river basin compact commissions and the International Joint Commission, Council of Great Lakes Governors and Premiers, American Ports Association, American Great Lakes Ports Association, Inland Rivers, and Ports &Terminals Inc. – should be continued and encouraged.
8. Where appropriate, the Pennsylvania Fish and Boat Commission and other agencies should encourage the development and improvement of boat launches, public access points, transient boating facilities, and associated facilities that enhance recreational boating opportunities. A diversity of recreational boating facilities should be facilitated to accommodate the increase in non-powered watercraft use (i.e., kayaks, standup paddleboards, and canoes) to enhance safety and reduce congestion and user conflict on waterways. Diverse considerations may apply for different types of watercraft.

To enhance the reliability of the shipping system, attract new cargoes and foster employment in the maritime sector, the United States and Canada should harmonize the Seaway's opening and closing dates with those of the Soo Locks in northern Michigan. Doing so would establish a fixed navigation season (March 25th to January 15th) for the entire Great Lakes navigation system. The commonwealth should advance and encourage these efforts.

2.4.9 Agriculture Nonpoint Source Pollution

Agricultural Workgroup

The statewide committee recognized the impact of nonpoint source runoff from agricultural operations on the water quality of Pennsylvania's waterways and its related effect on water availability. An agricultural workgroup was therefore established to consider the issues and provide recommendations; Section 2.4.9 is the result of the Agriculture Workgroup's efforts. It provides background information about stream impairment from agricultural operations, explains ongoing efforts by the agricultural community and of the Chesapeake Bay Program in addressing concerns, and outlines legislative priority recommendations that could support related legacy commonwealth programs and proposed legislative bills addressing agricultural nonpoint source pollution.

Background

Pennsylvania is lush in its 86,000 miles of streams and rivers. However, nearly one-third of our waters are impaired (approximately 28,000 miles of streams of rivers)[50]. Agriculture is the leading source of impairment for aquatic life and the second-leading cause of impairment for potable drinking water in the commonwealth.

Drinking water resources, public health and safety, outdoor recreation, and our natural resources will remain impacted if we fail to improve, protect, and restore Pennsylvania's waters. Local communities will continue to be negatively affected by stormwater and flood damage, contaminated drinking water sources, polluted streams, and lost recreation and tourism opportunities.

The commonwealth's 58,000 farms produce $7.4 billion worth of crop and livestock products on 7.6 million acres.[51] What happens on this farmland directly impacts our communities and access to clean water. As the commonwealth continues to adapt, it is imperative that it take responsibility for its streams that are impaired by the results of historic agricultural activities – especially nutrient and pathogen runoff, soil erosion, and unrestricted livestock access to streams and surface waters – while also maintaining a balance with the important need for agricultural production.[52,3]

Further, according to DEP's Pennsylvania Phase 3 Chesapeake Bay Watershed Implementation Plan, amended December 2021 [53]("Phase 3 WIP"), "approximately half of Pennsylvania's land area drains into the Chesapeake Bay, primarily from the Susquehanna and Potomac River basins. The Susquehanna is the largest tributary to the Bay, providing half of the total freshwater flow and 90% of the freshwater flow to the upper bay. Without the support of Pennsylvania, the Chesapeake Bay cannot be restored. Even

[50] Pennsylvania Department of Environmental Protection, Draft 2022 Pennsylvania Integrated Water Quality Report
https://storymaps.arcgis.com/stories/b9746eec807f48d99decd3a583eede12
[51] USDA National Agricultural Statistics Service, 2017 State Agriculture Overview.

[52] Team Pennsylvania, Pennsylvania Department of Agriculture, Econsult Solutions and Temple University's Fox School of Business, May 2018, Pennsylvania Agriculture: A Look at the Economic Impact and Future Trends.

[3] Penn State Agriculture & the Environment Center, March 2017, Pennsylvania in the Balance: Harnessing Agriculture's Culture of Stewardship as a Solution to Clean Water.

more importantly, the water that feeds into the Chesapeake Bay is local to Pennsylvania. It is crucial that the local waters of Pennsylvania be restored for use by our citizens."[54]

The Phase 3 WIP "describes the work to be done to reduce nutrient and sediment pollution within the Chesapeake Bay watershed. In 2018, the Chesapeake Bay Program Partnership completed a Midpoint Assessment of the 2010 Total Maximum Daily Load (TMDL) allocations for each state and re-established nutrient reduction planning targets for each jurisdiction within the watershed. The goal of the Chesapeake Bay TMDL is to have all practices to achieve these reductions in place by 2025. Each jurisdiction's plan for meeting their phosphorus (P) and nitrogen (N) pollution reduction goals is outlined in WIPs."[55]

The Phase 3 WIP outlines seven strategic areas in addressing nonpoint source agricultural runoff within the Susquehanna and Potomac River basins: agricultural compliance, soil health, expanded nutrient management, manure storage facilities, precision feeding, integrated systems for elimination of excess manure, and forest and grassed riparian buffers. But these opportunities cannot be achieved without the support of many partners, including those at the local, state, federal, legislative, private, and non-governmental organization levels. In total, the Phase 3 WIP requires over an additional $300 million/year to be implemented by 2025 and currently has over 1,200 stakeholders fully engaged in the implementation of the Phase 3 WIP and 34 Countywide Action Plans.

Farmers and the agricultural community are ready and willing to do their part to reduce runoff while also improving their farm practices, but that cannot be achieved without support. For example, farmers are required to develop and implement management plans to reduce pollution from nutrient sources, mitigate sediment loss, and prevent erosion. These plans are often one of the critical first steps to set the framework for implementing conservation practices on farms. They promote a healthy farming economy, while providing local benefits to surrounding communities. If implemented according to schedule, these plans not only reduce water pollution, but also improve crop utilization of nutrients and keep topsoil in place to sustain long-term production. It is crucial that funding is available for planning and technical assistance to farmers, for the initial outreach and development of these plans, as well as for the implementation of best management practices.

Many farms have increased their focus on production systems that reduce tillage intensity to maintain soil structure, responsibly incorporate manure, and sustain a cover of living plants to improve soil health and reduce water pollution. This increases water infiltration, retains manure nitrogen for crop production, retains soil moisture for periods of drought, and reduces stormwater runoff and soil erosion during heavy rains. Soil and nutrients stay in agricultural fields for production, rather than run off into local streams. When adopting new production methods, farms often need technical advice adapted to their specific agricultural operation, soil, terrain, climate, and production goals. Conservation district technicians and specialists, federal NRCS staff, Certified Crop Advisors, and other private and nonprofit Technical Service Providers are finite in number and cannot currently meet the vast and varied needs of the thousands of agricultural producers in Pennsylvania.

Coinciding with nutrient pollution impacts, pathogens such as *Cryptosporidium* are directly attributed to dairy and other animal farming operations. The Chapter 109 Safe Drinking Water regulations[56] under the

[54] Department of Environmental Protection, amended December 2021, Pennsylvania Phase 3 Chesapeake Bay Watershed Implementation Plan.
[55] Id.
[56] Pennsylvania Code, Chapter 109. Safe Drinking Water
https://www.pacodeandbulletin.gov/Display/pacode?file=/secure/pacode/data/025/chapter109/chap109toc.html

authority of the Pennsylvania Safe Drinking Water Act[57] require drinking water utilities to monitor and subsequently develop drinking water treatment and watershed management approaches to mitigate *Cryptosporidium* impacts on Pennsylvania's drinking water supplies. While challenging, it is imperative that farming practices take into consideration mitigation and best management practices to protect downstream water suppliers from regulated pathogens such as *Cryptosporidium.*[58,59]

Legislative Priorities

Responsible farming practices that provide clean water to downstream communities depend on technical and financial assistance. Implementing agricultural best management practices to address local water quality needs comes at high costs, which make conservation investments difficult for family farmers to bear on their own, especially now with market instability. Current federal and state conservation programs can meet only a fraction of the annual need, so additional resources are imperative to help farms invest in conservation.

1. Provide a dedicated and increased funding source for the Environmental Stewardship Fund (ESF). The ESF provides funding for Pennsylvania's Growing Greener Plus grants as well as Pennsylvania's Chesapeake Bay Clean Water Coordinator and Countywide Action Plan Implementation block grant programs. These two grant programs invest in agricultural conservation practices as well as riparian corridor practices like stream restoration and riparian forested buffers, as well as stormwater best management practices. ESF also funds Conservation District Watershed Specialists who help to administer and oversee project implementation.

2. Recommend that the General Assembly pass a program specifically for agricultural conservation practices, such as Agricultural Conservation Assistance Program (ACAP) (currently SB 465, SB 837 and HB 1901) that could complement the existing Conservation Excellence Grant (CEG) program. Establish dedicated and equitable funding for ACAP that will target funding for local farms to invest in conservation practices. Although this program would benefit the whole commonwealth, having a dedicated agriculture funding program that compliments the CEG is an expectation from EPA regarding Pennsylvania implementing its Phase 3 WIP.

   (Note: If any of these bills are passed by the time the 2022 Update is finalized, then this can be altered to state, "Continue support of the Agricultural Conservation Assistance Program through additional state funding.")

3. Increase funding for available Resource Enhancement and Protection (REAP) (under the Pennsylvania Farm Bill) tax credits.

4. Eliminate prohibitions on restricting livestock access to streams through applicable legislation.

5. Enhance existing state budget line items, such as the Chesapeake Bay Agricultural Source Abatement Fund, the Conservation District Fund Allocation Program, and the Nutrient Management

[57] Pennsylvania General Assembly, Pennsylvania Safe Drinking Water Act https://www.legis.state.pa.us/WU01/LI/LI/US/HTM/1984/0/0043..HTM

[58] Sischo WM, Atwill ER, Lanyon LE, George J., Prev Vet Med., February 29, 2000, Cryptosporidia on dairy farms and the role these farms may have in contaminating surface water supplies in the northeastern United States, https://pubmed.ncbi.nlm.nih.gov/10718494/

[59] Philadelphia Water Department, March 2011, Queen Lane LT2 Watershed Control Program Plan, https://water.phila.gov/pool/files/PWD_Watershed_Control_Plan_final.pdf

Fund, to provide additional funding for conservation district staff. More funds per Full Time Equivalent (FTE) are needed, as are additional funds for expanding capacity.

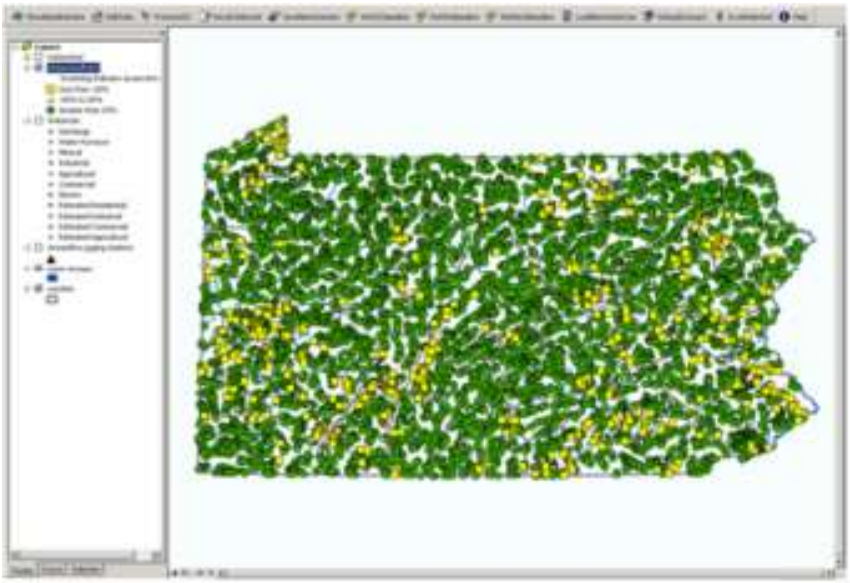
6. Further investment in the USDA-NRCS, through the congressionally supported Chesapeake Resilient Farms Initiative, would yield greater amounts of funding for technical assistance and agricultural cost-share throughout the Chesapeake Bay watershed.

2.5 Critical Water Planning Areas

2.5.1 Designation of Critical Water Planning Areas

Act 220 of 2002 established a process to designate Critical Water Planning Areas (CWPAs). CWPAs are areas where existing or future water demands exceed or threaten to exceed water availability. Act 220 of 2002 also authorized the preparation of Critical Area Resource Plans (CARPs) for any watershed or watersheds within a CWPA. During the State Water Plan update in 2009, considerable work was done to "screen" the entire state for CWPAs.

Figure 9. Opening Screen of the WAST displaying over 10,000 Pour Points



A GIS model named the Water Analysis Screening Tool (WAST) as shown in Figure 9 was built for DEP by USGS to accomplish this screening. The WAST compares net water withdrawals (withdrawals minus discharges) against designated criteria (percentage of the 7-day, 10-year low flow (7Q10)). It measures the influence of net withdrawals on aquatic resources at over 10,000 mouth-of-the watersheds (or "pour-points") across the state.

The specific requirements for identifying a CWPA are outlined in a DEP Technical Guidance Document 392-2130-014, "Guidelines for Identification of Critical Water Planning Areas."[60]

Results from the WAST and consultation with regional committees narrowed the potential CWPA candidates to 32 watersheds selected for verification of data and further technical review before continuing the process of CWPA designation. After the verifications, the regional committees nominated 23 watersheds to the statewide committee for designation consideration. More information on the screening process is available in the State Water Plan Principles document of 2009[61]. From the 23

[60]Guidelines for Identification of Critical Water Planning Areas 392-2130-014 www.depgreenport.state.pa.us/elibrary/GetFolder?FolderID=4670

[61] State Water Plan Principles, 2009 files.dep.state.pa.us/Water/Division%20of%20Planning%20and%20Conservation/StateWaterPlan/StateWaterPlanPrinciples/3010-BK-DEP4222.pdf

regional committee-selected watersheds, the statewide committee recommended four watersheds for CWPA designation. On December 20, 2010, these four watersheds were officially designated CWPAs by the Secretary of DEP: Marsh and Rock Creeks, Adams County (Potomac Region); Back Creek, Fayette County (Ohio Region); and Laurel Hill Creek, Fayette and Somerset counties (Ohio Region). Interactive maps showing all these watersheds' locations are available in the Water Use and Planning section of the updated State Water Plan Atlas[62].

2.5.1.1 Marsh and Rock Creeks CWPA[63]

The Marsh and Rock Creek watersheds are located in Adams County. They have a combined drainage area of approximately 143 square miles. The watersheds were combined into one CWPA because the populated area surrounding the Borough of Gettysburg lies in both Marsh Creek and Rock Creek watersheds. The major water supplier in the Gettysburg area has groundwater withdrawal wells in both watersheds and a surface water withdrawal on Marsh Creek.

The WAST identified a significant number of negative Screening Indicator Percentage (SIP) values within Marsh Creek. Negative SIP values indicate potential water imbalances (higher net withdrawals than streamflow) under extreme low-flow conditions. Water is withdrawn from Marsh and Rock Creeks by the Gettysburg Municipal Authority and discharged outside the watershed in Rock Creek. In Rock Creek, negative SIP values were indicated in the upper third of the watershed, primarily driven by agricultural water withdrawal estimates and public water supply withdrawals. In 2003, withdrawals for estimated water users (groundwater and surface water) were 1.44 million gallons per day (MGD) and accounted for 47.9 percent of the total. Registered groundwater withdrawals accounted for 1.57 MGD (52.1 percent) of the total, and there were no registered surface water withdrawals.

2.5.1.2 Back Creek CWPA[64]

Back Creek watershed has a drainage area of 11.4 square miles, is located in Fayette County, and is a tributary of Indian Creek. This watershed was designated as a CWPA primarily due to the potential situations in which water demand exceeds supply. Three of the four negative SIP values in the Indian Creek watershed occur in the Back Creek watershed, partly due to public supply withdrawals from groundwater sources totaling approximately 0.5 MGD in 2003.

2.5.1.3 Laurel Hill Creek CWPA[65]

Laurel Hill Creek is an approximately 125 square mile watershed located in Somerset and Fayette Counties. The watershed is predominately undeveloped, with most of its area forested or within

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[62] Insert URL

[63] Supporting Documentation Marsh Creek and Rock Creek, Adams County, Nomination for Critical Water Planning Area Under Pennsylvania State Water Plan, September 2009 files.dep.state.pa.us/Water/Division%20of%20Planning%20and%20Conservation/StateWaterPlan/CWPA/Marsh%20Rock%20Creeks%20Report.pdf

[64] Indian Creek, Fayette and Westmoreland Counties Nomination for Critical Water Planning Area Under Pennsylvania State Water Plan August 2009 files.dep.state.pa.us/Water/Division%20of%20Planning%20and%20Conservation/StateWaterPlan/CWPA/Indian%20Creek%20Report.pdf

[65] Laurel Hill Creek, Somerset and Fayette Counties Nomination for Critical Water Planning Area Under Pennsylvania State Water Plan August 2009 files.dep.state.pa.us/Water/Division%20of%20Planning%20and%20Conservation/StateWaterPlan/CWPA/Laurel%20Hill%20Report.pdf

agricultural land use. Within the developed portions of the watershed are ski resorts and a quarry operation. As of 2009, there were 32 dams in the Laurel Hill Creek watershed, including two with a conservation release and one with a minimum pass-by requirement. All reported and estimated withdrawals in the Laurel Hill Creek watershed were 2.27 MGD in 2003. Nineteen of the 26 pour points in the watershed had negative SIP values, primarily due to water supply withdrawals exported outside the watershed.

2.5.2 Critical Area Resource Plans

Act 220 of 2002 requires that for each designated CWPA the regional committee shall form a critical area advisory committee (CAAC) which assists in guiding the development of a CARP. DEP is responsible for drafting the CARP, although the regional committee may recommend that DEP engage county or regional agencies or expert consulting firms to assist them.

A CARP shall be subject to review and adoption through the same process as a regional plan. However, before final recommendation by the regional committee to the statewide committee, a copy of the proposed CARP shall be submitted to each county's and municipality's official planning agency and governing body in the designated CWPA for comment, as to ensure consistency with other plans and programs affecting the CARP. These planning agencies, along with relevant state agencies, shall be provided 45 days to offer comments.

The review and adoption processes are outlined in DEP Technical Guidance Document 392-2130-015 "Guidelines for Development of Critical Area Resource Plans."[66]

2.5.3 Status of Critical Area Resource Plans

All the following major components for the Marsh and Rock Creek, Laurel Hill Creek, and Back Creek CARPs (as described in Chapter 2, "Developing Critical Area Resource Plan Elements" of the above reference guidance) have been drafted.

- Verification and Statement of Problems
- Existing and Future Reasonable and Beneficial uses
- Water Availability Evaluation
- Quantity of Water Available and Required for Future Water Uses
- Assessment of Water Quality Issues
- Stormwater and Floodplain Management
- Adverse Impacts and Conflicts
- Supply-side and Demand-side Alternatives
- Recommendations

Below is an outline from Chapter 4, "Process for Reviewing and Adopting a Critical Area Resource Plan," identifying the process steps. To view the status and actions of each process for draft CARPs, refer to DEP's State Water Plan[67] website for this information.

[66] Pennsylvania Department of Environmental Protection, www.depgreenport.state.pa.us/elibrary/GetDocument?docId=7902&DocName=GUIDELINES%20FOR%20DEVELOPMENT%20OF%20CRITICAL%20AREA%20RESOURCE%20PLANS.PDF

[67] Pennsylvania Department of Environmental Protection, State Water Plan https://www.dep.pa.gov/Business/Water/PlanningConservation/StateWaterPlan/Pages/default.aspx

A. Review of CARP

1. In cooperation with the CAAC, the regional committee shall hold at least one combined public meeting and hearing within the watershed(s) to solicit input on the draft of the initial CARP. The regional committee should provide for a public comment period to receive written comments, including soliciting comments from those entities identified in Paragraph 3 below.
2. A copy of the draft CARP shall be submitted to the official planning agency and governing body of each municipality in the watershed(s), the appropriate county planning agency(s), and regional planning agencies for review and comment as to consistency with other plans and programs affecting the watershed(s) and relevant state agencies. Each such agency and governing body shall be provided forty-five (45) days to provide comments.
3. Following public participation and the combined public meeting and hearing required under Paragraph 1, above, and following the receipt of comments from appropriate planning agencies and municipal governing bodies of each municipality in the watershed, the regional committee, in consultation with the CAAC, shall select by a majority vote the planning alternatives and provisions to be recommended as part of the CARP.

B. Recommendation of CARP to statewide committee and Secretary of DEP

1. Each regional committee may, by majority vote, recommend the CARP to the statewide committee.
2. If the regional committee fails to transmit the CARP to the statewide committee, the statewide committee shall, after providing ninety days' written notice to the regional committee, proceed to act on the CARP per Section C, below.

C. Approval of CARP and inclusion in State Water Plan

1. Upon receipt of the CARP, the statewide committee or the DEP Secretary may direct modification of the CARP, in whole or in part, upon finding:
    a. The planning or management alternatives are inconsistent with the regional plan.
    b. The CARP is inconsistent with the statute; federal or state laws or regulations, or officially adopted policies or plans; or compacts or other interstate agreements and plans.
    c. The CARP is inconsistent with or conflicts with the provisions or objectives of the overall State Water Plan.
    d. The CARP fails to conform to the CARP elements in Chapter 2 or other requirements established by this policy.
2. Following consultation with the regional committee, the statewide committee shall, by majority vote, approve and recommend to the DEP Secretary approval and adoption of the CARP as a component of the State Water Plan.
3. Within ninety days of submission of the CARP, the DEP Secretary shall in writing either approve the CARP or disapprove the CARP if the DEP Secretary finds:
    a. The planning and management alternatives are inconsistent with the regional plan.
    b. The CARP is inconsistent with the statute; federal or state laws or regulations, or officially adopted policies or plans; or compacts or other interstate agreements and plans.

c. The CARP is inconsistent with or conflicts with the provisions or objectives of the overall State Water Plan.

d. The CARP fails to conform to the CARP elements in Chapter 2 or other requirements established by this policy.

4. Upon disapproval of the CARP, the DEP Secretary shall advise the statewide committee and the affected regional committee, in writing, of the reasons for disapproval.

5. Upon receiving notice of disapproval, the statewide committee, the affected regional committee, and DEP shall undertake expeditious and diligent efforts to confer and resolve the issues identified as the reasons for disapproval.

6. Within ninety days of receiving any disapproval notice, the statewide committee shall recommend a revised plan addressing and resolving the issues.

7. Upon adoption of the CARP, DEP shall publish notice of the amendment of the State Water Plan in the Pennsylvania Bulletin and on the DEP website.

8. The CARP shall be construed as a component of the State Water Plan and may be implemented voluntarily.

3.0 Assessment of Climate Change Adaptation Strategies

3.1 Pennsylvania Climate Change Initiatives

Under the commitments of the Pennsylvania Climate Change Act (Act 70 of 2008)[68], DEP in May 2021 released the *Pennsylvania Climate Impacts Assessment 2021*[69] that provided a review of scientific findings and relative risks to inform priority climate change adaptation needs.

In addition to environmental justice/equity considerations and continued research needs, the *Climate Impacts Assessment 2021* identified the following five priority considerations for climate adaptation:

- Reduce extreme heat risks to human health, particularly for vulnerable populations
- Support key sectors in the transition to a warmer climate, including agriculture, recreation, and tourism, as well as forests, ecosystems, and wildlife
- Reduce flood risks to infrastructure and communities
- Help low-income households cope with an increased energy burden
- Enhance tropical storm and landside risk mitigation

Examples of climate changes by mid-century[69]:

- Increases in average annual temperature
- More frequent intense extreme heat events
- Increased total average rainfall with less frequent, but higher intensity rainfall events
- Tidal influenced flooding in the Delaware Estuary coastal zone
- Significant changes in water level, coastal erosion, and water temperature in Lake Erie

These five priority considerations formed a basis for developing priority adaptation needs as outlined in the *Pennsylvania Climate Action Plan 2021*[70] (CAP 2021), released in September of that year. The CAP 2021 outlines strategic opportunities in reducing greenhouse gases, a principal cause of climate change, along with the strategic opportunities in adapting to the impacts of climate change.

[68] Pennsylvania Climate Change Act www.legis.state.pa.us/CFDOCS/LEGIS/LI/uconsCheck.cfm?txtType=HTM&yr=2008&sessInd=0&smthLwInd=0&act=0070.

[69] Pennsylvania Climate Impacts Assessment 2021 www.depgreenport.state.pa.us/elibrary/GetDocument?docId=3667348&DocName=PENNSYLVANIA CLIMATE IMPACTS ASSESSMENT 2021.PDF

[70] Pennsylvania Climate Action Plan 2021 www.depgreenport.state.pa.us/elibrary/GetDocument?docId=3925177&DocName=2021 PENNSYLVANIA CLIMATE ACTION PLAN.PDF

3.2 Implementing Climate Adaptation Strategies through State Water Plan Priority Action Recommendations

It is in the domain of adaptation where specific water resources-related recommendations developed in the State Water Plan Update align with the adaptation strategies from both the CAP 2021 as well as the Pennsylvania Climate Action Plan 2018[71] (CAP 2018). These recommendations provide opportunities to help achieve climate adaptation strategies through informed policy, planning, and program decision making under the State Water Plan.

The following sections help make the connection between the strategies within the CAP 2018 and CAP 2021 with the State Water Plan regional and statewide priority assessment through: 1) relational tables in Section 3.4 that correlate climate adaptation impacts, approaches, and strategies to specific recommendation topic sections previously described in Chapter 2; and 2) narratives in Section 3.4 for each of the regional water resources committees that describe the priorities reflecting each of their unique water resources needs and challenges.

[71] Pennsylvania Climate Action Plan 2018 www.depgreenport.state.pa.us/elibrary/GetDocument?docId=1454161&DocName=2018 PA CLIMATE ACTION PLAN.PDF

3.3 Cross-referencing of Climate Adaptation with Statewide Priority Actions

Table 4. 2018 Pennsylvania Climate Action Plan Compared with State Water Plan Priority Action Recommendations

Water Resource Opportunities to Adapt to Climate Change	Related State Water Plan Priority Action Recommendation Topics	State Water Plan Priority Actions Recommendations
Use Stormwater Best Management Practices	Floodplain and Stormwater Management	• DEP establish an information center/clearinghouse to provide education and training on related permitting, design, maintenance, and reporting of stormwater infrastructure • Fund of regular updates and addenda to the *Pennsylvania Stormwater Best Management Practices Manual* • Continue maintaining and updating the Stormwater Management Model Ordinance
Promote Integrated Water Resources Management and Water Conservation	Integrated Water Resources Management	• Develop a baseline assessment of IWRM for DEP and formulate guidance on roles of DEP and other agencies. • Identify and assess potential programmatic, policy, or regulatory options for actions to reflect linkage of land use to water resources management.

Table 5. 2021 Pennsylvania Climate Action Plan Compared with State Water Plan Priority Action Recommendations

Adaptation Opportunities to Impacts of Climate Change			Related State Water Plan Priority Action Recommendation Topics	State Water Plan Priority Action Recommendations
Most Significant Impacts	Water Resource Related Approaches	Example Strategies		
Impacts of increasing heat and flooding on health – harmful algal blooms	• State revise policies to support health given projected increased heat and flood risks	• Review zoning codes, create system to reflect climate projection data	• Floodplain and stormwater management	• Review and update flood control hazard mitigation plans, invest in enhanced flood forecasting and warning systems, update flood insurance maps and communications with property owners, and establish information centers/clearing houses for education and training for municipal decisions
Impacts of increased heat and flooding on overburdened and vulnerable populations	• Support vulnerable populations when integrating climate risks into key plans • Improve infrastructure in vulnerable communities to reduce impacts	• Plant trees • Increase flood mitigation grant funds and reduce application barriers	• Integrated water resources management • Floodplain and stormwater management	• Identify and assess potential programmatic, policy, or regulatory options for actions to reflect linkage of land use to water resources management. • Increase efforts to enhance community recovery assistance following flood events

Adaptation Opportunities to Impacts of Climate Change			Related State Water Plan Priority Action Recommendation Topics	State Water Plan Priority Action Recommendations
Most Significant Impacts	Water Resource Related Approaches	Example Strategies		
Impacts of increasing average temperatures on forests, ecosystems, and wildlife	• Identify and manage human stressors • Maintain and enhance genetic diversity • Ecosystem restoration • Ecosystem or species conservation • Improve connectivity	• Develop and use ecological flow thresholds to manage water withdrawals so they do not increase thermal stress on sensitive species and habitats • Adopt regulations that provide streamflow levels necessary to ensure the resilience and ecological integrity of both warm-water and cold-water streams • Promote sustainable land use planning and development - Intelligent land use planning promotes practices that provide the critical elements for quality of life for residents as well as protects and restores naturally functioning ecosystems and agriculturally productive lands	• Integrated water resources management • Water withdrawal and use	• Identify and assess potential programmatic, policy, or regulatory options for actions to reflect linkage of land use to water resources management. • Improve the use of water use data in projecting future demand trends

Adaptation Opportunities to Impacts of Climate Change			Related State Water Plan Priority Action Recommendation Topics	State Water Plan Priority Action Recommendations
Most Significant Impacts	Water Resource Related Approaches	Example Strategies		
Impacts of a warmer and wetter climate on agriculture	• Expand regional planning and coordination • Education and outreach • Improve research and analysis • Provide decision support tools and technical assistance	• Promote sustainable land use planning and development - Intelligent land use planning promotes practices that provide the critical elements for quality of life for residents as well as protects and restores naturally functioning ecosystems and agriculturally productive lands • Establish an information clearinghouse for growers on water conservation technology	• Integrated water resources management • Water efficiency	• Identify and assess potential programmatic, policy, or regulatory options for actions to reflect linkage of land use to water resources management. • Develop information and materials on water efficiency technologies and practices

Impacts of flooding on built infrastructure	• Harden, protect or relocate at-risk assets • Encourage utilities to assess vulnerable assets • Implement new or modified land use policies and practices • Education and outreach • Stakeholder engagement and collaboration • Improve preparedness and early warning systems • Encourage adoption of adaptive design and flood management practices • Provide decision support tools and funding opportunities	• Improve the accuracy and technological capabilities of flood forecasting, early-warning, and emergency-preparedness systems • Update flood insurance rate maps and other regulatory tools that rely on FEMA maps to reflect evolving risks from climate change • Work with local jurisdictions to incorporate consideration of climate change into ongoing land use planning efforts (e.g., growth management, development planning) • Upgrade or implement design improvements for flood-control structures (e.g., levees, flood walls) that protect existing critical infrastructure • Require maps of areas vulnerable to future flooding in applications for new development • Preserve open space in flood hazard areas and channel migration zones	• Integrated water resources management • Sustainability of Pennsylvania drinking water and wastewater infrastructure • Stormwater and floodplain management • Water withdrawal and use	• Improve inter- and intra-agency coordination related to integrated water use planning to ensure consistent planning, operations, and application of regulations and policies • Develop and implement asset management plans for water and wastewater systems • Invest in enhanced flood forecast and warning systems • Update floodplain and flood insurance rate maps • Increase efforts to protect Pennsylvania floodplains • Increase/enhance recovery assistance following flood events • Include floodplain management and floodplain regulations into local integrated water resource planning • Establish floodplain studies outside of detailed FEMA study areas • All community water systems (as well as self-supplied users) should evaluate the vulnerabilities of their respective sources to the impacts from expected increases in both

Adaptation Opportunities to Impacts of Climate Change			Related State Water Plan Priority Action Recommendation Topics	State Water Plan Priority Action Recommendations
Most Significant Impacts	Water Resource Related Approaches	Example Strategies		
				the frequency and intensity of flooding and droughts. • Establish technical design guidance for new encroachments and obstructions

3.4 Climate Change Adaptation Considerations within Regional Priority Assessments

3.4.1 Delaware River Region Climate Change Adaptation Considerations

The Delaware Regional Water Resources Committee assembled a series of priorities based on the unique needs and challenges which climate change presents for their region. With large population centers like Philadelphia and others in the region, there is increased risk from stormwater issues brought on by increased impervious surfaces in areas experiencing population growth and expanding development. The exacerbation of flooding problems by intensifying rain events brought on by climate change led the committee to focus on municipal infrastructure management and land development practices to adapt to these evolving conditions. The increased runoff from these events could also have a negative impact on water quality in the region, which will require further investigation. With temperatures on the rise, invasive species may also become more prevalent and disrupt the ecosystems of the region.

The committee advocates for leveraging the Delaware River Basin Commission's Advisory Committee on Climate Change, where possible, to assist with the research challenges of grasping this broad problem as well as creating needed tools. This emphasis on research and tool-crafting leans into the creation and updating of scenarios and models that will give decision makers a clearer vision of their changing environment.

Even though it is predicted there will be increased annual precipitation, it is anticipated that this will mostly manifest in more frequent intense short-duration storm events. The spacing between those storms may still be long enough that periods of drought are possible. Additionally, because healthy aquifers and soils are best served by consistent rain rather than isolated intense storm events, the committee desires to increase awareness of a potentially lowered water table that may damage soils in the region.

Finally, the Delaware Estuary's port infrastructure and drinking water sources present a unique challenge for the region. Saltwater intrusion is a concern for drinking water sources, and the region could face potential problems if critical infrastructure is not adapted to climate change.

The region has several water resources challenges to meet in the coming years which can be mitigated by consolidating research, ensuring broad access to needed data, and adopting a holistic approach to climate change adaptation.

3.4.2 Great Lakes Region Climate Change Adaptation Considerations

Given the unique nature of the Great Lakes region's hydrologic complexity, relatively large economy given its land area, and vast number of potential stakeholders, the Great Lakes Regional Water Resources Committee had a challenging task in establishing priorities and recommendations for climate change adaptation. The first consideration was the many hands that would be involved in implementing potential policies. The committee recognizes that there are multiple state and provincial governments and municipalities with some jurisdiction over the Great Lakes. It is essential that the commonwealth continue to play a role in interstate efforts to identify regional climate stressors and plan for economic and environmental resiliency efforts.

Due to its natural beauty and abundant fresh water, the Lake Erie coastline has also proven to be an attractive proposition to many industrial and commercial businesses (including a large tourism and recreation industry), as well as the many residents who call it home. The lake's surface elevation naturally fluctuates over time, but the changing climate has led to shorter intervals on these changes.

The committee sees this as an opportunity to consider the potential impacts of these changes on bluff and beach erosion, industries, and coastal residences.

Present indicators show that climate change is increasing storm intensity, which poses an increased flooding risk. Climate change presents an opportunity to develop more robust resiliency strategies within the region's municipalities, such as broader consideration of flash flooding and stormwater management. These local strategies should be developed with a regional strategy in mind because of the increasing vulnerability to these intense storm events.

While more intense storms are anticipated, the time intervals between these events are likely to increase. This means that there could be increased risk of both flood and drought, particularly where groundwater recharge is concerned. Though the coastal regions of the watershed have a large fresh drinking water supply in the form of Lake Erie, the Genesee River watershed in Potter County makes use of private wells. Water supply vulnerability in regions that are more reliant on groundwater should be considered a high priority as these impacts of climate change take effect.

3.4.3 Lower Susquehanna River Region Climate Change Adaptation Considerations

The Lower Susquehanna Regional Water Resources Committee crafted recommendations that would account for the unique impacts that climate change would have on their region. One of the primary concerns of the committee was the increased number of intense storms passing through the region. Due to population growth and the presence of major highways intersecting in the region, which have given rise to many logistics centers and other developments, the committee initially focused on flooding and stormwater management. The committee favored an approach which highlights floodplain restoration while considering obstructions and encroachments such as buildings, legacy sediment, undersized bridges, or culverts. Additionally, the committee recommended the development of floodplain management ordinances to keep these floodplains clear and encouraged the enhancement of structural and nonstructural strategies to reduce environmental impacts. These are long-term changes that will require a system of incentives to promote a more proactive approach to climate change that favors planning and adaptation.

While flooding and stormwater are the obvious concerns stemming from intense rain events, there are other impacts that should be considered. With large run-of-the-river dams and reservoir drinking water sources, harmful algal blooms (HABs) may be exacerbated by increasing temperatures, creating conditions that are favorable to HAB growth. Storms not only flood developed areas but can also wash debris and pollutants into streams. Engaging stakeholders on the implications of intense rain events, their impacts on soil, and HABs is critical to establishing robust strategies with broad public support.

Despite predictions that annual precipitation will increase with intense short-duration storm events, increased time intervals between these storm events can potentially lead to droughts in the region. This could present some difficulty for the many manufacturers that are active in the region who need large quantities of water to function. Therefore, the committee recommended proactive drought management for reservoir systems to facilitate protection and conservation of water resources.

All the above solutions will require continued cooperation and coordination among agencies at many levels to help effectively leverage resources to reduce these impacts of climate change.

3.4.4 Ohio River Region Climate Change Adaptation Considerations

The Ohio River region has a high municipal density with an inland port in Pittsburgh and receives water from southern New York and West Virginia before contributing to the broader downstream

network that comprises the enormous Ohio River basin. The Ohio Regional Water Resources Committee sought to address climate change using a number a of strategies which focused on increased storm intensity and a concern for more frequent flash flooding. Floodplains are critical to containing and controlling floods; therefore the committee recommended the maintenance and use of riparian buffers, especially surrounding headwaters.

Despite increased instances of high-intensity storms, the time intervals between these storms could increase, leading to longer dry stretches and potential drought. This can pose a problem for replenishing aquifers, as intense storms tend to lead to more runoff than infiltration. The committee therefore recommended that, where possible, rain barrels and swales can be utilized to capture the runoff from intense storms, mitigating stormwater runoff and allowing for more infiltration. Additionally, municipalities should consider water supply vulnerability, availability, and reliability going forward despite the overall increased annual precipitation.

The United States Army Corps of Engineers owns and operates locks and dams within the region, and with continued proper maintenance, may help contribute to the region's overall climate resilience. These adaptive measures will help to ensure that the Ohio River region continues to be well supported and resilient in the face of a changing climate.

3.4.5 Potomac River Region Climate Change Adaptation Considerations

The Potomac River region represents a headwater for the watershed, making interstate coordination vital. The region also has diverse topography and population densities – including urban sprawl from Baltimore and Washington, D.C., farmland, and mountainous regions. This broad spectrum of natural and anthropogenic characteristics across the region compounds the challenge for the Potomac Regional Water Resources Committee to develop priorities for climate change adaptation.

Because of the region's uniqueness, the committee recommended a focus on local data collection, such as using the Community Collaborative Rain, Hail and Snow Network (CoCoRaHS)[72] and on-site assessment where possible, rather than relying exclusively on global data trends. In addition to these data tools, the committee recommends that stakeholders explore ways to communicate climate change that won't alienate potential allies. These methods should bring a diverse array of stakeholders to the table to help promote an adaptive approach to climate resiliency.

Climate change will likely continue to impact the region with increased frequency of intense storm events. Since local geology and topography make groundwater recharge challenging, there is a greater risk of drought if the region experiences longer time intervals between storm events. The committee recommends riparian buffers and conveyance structures to help reduce the effects of flooding and promote groundwater recharge. Additionally, since much of the region is mountainous, the committee saw a need to draw attention to the risks of flash flooding and preparing for intense storm events. The dual problems of both flooding and drought represent a broad, far-reaching suite of challenges that will require a holistic solution. Therefore, the committee recommends an integrated water resource planning approach to help coordinate these efforts throughout the region.

These various strategies will contribute to a better prepared Potomac River watershed that can adapt to the diverse challenges presented by climate change.

[72] Community Collaborative Rain, Hail and Snow Network
www.cocorahs.org

3.4.6 Upper-Middle Susquehanna River Region Climate Adaptation Considerations

The Upper-Middle Susquehanna River region is densely forested and has large variations in both its topography and many rural communities. The Upper-Middle Susquehanna Regional Water Resources Committee's efforts on climate change adaptation focused on the major trends that are taking root in Pennsylvania, namely, more intense storms with larger time intervals between events, as well as seeking buy-in from the region's residents. Densely forested regions perform well at recharging ground water supplies, but intense rain events are less beneficial for infiltration and create more runoff. The committee chose to highlight water supply vulnerability, especially in smaller communities that rely on groundwater sources.

Due to the regional variance, the committee believes an in-depth study of climate change implications on water supply, vulnerability, availability, and reliability would be beneficial. There are some areas within the region that have steep topography, which means that flash flooding may become a central issue for communities located in those areas.

Stakeholder buy-in is a key issue in this region, as are funding issues and the need to adopt a long-term flexible outlook that allows for incremental steps – especially important where tight budgets are a concern. Education and outreach are critical components of this effort, where adaptation strategies are promoted to boost a community's resiliency and where scientific data is used to help guide climate adaptation discussions. Co-benefits, such as a healthier ecosystem, should be emphasized to help persuade stakeholders to take part in adaptation efforts.

The combined work of adapting to trends that are already understood, analyzing the problem from a regional perspective, and pursuing stakeholder buy-in are essential strategies toward a well-adapted Upper-Middle Susquehanna River region.

4.0 Data Access and Collaboration

4.1 Description of Pennsylvania's Water Use Data Program

Pennsylvania's water use data program has collected water use reports from users for several decades. Water use data was collected mainly through required reporting from public water suppliers (PWSs). Also, periodic mailings of water use survey forms to facilities using large quantities of water provided additional water use data.

Act 220 of 2002[73] called for the DEP to perform an initial registration and annual report from: any person who withdraws more than 10,000 gallons of water per day averaged over any 30-day period; all PWSs (which serve at least 15 service connections or at least 25 residents year-round); and hydropower facilities regardless of amount or type of withdrawal. Act 220 of 2002 led to the adoption of 25 Pa. Code Chapter 110 Water Resources Planning regulations[74] in 2008. These regulations established ongoing registration, reporting, and recordkeeping requirements, including user-specific content for PWSs, power generation facilities, manufacturing industries, mining, agriculture, golf courses, and ski resorts. Data from water use reporting is stored in DEP's enterprise Water Use Data System (WUDS) database.

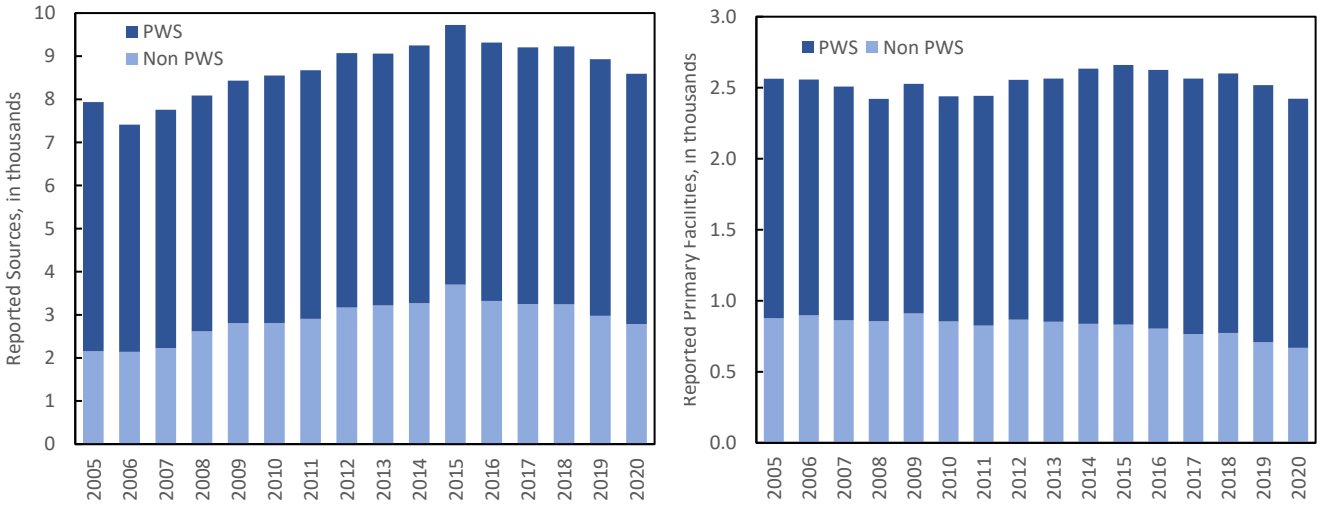
Figure 10. Screen Capture of the Sub-facility (SF) Water Use Report Input Screen

Annually, DEP receives over 8,000 sub-facility (SF) reports and over 2,000 primary facility (PF) water use reports. An SF is a site-specific record of a water source, such as a groundwater well or surface water intake. In addition, an SF report contains information such as the monthly amount withdrawn, purchased, or sold (in case of a PWS), days used per month, and how the source was measured (Figure 10).

[73] Act 220 of 2002 www.legis.state.pa.us/CFDOCS/LEGIS/LI/uconsCheck.cfm?txtType=HTM&yr=2002&sessInd=0&smthLwInd=0&act=0220.

[74] Chapter 110 Water Resources Planning regulations www.pacodeandbulletin.gov/Display/pacode?file=/secure/pacode/data/025/chapter110/chap110toc.html

Figure 11. Trends in Reported Sources (Sub-facilities, SFs) and Primary Facilities (PFs), 2005-2020



A PF is the business entity or system that owns and operates one or more SFs. A PF water use report contains system water use information and is divided into PWS PF and NonPWS PF reports. The PWS PF report is only for PWSs (which serve year-round at least 15 service connections or at least 25 residents); there are over 1,900 active PWSs within the commonwealth. The other PF report is the NonPWS PF report. This report is for all other facilities, such as industrial, commercial, power generation, etc. A notable change in reported facilities has been water use for unconventional natural gas extraction by hydraulic fracturing of shale formation, commonly known as the Marcellus Formation. Reporting for these SFs (oil and gas) started in 2007. The number of reported sources peaked in 2015 (Figure 11).

A PWS PF report includes the average daily water distributed to different connection types (domestic, industrial, institutional, commercial, bulk sales to other PWSs, oil and gas, other, and water losses). The report also includes the number of connections by type, number, and type of connections per municipality, total population served, percent population served by municipality, peak and minimum daily use, and other system information.

The NonPWS PF report contains information on returned water at the primary facility, whether the amount of water is discharged to a receiving waterway, to a public sewage system, by another method of discharge, or a combination of all these. An example would be a power generating plant reporting the water discharged to a waterway after leaving the plant's cooling system. Another example is a golf course reporting no water discharged from the site when all water withdrawal was consumed for irrigation. The report preparer is instructed not to account for stormwater runoff in the discharge amounts and not to include consumptive use amounts (i.e., evaporation, incorporation in product, deep-well injection, off-site disposal) as an "other" discharge method. By reporting the amount of water disposed at the primarily facility, a mass balance equation (consumptive use = total withdrawal from SF reports - returned water from PF report) can be used to calculate the consumptive use for the facility.

DEP reviews all water use registrations and annual water use reports for completeness and accuracy before accepting and sharing with the public. Registrations and reports not meeting DEP's acceptance review are returned with comments to the report preparer to address before resubmission.

4.2 Data Access Tool – Downloads and Viewers

In 2017, DEP launched a series of six water use report viewers to readily share users' registration and periodic reporting of water use information with the public. The project was fully funded by the USGS Water Use Data and Research (WUDR) grant. The report viewers are a web-based program using an SQL Server for Report Services (SSRS) server-based reporting platform. The report viewers and instructions are available on DEP's Water Reports[75] webpage. All report viewers have a function to export a dataset to various file formats, including XML, CSV, and Excel. The viewers are as follows:

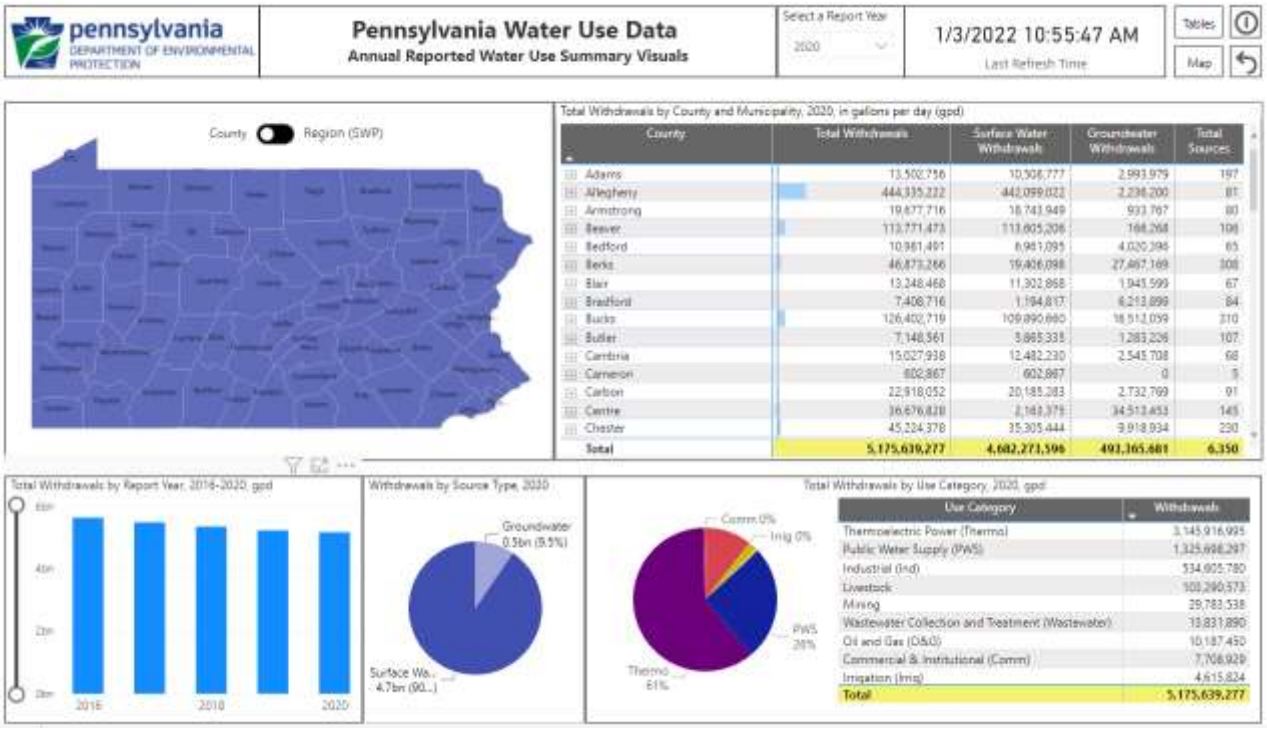
1. **Water Source Registration Viewer** extracts Act 220 of 2002 registration data. Information includes identifying and describing the registrant's name, description, and location of water sources. In addition, the viewer will allow the user to define a specific facility by ID or filter/query by the following fields: water use type (commercial, industrial, livestock, irrigation, mining, hydroelectric power, public water supply, oil and gas, thermoelectric power, wastewater collection and treatment, and other); SF type (surface water withdrawal, groundwater withdrawal, and interconnection); status (active or inactive); county; and watershed levels (two-digit to ten-digit hydrologic unit codes[76]). Due to DEP's sensitive information policy, PWS source locations will be limited to only municipality/county and watershed.
2. **Water Quantity Report by Source Viewer** extracts collected data from Chapter 110 annual SF reports. SF reports are relevant to all water use categories. They contain detailed source information, including monthly water withdrawals and days of use. Where applicable, SF reports include records of quantities purchased or sold, and days used through public water supply interconnections. Multiple fields can be used to filter the data in the viewer. Fields for filtering are: water use type, SF types, SF status, report years, counties, and watershed levels. An option to select a single facility requires an ID type and unique ID number.
3. **Water Use Report by Water Supplier Viewer** extracts Chapter 110 annual PF reports for PWSs. PF reports contain information about average daily water use by use type, number of connections by use type, connections by municipality by use type, total population served, percent of population served by municipality, peak and minimum amount and date, and other system information. In addition, the viewer contains filter/query boxes for the user to limit their search. Filters allow for searching by a system (PF) status, report year(s), watershed levels, and counties. The user can select an individual system using an ID type and unique ID number.
4. **Water Use Report by Facility Viewer** extracts data from the Chapter 110 annual PF reports from NonPWS PFs. The NonPWS PF report contains the amount and manner of water discharged after use. Currently, three forms of discharge are used: (1) direct discharge to receiving waterway, (2) discharge to a public sewage system, and (3) other. The viewer contains filter boxes for the user to limit their search; filters include facility status, report years, and counties. The user can select an individual system using an ID type and unique ID number.
5. **Water Allocation Daily Withdrawal Report Viewer** extracts data from daily water withdrawal reports submitted by PWSs monthly to DEP. The viewer contains filter boxes for the user to limit their search; filters include report years and counties. In addition, the user has the option to select an individual system using an ID type and unique ID number.

[75] DEP Water Reports webpage
www.dep.pa.gov/DataandTools/Reports/Pages/Water.aspx
[76] For explanation of hydrologic unit codes (HUCs), see the USGS Hydrologic Unit Maps webpage
https://water.usgs.gov/GIS/huc.html

6. **Water Management Plan Daily Water Use Report Viewer** extracts data from daily water withdrawal reports submitted by oil and gas operators monthly to DEP. The viewer has filter boxes for the user to limit their search; filters include report years and counties. In addition, the user can select an individual system using an ID type and unique ID number.

In 2021, an additional viewer and data export tool was added to the DEP Water Reports webpage (Figure 12). The water use summary report[77] summarizes total withdrawals by categories and source types using charts, maps, and tables at state, county, and watershed scales for the past five reporting years. The report also displays the locations of reported sources. However, the water use summary report excludes showing and providing the coordinates of PWS sources due to DEP's sensitive locational policy prohibiting readily sharing coordinates of these sources.

Figure 12. Screen Capture of Water Use Summary Report Viewer



4.3 Refined Acquisition of Water Use Data

Data acquisition has significantly improved since the initial Act 220 of 2002 registrations were submitted in 2003. Back then, paper forms were mailed to water users and sent back to DEP. They were scanned and checked for errors before the information was uploaded into WUDS. Act 220 of 2002 also provides a periodic reporting requirement established by regulation for water users subject to the registration requirements as aforementioned. Act 220 of 2002 also states that the reporting frequency shall not be more frequent than annually. Annual reporting of monthly water use was initiated for the 2004 reporting for NonPWS water users and the 2005 reporting year for all PWSs. The collection of these reports was accomplished with the combination of "paper" and "paperless" reporting. Like the

[77] Water Use Summary Report
http://cedatareporting.pa.gov/reports/powerbi/Public/DEP/WUDS/PBI/PA_Water_Use_Annual_Summary_Report

registrations, paper reports were scanned and checked for errors before uploading into WUDS. To accept electronic reporting, a web application was developed accessible from DEP's GreenPort[78].

The decision to require only electronic submission of all water use reports for the 2012 report year resulted in significant improvement in data accuracy and submission rates. It also reduced the staff time necessary to process and upload data from paper reports to WUDS. For example, the percentage of unreported withdrawals from the industrial sector improved from nearly 20 percent in 2011 to less than 10 percent in 2012.

Chapter 110 report application improvements

- Internal completion checks
- Added user functionality
- Additional validation, acceptance, and verification checks

With support from USGS via grants from the WUDR program, further refinement in the collection of water use data focused on increasing the accuracy and quality of the data reported to DEP. Making these refinements was essential to maintain the data with reduced staff and resources over the years.

Specifically, the following is a list of improvements made to the report application since 2018:

- Linking SF and PF reports and requiring the report preparer to complete and submit at least one SF report before starting a PF report was added. Establishing this link eliminates the chance of receiving only an SF report(s) without a PF report and vice versa.
- Filtering functionality was added to the user interface screen.
- The SF report(s) values are totaled within the application. They are then used to compare the total values submitted in the PF report to validate values between SF and PF reports.
- The application's PWS PF report checks whether the reported values for minimum and maximum daily water use are acceptable based on their average daily water use.
- In the NonPWS PF report, the previously submitted method(s) of reported discharge or return automatically populates on the form. Therefore, the report preparer cannot remove the method(s) until they provide a reason for the change.
- The application checks the previous value (from the most recent prior accepted report) when any water quantity amount is entered. For example, if the new amount is less than half or one and half times greater than the previous value, the field will be flagged as a possible error. Population served by a public water system is checked against the previously accepted reported value.

Finally, to improve the process of collecting water use registrations and encouraging compliance with registering new and existing water use sources, three remaining Chapter 110 forms were converted from paper to online forms for electronic submission. The remaining Chapter 110 forms are water use registration, termination of the registration, and SF revision. These forms were developed into separate applications within GreenPort and made available in 2021.

[78] DEP's GreenPort
https://greenport.pa.gov

4.4 Data Collaboration

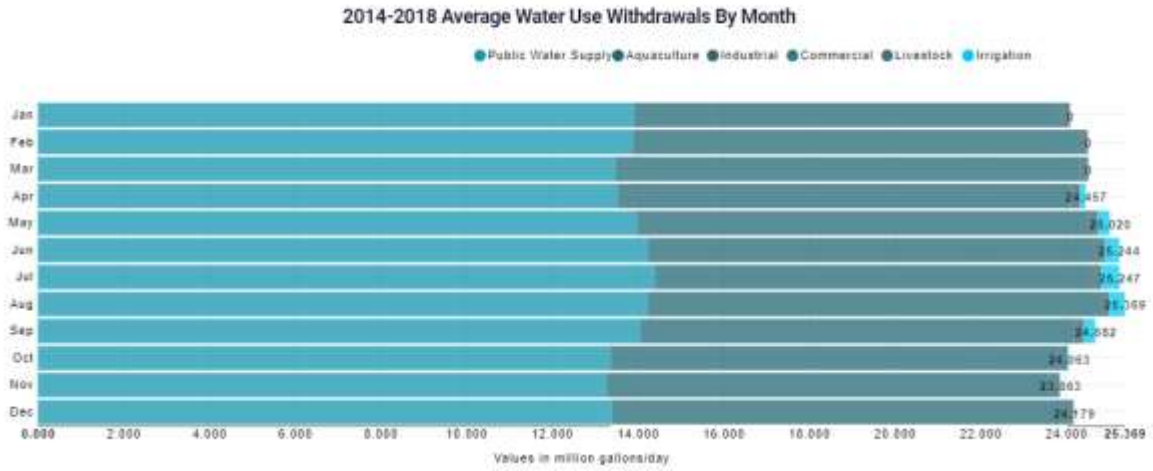
In 2021, a secure centralized site for sharing water use data was set up to exchange large amounts of water data between DEP and partner agencies. The site was designed to automate transferring data for integration in a partner agency's own applications. This eliminates the labor-intensive manual processes involved with sharing large datasets or the need for a user to manually query and download data from a web-based application, such as DEP's report viewers described above in Section 4.2.

4.4.1 USGS

The centralized data sharing site allows DEP to electronically deliver water use data to USGS. USGS has prioritized improving data delivery from states, which was beneficial in securing a 2019 WUDR grant to develop this centralized data sharing site.

DEP will continue to support USGS's StreamStats[79] application by providing monthly water withdrawals and point source discharge flow data reported to DEP's Electronic Discharge Monitoring Report (eDMR) System[80]. StreamStats is a national GIS-based application useful for water resources planners and engineers. The application allows a user to delineate a drainage area on streams and deliver basin characteristics and flow statistics estimates. An additional function was added to the Pennsylvania version of StreamStats[81] to compute total withdrawals and returns for a delineated drainage area from the water use provided by DEP (Figure 13).

Figure 13. StreamStats Water Use Data in Yellow Breeches Creek Watershed, New Cumberland, Pennsylvania



[79] USGS StreamStats
https://streamstats.usgs.gov/ss/
[80] Electronic Discharge Monitoring (eDMR) System
www.dep.pa.gov/Business/Water/CleanWater/WastewaterMgmt/eDMR/Pages/default.aspx
[81] Pennsylvania StreamStats Information
www.usgs.gov/centers/pennsylvania-water-science-center/science/pennsylvania-streamstats

4.4.2 River Basin Commissions

Within Pennsylvania, DEP, the Susquehanna River Basin Commission (SRBC), and the Delaware River Basin Commission (DRBC) routinely collect water use reports from users and the regulated community. In some cases, due to permitting and/or regulation requirements, users are reporting the same or similar data to these multiple agencies. As previously noted, a secure centralized location for sharing water use data was developed in 2021. The water use data tables from DEP and SRBC are currently updated every week using overnight automated batch loads and uploaded into each other's enterprise databases.

The development of the centralized data sharing site has made it easier for DEP to exchange data with partner agencies on a more frequent basis. Because similar reporting requirements within the basin commissions and DEP result in some duplicated water use data being collected, a project is planned to develop an application to identify identical sources stored within the agencies' databases. These sources will be identified with a unique reference number shared between the agencies' datasets.

DEP provides water use summary data for the Great Lakes portions of the state for uploading to the Great Lakes Regional Water Use Database[82]. Specifically, the data uploaded is summarized by withdrawals and consumptive use by use categories within the Lake Erie and Lake Ontario basins. A report of this database has been provided by the Great Lakes Commission each year since 1987.

[82] Great Lakes Regional Water Use Database
https://waterusedata.glc.org/index.php

5.0 Path Forward

5.1 Introduction

A consistent message during this update of the State Water Plan was for DEP to confidently execute the priorities and recommendations from this update. Many of these priorities center around a call for integrating the efforts of DEP programs and agencies with local governments and stakeholders, sustaining existing water resources programs, and forming actionable and implementable steps toward a better consensus and understanding of the linkage of water resources management to land use issues.

To achieve this, a phased or incremental implementation plan – or "Path Forward" – has been developed, as shown by Figure 14, that will:

- Provide a high level of awareness to water resources needs through public education and participation
- Prioritize and initiate work on the most important issues identified within priority recommendations
- Establish levels of accountability by measuring success in quantifiable ways
- Institute the framework for a continuous planning process for effective administration of the State Water Plan Program

5.2 Phase One (Year One)

Phase One tasks will focus on educating the public on the research and recommendations provided in the 2022 Update and instituting outreach efforts to engage key stakeholder constituencies with the plan's implementation. Under this phase, DEP will take advantage of opportunities in working with community liaisons within Environmental Justice (EJ) communities and areas to improve local engagement by providing information about the State Water Plan, soliciting participation on committees or workgroups, and providing feedback on state water planning activities through public commenting. More information on State Water Plan EJ actions is found in Chapter 1.6.3 Public Process and Environmental Justice. Activities may include but are not limited to:

- Bringing a prominent level of public awareness to the State Water Plan, including opportunities for education and outreach on water resources data, water resources issues, and the recommendations developed in the updated State Water Plan.
- Establishing paths for recruiting and maintaining interested and experienced individuals for participation in the State Water Plan statewide and regional committees.
- Developing education and training content for Pennsylvania Clean Water Academy learning modules.
- Continuing engagement of the statewide and regional committees through scheduled meetings and establishing applicable workgroups. Principal work will include:
    - Establishing DEP agency groundwork for IWRM initiatives, including examining alternative approaches for optimum agency, programs, and stakeholder engagement with committees and workgroups.
    - Completing any outstanding CARPs and ranking priority recommendations that would lead to developing implementation workplans. During this exploratory time, stakeholders will be consulted, fundamental questions will be answered, and programmatic solutions assessed.

- Initiating steps in support of legislative priorities.
- Exploring elements of a continuous planning process with input from the statewide committee for the program to effectively address environmental goals through agility in addressing changing priorities and meeting short-term needs while being prepared for longer-term initiatives. Continuous planning approaches would improve state water planning progress by eliminating long gaps between planning periods and a frequently updated State Water Plan.
- Prioritizing the statewide and regional committees' recommendations for implementation during subsequent planning phases.

5.3 Phase Two (Years Two and Three)

Phase Two will focus on defining and implementing strategies, tasks, activities, and projects for the prioritized recommendations developed by the statewide and regional committees and the development of measurable success indicators when possible. Activities may include:

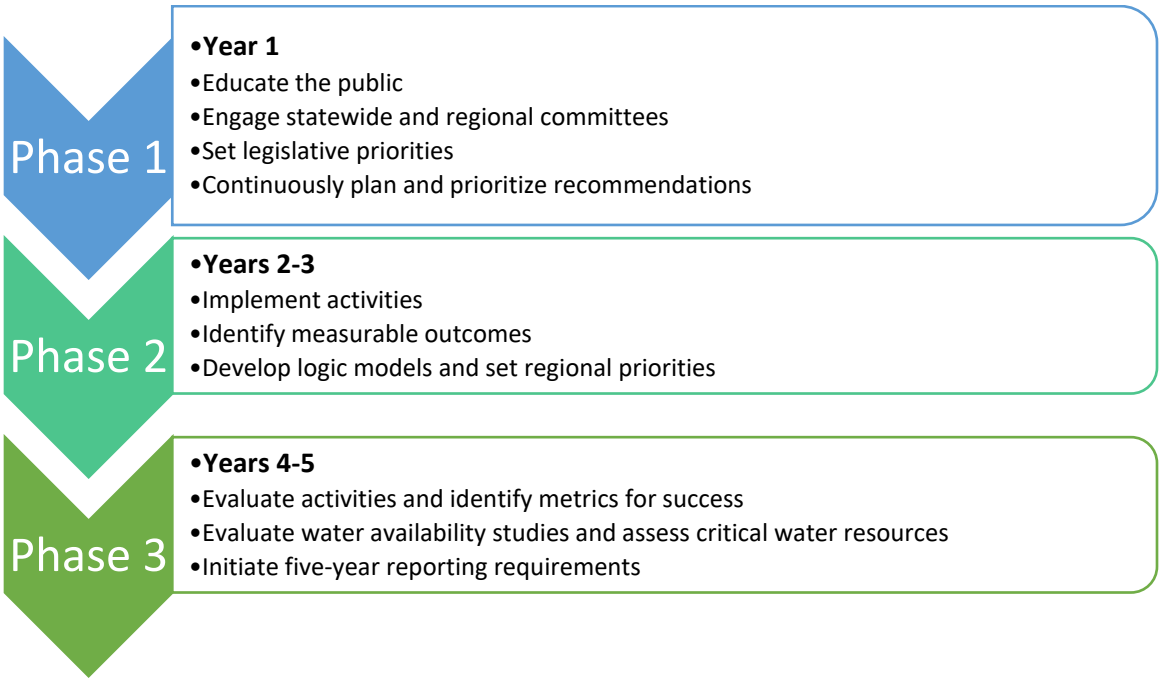
- Developing implementation activities for the recommendations developed by the workgroups of the statewide committee.
- Identifying measurable outcomes to be achieved for the implementation activities.
- Continuing development of the logic models on the regional priorities identified by each of the regional committees, including activities, resources, outputs, and intermediate and long-term outcomes.

5.4 Phase Three (Years Four and Five)

Phase Three activities will focus on executing assessments and evaluations of evolving water resources issues in establishing a long-range and strategic workplan for the State Water Plan. In addition, a system of accountability and planning success will be pursued through quantifiable measures.

- Evaluating activities initiated or completed by the statewide and regional committees and the progress being achieved.
- Identifying metrics for measuring success of initiatives of the updated State Water Plan.
- Evaluating the need for major water resource projects, such as water availability studies and critical water resources assessments, as well as identifying new activities that can be initiated by committee or workgroups.
- Initiating the process for producing the required five -year report, by DEP determining whether the State Water Plan and any ongoing revisions and updates reflect the objectives, policies, and purposes of Act 220 of 2002.

Figure 14. Path Forward Implementation



Appendix A Acknowledgements

The Department of Environmental Protection would like to thank everyone who participated in the 2022 Update of the State Water Plan:

- Those who served on the statewide and regional committees as listed below
- DEP staff as well as other commonwealth and federal agency staff
- Monica Gould and Bob Whitmore of Strategic Consulting Partners, consultants on the project; and
- All the individuals and organizations who provided input into the project

Regional Committee Members

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Appendix B Glossary, Abbreviations, and Acronyms

Glossary

CARP (Critical Area Resources Plan): A water resources management plan established for a Critical Water Planning Area that identifies practicable supply-side and demand-side alternatives for assuring an adequate supply of water to satisfy existing and future reasonable and beneficial uses.

CEC (Contaminates of Emerging Concern): Increasingly detected chemicals including nanoparticles, pharmaceuticals, personal care products, estrogen-like compounds, flame retardants, detergents, and some industrial chemicals with potential significant impact on human health and aquatic life.

CFC (Commonwealth Flood Coordinator): A proposed appointment that would be charged with coordinating flood prevention and recovery activities among state agencies.

CWPA (Critical Watershed Planning Areas): Any significant hydrologic unit where existing or future demands exceed or threaten to exceed the safe yield of available water resources.

CSO (Combined Sewer Overflow): intermittent overflows or other untreated discharges from a combined sewer system (CSS) to surface waters prior to reaching a sewage treatment facility.

EDCs (Endocrine Disrupting Compounds): Agents that affect the endocrine system.

EJ (Environmental Justice) Areas: Any census tract where 20 percent or more individuals live at or below the federal poverty line, and/or 30 percent or more of the population identifies as a non-white minority, based on data from the U.S. Census Bureau and the federal guidelines for poverty.

GIS (Geographic Information System): a computer system that analyzes and displays geographically referenced information.

GREENPORT: DEP's access to online applications.

IWRM (Integrated Water Resources Management): An approach to managing water that looks holistically at the planning and management of water supply, wastewater, and stormwater systems. IWRP (Integrated Water Resources Planning/Plan) is another acronym frequently paired with or used in place of IWRM. For the purposes of this document IWRP is considered a discrete plan whereas IWRM is understood to be the broader concept on which those plans are based.

Mesonet: A network of collectively owned and operated automated weather stations

MS4 (Municipal Separate Storm Sewer Systems): An MS4 is a conveyance or system of conveyances that is owned by a state, city, town, village, or other public entity that discharges to waters of the U.S., that is designed or used to collect or convey stormwater (e.g., storm drains, pipes, ditches), that is not a combined sewer, and is not part of a sewage treatment plant, or publicly owned treatment works.

PFAS (perfluoroalkyl and polyfluoroalkyl substances): man-made chemicals, are resistant to heat, water, and oil, and persist in the environment and the human body.

PFC (Perfluorochemicals): a group of chemicals used to make fluoropolymer coatings and products that resist heat, oil, stains, grease, and water.

PFOA (Perfluorooctanoic Acid): a manufactured perfluorochemical and a byproduct in producing fluoropolymers.

PFOS (Perfluorooctanesulfonic **Acid):** a manufactured perfluorochemical and a byproduct in producing fluoropolymers.

RGGI (Regional Greenhouse Gas Initiative): RGGI is an initiative of 10 New England and Mid-Atlantic states, to reduce greenhouse gas emissions from the power sector while generating economic growth.

WUDS (Water Use Data System): The Department of Environmental Protection database of water withdrawals and uses collected from self-monitoring records submitted from public water supply agencies, hydropower facilities and each person whose total withdrawal exceeds an average rate of 10,000 gallons per day in any 30-day period.

Abbreviations and Acronyms

AML	Abandoned Mine Lands
AOP	Aquatic Organism Passage
CAP	Pennsylvania Climate Action Plan
CARP	Critical Area Resource Plan
CWPA	Critical Water Planning Area
DCED	Department of Community and Economic Development
DCNR	Department of Conservation of Natural Resources
DEP	Department of Environmental Protection
DRBC	Delaware River Basin Commission
EPA	Environmental Protection Agency
EQB	Pennsylvania Environmental Quality Board
FEMA	Federal Emergency Management Agency
GIS	Geographic Information System
HU	Hydrologic Unit
HUC	Hydrologic Unit Code
ICPRB	Interstate Commission on the Potomac River Basin
NEPA	National Environmental Policy Act
NRCS	Natural Resources Conservation Service
OSMRE	Office of Surface Mining Reclamation and Enforcement
ORSANCO	Ohio River Valley Water Sanitation Commission
PEMA	Pennsylvania Emergency Management Agency
PENNVEST	Pennsylvania Infrastructure Investment Authority
PFBC	Pennsylvania Fish and Boat Commission
PSATS	Pennsylvania Association of Township Supervisors
PUC	Pennsylvania Utilities Commission
SPOC	Single Point of Contact
SRBC	Susquehanna River Basin Commission
USGS	United States Geological Survey
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
WAST	Water Analysis Screening Tool
WIIN	Water Infrastructure Improvements for the Nation grants

Appendix C Pennsylvania State Water Plan Regions

Appendix D Legacy Histories

Appendix D-1 Overview of Pennsylvania's Coal Mining Legacy

Introduction

Pennsylvania's coal mining legacy includes past, present, and future issues that need to be assessed and have plans developed to address these issues. The efforts toward net decarbonization of the grid and industrial sector is placing a strain on coal mining within Pennsylvania. As the remaining coal-fired power plants are decommissioned, the thermal coal market in Pennsylvania is impacted, resulting in a consolidation of the industry with smaller markets to sell coal. This resulted in the largest remaining market being metallurgical coal.

This push for decarbonizing the grid, as well as regulatory restrictions, coupled with the "shale gas" industry has resulted in coal moving from baseload facilities to seasonal operations, acting more like a peaking plant. Thus, it is essential to view coal mine land reclamation in terms of past, present, and future. Each of these areas have unique issues to be considered.

The Past

The past is defined as the abandoned mine lands in existence as of August 3, 1977, based on the date the federal Surface Mining Control and Reclamation Act (SMCRA) was signed into law (PL-95-87).

With the $1.26 billion in grant funds, Pennsylvania's Abandoned Mine Land (AML) Program under the Department of Environmental Protection (DEP) has operated since 1980 and has reclaimed thousands of dangerous sites left by abandoned coal mines and treated or abated over 10 billion gallons of acid mine drainage (AMD) annually resulting in increased safety and an improved environment for the citizens of Pennsylvania. Through reclamation activities:[83]

- Over 91,400 acres of high priority abandoned coal mine sites have been reclaimed.
- Hazards associated with more than 1,880 open mine shafts and portals have been eliminated.
- Over 1,433,000 linear feet (271 miles – the equivalent of a trip from Harrisburg to Erie) of dangerous highwalls are no longer a threat to people.
- Over 1,800 acres of dangerous piles and embankments have been eliminated and the land reclaimed.
- Over 2,500 AML impacted water supplies have been replaced with clean and reliable water lines and $142.8 million has been dedicated to abating or treating AMD to improve water quality.

[83] Department of Environmental Protection, Pennsylvania's Surface Mining Control and Reclamation Act https://files.dep.state.pa.us/Mining/Abandoned%20Mine%20Reclamation/AbandonedMinePortalFiles/AML_Fact_Sheet_Final_2019_03_11.pdf

However, Pennsylvania AML legacy has a long way to go. Consider that today: [84,85]

- Pennsylvania currently has inventoried over 287,000 acres of land in need of reclamation, and the estimated construction cost to complete this important work is expected to exceed $5 billion.
- Approximately 10 percent of Pennsylvania's land area has been undermined by underground coal mining operations.
- Pennsylvania also has over 5,500 miles of streams which are degraded by AMD based on the Pennsylvania Integrated Water Quality Monitoring and Assessment Report.[86]
- Pennsylvania addresses roughly 77 emergencies per year relating to mine subsidence problems, burning mine fires, and AMD breakouts.
- It is estimated that there is over 9,000 acres filled with coal refuse and that over 3,700 acres have been reclaimed.
- At least 40 coal refuse piles are burning and there may be as high as 90 coal refuse piles and underground mine fires still burning.

On November 15, 2021, President Biden signed the Bipartisan Infrastructure Investment and Jobs Act (IIJA) that reauthorized the collection of the coal AML reclamation fee and authorized the deposit of $11.3 billion in additional US Treasury funding into the national AML Trust Fund for pre-1977 coal AML reclamation. The IIJA brings transformative changes to the coal AML and AMD program with US Treasury funding that will be distributed over the next 15 years. Pennsylvania will receive $244.9 million annually for 15 years in addition to the traditional AML grant based on the fee collected from coal producers.

The Present

The present refers to those sites where bonds were forfeited by DEP. Forfeited bonds are almost always a result of progressive enforcement of an unabated violation. As a result of the bond forfeitures, DEP is to utilize the bonds moneys (if any) to reclaim these sites.

DEP has been addressing this program. However, the ability to complete the reclamation has been tied to the availability of funds ensuring the reclamation is completed. The three categories of bond forfeitures are based on timing of the permitting programs per the federal Surface Mining Reclamation and Enforcement Control Act and bonding program in place at the time of the bond forfeiture. The categories are pre-primacy sites, primacy sites covered by the Alternative Bonding Program (ABP), and primacy sites tied to the Conventional Bonding Program. The following table summarizes the sites falling into these categories (Table 6).

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[84] Pennsylvania DEP, Pennsylvania's Surface Mining Control and Reclamation Act https://files.dep.state.pa.us/mining/Abandoned%20Mine%20Reclamation/AbandonedMinePortalFiles/AML_Fact_Sheet_Final_2019_03_11.pdf

[85] Appalachian Region Independent Power Producers Association (ARIPPA), What is Coal Refuse https://arippa.org/wp-content/uploads/2018/12/ARIPPA-Coal-Refuse-Whitepaper-with-Photos-10_05_15.pdf

[86] Pennsylvania DEP, Integrated Water Quality Report – 2022 https://www.dep.pa.gov/Business/Water/CleanWater/WaterQuality/IntegratedWatersReport/Pages/2022-Integrated-Water-Quality-Report.aspx

Table 6. Three Categories of Bond Forfeiture.

Source: DEP, Office of Active and Abandoned Mine Operations

	Pre-Primacy	Primacy ABP	Primacy Conventional Bonding
Surface Mines	810	377	84
Surface Mines Reclaimed	544	371	65
Surface Mines with Discharges	93	65	4
Coal Refuse Disposal	5	0	24
Coal Refuse Disposal Reclaimed	5	0	19
Coal Refuse Disposal with Discharges	0	0	11
Deep Mines	9	0	48
Deep Mines Reclaimed	9	0	41
Deep mines with Discharges	0	0	9
Prep Plants	1	28	2
Prep Plants Reclaimed	1	26	2
Prep Plants with Discharges	1	13	0

(Note-The pre-primacy sites had different levels of bonds posted. In some cases, there were no bonds posted based on the status of these programs at that point in time. Unlike today, prior to primacy in 1982, the coal mining activities were being permitted by different programs within DEP (i.e., Surface Mining (Mining and Reclamation), Underground Mining (Water Quality), Coal Refuse (Land Protection/Solid Waste), and agency programs that had their own roles as part of the permit process from encroachments, dams, wetlands, water quality, mine safety.)

With the primary emphasis is on addressing alternative bonding sites, DEP is providing treatment on 65 of the 73 sites. Work is underway to address the remaining sites with discharges.

DEP has 63 fully funded trust funds covering discharges for 131 permits. It should be noted that in most of these cases, the company establishing the trust fund is providing the treatment, as these sites would not be part of the bond forfeiture program. There are 15 trust funds that are partially funded with the operator continuing to fund the trust based on a payment schedule.

If a company fails to treat or ensure that the trust is fully funded, DEP will initiate steps to forfeit the trusts and/or direct the trustee to continue to provide the financing for the required treatment.

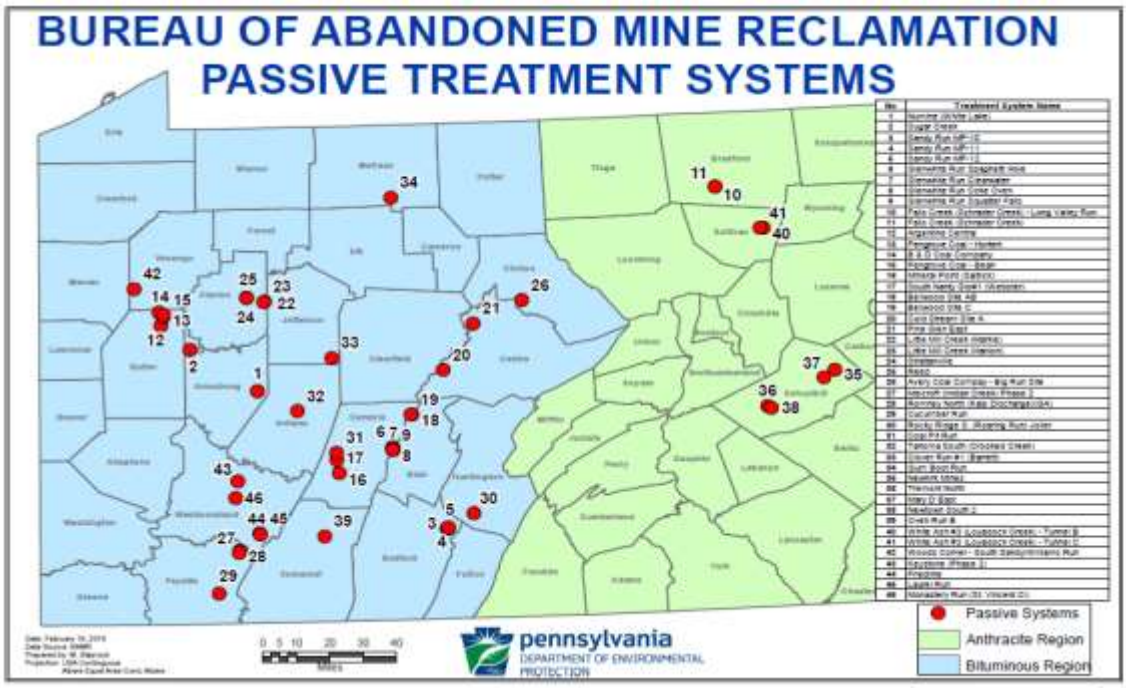
The trust was designed to provide a mechanism for both the operator and DEP to have a source of funds that paid for the long-term cost of treatment. A trustee's sole purchase purpose is to manage the investment and to provide the funds from the trust for the required water treatment. The trust funds have a built-in hedge of 116 percent of the project cost of treatment to be considered fully funded.

Another critical component of the present are the various mine drainage treatment systems that been constructed to treat and/or ameliorate the impacts of mine drainage on water quality. These systems have been established by DEP, non-profit organizations, and industry. These systems have helped improve the water quality of streams previously impacted by mine drainage.

According to an inventory of AMD treatment projects compiled by Datashed[87], Pennsylvania has over 325 passive treatment systems and at least 15 active publicly-funded systems. These systems are treating billions of gallons of water, reducing the pollution loads of metals and acid to the steams. (Through integrated land reclamation and installations of treatment systems, the water quality in many streams has been improved or restored.) Many, if not most, of the passive treatment systems have been built by watershed associations.

DEP Bureau of Abandoned Mine Reclamation (BAMR) and District Mining Offices (DMO) constructed 46 of these passive treatment systems (4 in the Anthracite Region) and continue to monitor them (for various reasons - Figure 15). They have nine active AMD treatment plants with one in the anthracite region that they treat with set-aside money from the AML Trust Fund and seven more in the planning stages (Figure 16).

Figure 15. DEP Abandoned Mine Reclamation Passive Treatment Systems



[87] Datashed, Stream Restoration Incorporated (SRI)
https://www.datashed.org/

Figure 16. DEP Abandoned Mine Reclamation Active and Planned Treatment Plants

The Good Samaritan Act

Pennsylvania's Good Samaritan Act[88] has provided a mechanism to allow non-profits to support AML reclamation projects.

Pennsylvania is extremely fortunate to have numerous non-profit organizations such as the Eastern Pennsylvania Coalition for Abandoned Mine Reclamation (EPCAMR), Western Pennsylvania Coalition of Abandoned Mine Reclamation (WPCAMR), Foundation of Pennsylvania Watershed Associations, and watershed associations working with the conservation districts, government (local, county, state and federal), industry, along with the inter-state river basin commissions, as well as our state legislators and the Pennsylvania Congressional Delegation in addressing the impacts of mining in the watersheds and their local communities.

These groups' assistance includes but is not limited to:

- Playing a major role in reducing impacts of AMD on water quality through the development, construction, and operations of passive treatment systems that reduced the pollution load of these discharges resulting in the improvement of the water quality in streams where the discharges are located.
- Playing a major role to ensure that the federal AML Program was extended in the past and are now playing a major role in obtaining another extension to continue funding of the AML Trust Fund.

[88] Pennsylvania DEP, Good Samaritan Act https://www.dep.pa.gov/Business/Energy/OilandGasPrograms/OilandGasMgmt/LegacyWells/Pages/Good-Samaritan.aspx

- Working to secure funding through grants and donations allowing them to focus on improving the health of the watersheds.
- Supporting and developing concepts to generate revenue streams that can be used for addressing mining related problems or the use of the water in mine pools as economic development tools.
- Leading the efforts to extend the federal AML Trust and the reclamation fees.

These groups have been able to obtain Growing Greener grants for environmental projects and other grants at the state level. These groups are keys to addressing legacy mining issues.

These groups have developed in excess of 300 passive AMD treatment systems that have improved the pH and lowered the acidity through simple alkaline addition systems to more complex designed wetland treatment systems that reduced the metals loading, improved pH and lowered the acidity that were associated with past abandoned mining operations.

The Coal Industry

With a viable and substantial coal industry, Pennsylvania has been able to address a small portion of its AML Program through its mining regulatory program and its AML programs.

The coal industry has conducted remining operations of previously impacted mine lands, and in the process, have reclaimed these properties and have ameliorated AMD emanating from portions of these sites. Further, members of the coal industry had funded Mine Drainage Treatment Trusts related to sites that will or have polluted discharges that require long-term treatment.

In addition, the coal industry, in developing coal mines where the new mine will be dewatering abandoned mines with discharges to surface waters of the commonwealth, have developed a program to build long-term treatment facilities funded through a charge based on tons of coal produced so that when they stop mining, the state will be able to provide for long-term treatment of the pre-existing discharges.

The Waste Coal Industry

The waste coal industry is a subset of the coal industry and has played a major role in addressing the environmental issues related to un-reclaimed coal refuse sites (coal refuse, coal slurry, gob, culm). This industry has delivered the fuel to the waste coal power plants with air pollution controls that minimized the impact of their emissions by controlling sulfur dioxide (SO2), nitrogen oxides (NOx), and particulate matter (PM), and are low emitters of mercury.

The low British Thermal Unit (BTU), high ash fuel contains wide ranges in sulfur content based on its source being anthracite coal or bituminous coal. The waste coal, along with limestone, is burned in a Fluidized Bed Boiler that has baghouses controlling the PM emissions, and uses combustion controls, or combustion controls along with selective non-catalytic reduction systems to control NOx emissions.

These waste coal plants, together, have consumed over 210,000,000 tons of coal refuse, have used the alkaline ash as part of the remediation and reclamation of the sites, and improved hundreds of miles of AMD-impacted streams, as well as reclaimed thousands of acres of mine land.

Examples of Industry Lead Water Improvements

Coal Industry and Abandoned Deep Mine Discharge

EPA identifies one project and describes a consent order and agreement between DEP and Rosebud Mining as "Actions Eliminate Long-Time, Major Acid Mine Discharge."[89] EPA wrote:

> *An innovative cleanup project has eliminated a decades-long, 3,000-gallon-a-minute acid mine discharge to the Little Conemaugh River in Pennsylvania's Cambria County.*
>
> *Stark before-and-after photos* [Figure 17] *show the immediate benefits of an operation to halt pollution that had poured untreated from the abandoned St. Michael mine shaft since the early 1960s – enough to fill a pro football stadium more than 100 times. Waters that had flowed orange were soon near-clear.*
>
> **Figure 17. The Little Conemaugh River Before and After the Cleanup Effort.**
>
> **Photo Credit: Rosebud Mining Company**
>
> 
>
> *The EPA Mid-Atlantic Region's Office of NPDES Permits and Enforcement worked with the Pennsylvania Department of Environmental Protection (DEP) on a 2012 permit allowing Rosebud Mining Co. to pump and treat water from the mine pool as part of the company's proposal to gain access to underlying coal reserves. The permit – the first of its kind in Pennsylvania – requires the company to document that its treatment activities are improving water quality.*
>
> *Under a related Consent Order and Agreement between DEP and Rosebud, the company built a $15 million wastewater treatment plant next to the St. Michael shaft in 2013 to treat the polluted mine water. Rosebud also agreed to make annual payments to a special trust fund to permanently pay operation, maintenance, and other costs for the plant once mining is done.*
>
> *The actions support a Total Maximum Daily Load (TMDL) for the Kiskiminetas-Conemaugh watershed.*
>
> *The DEP had estimated that the St. Michael discharge was responsible for 3,700 tons of acid mine drainage (AMD) each year - nearly a third of the AMD pollution impacting the Little Conemaugh River, which runs into the Conemaugh, Kiskiminetas and Lower Allegheny rivers as the water moves downstream to Pittsburgh.*
>
> *District Mining Manager Joel Koricich of DEP's California District Mining Office said the project will yield "phenomenal" reductions in pollution – 1.7 million tons of iron alone. Iron loads are expected to drop by 98 percent, aluminum by 100 percent and manganese by more than half.*

[89] United States Environmental Protection Agency, Actions Eliminate Long-Time, Major Acid Mine Discharge https://www.epa.gov/pa/actions-eliminate-long-time-major-acid-mine-discharge

"There was a win for everybody," he said. "It was really quite exciting to see a 3,000-gallon-a-minute discharge dry up almost instantaneously after almost 50 years of flowing and polluting the streams. Hopefully, this builds momentum to where other major discharges in the area are taken care of similarly. We took care of the biggest one first."

Indeed, DEP, in cooperation with the federal Office of Surface Mining Reclamation and Enforcement, is discussing plans to build a mine water treatment plant to process three other significant sources of AMD to the Little Conemaugh, leading to potential restoration of cold and warm water fisheries along sections of the river.

The waste coal industry is tied to the Public Utility Regulatory Policies Act of 1978 (PURPA) plants that obtained a power sales agreement from the local utilities. These plants became "Qualifying Facilities." Some plants were classified as cogeneration facilities and other plants were classified as small power production facilities. The technology employed by these plants had several things in common: utilized fluidized bed combustion technology; used limestone injected into the boiler to control SO2 emissions; had baghouses designed to control particulate emissions; and either used combustion air and/or selective non-catalytic reduction to control the unit NOx emissions.

These facilities used waste coal (aka coal refuse, coal slurry, culm, gob, and a variety of other names). The waste coal had low BTUs (3,500 to 8,000 BTUs/pound), high ash (30 percent to 60 percent), and a wide range in sulfur pending the quality of the coal that was mined (0.5 percent to 7.5 percent).

Most of the waste coal sites that were mined had polluted discharges associated with the waste coal placed on the property. The companies mining the coal refuse developed mining plans, abatement plans to improve the quality of the discharge from the sites, and the reclamation of the sites. A key aspect of these plans was the beneficial use of fly ash in reclaiming the sites and ameliorating AMD by reducing the pollution load, improving the overall water quality in the steam.

A report entitled "Reclamation of Refuse Piles using Fluidized Bed Combustion Ash in the Blacklick Creek Watershed, Pennsylvania"[90] was prepared by Gregory Aaron, Rock Martin, and Gregory Greenfield (DEP's active mining program) which includes a study of five sites. The study concluded that the mining and operation reclaimed these sites and significantly reduced the pollution load to Blacklick Creek.

The five sites included in the study (listed in the order that they were permitted) were (Figure 18):

- Revloc #1 (Surface Mining Permit No. 11880201)
- Colver (Surface Mining Permit Nos. 11900201 & 11970201)
- Revloc #2 (Surface Mining Permit No. 11960202)
- Nanty Glo West (Surface Mining Permit No. 11020202)
- Nanty Glo East (Surface Mining Permit No. 11070202)

Four of the sites were associated with Ebensburg Power and the other (Colver) was operated by Maple Coal Company. The sites ended up being reclaimed and the mining, beneficial use of the ash, and the reclamation significantly reduced the pollution load to Blacklick Creek (Table 7).

[90] Blacklick Creek Watershed Association, Technical Documents and Reports https://blacklickcreekwatershed2.files.wordpress.com/2018/11/reclamation-of-refuse-piles-using-fluidized-bed-combustion-ash.pdf

Figure 18. Study of Five Sites from "Reclamation of Refuse Piles using Fluidized Bed Combustion Ash in the Blacklick Creek Watershed, Pennsylvania"

REVLOC before

COLVER before

REVLOC after – Photo source: Google Earth

COLVER after

Nanty Glo East before

Nanty Glo West after

Table 7. The Total Reduction of Loading to the Blacklick Creek Watershed

	Total Average Baseline Loading	Total Average Recent Loading	Total Reduction	Percent Reduction
Acidity (kg/day)	4,826	204	4,622	96
Iron (kg/day)	1,016	11	1,004	99
Aluminum (kg/day)	467	26	441	94
Manganese (kg/day)	23	3	20	87
Sulfate (kg/day)	3,789	689	3,100	82

Regional/Centralized Water Treatment

As part of the AMD set-aside of a portion of the AML grants, DEP has looked at consolidating discharges from multiple AMD discharges and bring those discharges to a centralized AMD treatment facility.

The Susquehanna River Basin Commission (SRBC) has recommended that in the anthracite area, DEP look at managing discharges from different mine complexes and bring the discharges to a centralized treatment plant by either piping the discharge or using the mine pools to convey the water to the centralized treatment plant.

The following is an overview of SRBC recommendations regarding the anthracite coal region and the Bennett Branch of the Sinnemahoning Creek of the Susquehanna River, where DEP constructed a treatment plant and piped 21 discharges to the centralized treatment plant.

Anthracite Regional AMD Treatment -- Example

SRBC (Report No. 279, published December of 2011) published a report "Anthracite Region Acid Mine Drainage Remediation Strategy"[91]. SRBC conducted a comprehensive study of the four different anthracite fields in Pennsylvania. The purpose of the study was to examine the impacts of mining on the water quality of the Susquehanna River. There is over 517 square miles of the anthracite area within the Susquehanna River Basin and the AMD has impacted 534 miles of surface water. The impact of AMD discharges varies from one area to another.

In 2009, a partnership emerged between SRBC and EPCAMR, particularly considering EPCAMR's Anthracite Region Mine Pool Mapping Initiative in the Western-Middle Field. The two organizations began sharing data, which proved beneficial to both parties in their project endeavors. That partnership endures as both agencies work together to implement the restoration strategy and continue the mine pool mapping effort in the other anthracite coal fields.

Based on this effort, the SRBC identified their top-20 prioritized discharges within the Anthracite Region of the Susquehanna River Basin and their separated pollution contribution percentage identified in Table 8.

[91] Susquehanna River Basin Commission, Anthracite Region Mine Drainage Remediation Strategy https://www.srbc.net/our-work/reports-library/technical-reports/279-anthracite-mine-drainage-strategy/docs/anthracite-mine-drainage-strategy.pdf

Table 8. Top 20 Prioritized Discharges within the Anthracite Region of the Susquehanna River Basin and their Separated Pollution Contribution Percentages.

Source: Susquehanna River Basin Commission

Discharge	Field	Watershed	Flow %	Fe Load %	Mn Load %	Al Load %	Acid Load %	Loading Average %
Jeddo Tunnel	Eastern-Middle	Nescopeck Creek	9.78	3.45	11.30	42.92	13.41	17.8
Old Forge Borehole	Northern	Lackawanna River	11.45	16.78	13.36	1.87	2.49	8.6
Nottingham-Buttonwood Airshaft	Northern	Solomon Creek	4.60	7.85	5.22	0.53	7.40	5.3
Solomon Creek Boreholes	Northern	Solomon Creek	4.70	9.07	4.77	0.34	4.30	4.6
Gowen Tunnel	Eastern-Middle	Nescopeck Creek	3.00	0.19	4.50	10.46	3.76	4.7
Duryea Breach	Northern	Lackawanna River	4.17	7.40	5.72	0.42	0.88	3.6
Audenreid Tunnel	Eastern-Middle	Catawissa Creek	3.00	0.26	2.05	9.56	8.75	5.2
Packer #5 Breach and Boreholes	Western-Middle	Mahanoy Creek	3.04	3.72	6.07	0.08	2.54	3.1
Gilberton Pump	Western-Middle	Mahanoy Creek	2.18	4.65	5.11	0.63	1.72	3.0
Centralia Tunnel	Western-Middle	Mahanoy Creek	1.27	0.49	2.48	3.76	2.54	2.3
Dundee Outfall	Northern	Nanticoke Creek	0.72	4.50	0.92	0.00	2.89	2.1
Derringer Tunnel	Eastern-Middle	Nescopeck Creek	0.78	0.04	1.09	2.82	1.16	1.3
Mocanaqua Tunnel	Northern	Susquehanna River	0.62	2.02	1.85	1.48	3.64	2.2
Porter Tunnel	Southern	Wiconisco Creek	0.17	0.82	0.34	2.03	1.40	1.1
West Penn Breaker Plant Discharge	Western-Middle	Mahanoy Creek	0.27	0.96	0.75	1.71	0.40	1.0
Jermyn Slope	Northern	Lackawanna River	2.72	0.25	0.31	0.12	0.27	0.2
Doutyville Tunnel	Western-Middle	Mahanoy Creek	1.49	0.47	0.88	1.54	1.07	1.0
Continental Plant Bypass	Western-Middle	Mahanoy Creek	1.48	1.36	3.00	0.18	1.80	1.6
Susquehanna #7 Shaft	Northern	Newport Creek	1.43	3.30	1.70	0.23	0.49	1.4
Plainsville Outlet	Northern	Susquehanna River	0.69	2.41	0.62	0.14	2.08	1.3
		Total %	57.6	70.0	72.0	80.8	63.0	

Based on the top 20 discharges, SRBC developed a conceptual strategy by approaching the discharges on a watershed by watershed basis for water treatment:

Conceptual Plant #1 – Lackawanna River
Conceptual Plant #2 – Solomon Creek
Conceptual Plant #3 – Nanticoke
Conceptual Plant #4 – Jeddo Tunnel
Conceptual Plant #5 – Black Creek
Conceptual Plant #6 – Catawissa Creek
Conceptual Plant #7 – Mahanoy Creek Plant #1
Conceptual Plant #8 – Mahanoy Creek Plant #2
Conceptual Plant #9 – Mahanoy Creek Plant #3
Conceptual Plant #10 – Mahanoy Creek Plant #4
Other Conceptual Plants – Jermyn Slope, Mocanaqua Tunnel, Porter Tunnel, Plainsville Outlet

It should be noted that the conceptual plans included moving water from one mine pool complex to another thus reducing the number of treatment plants as well as piping water from multiple mine discharges to a treatment plant.

Bituminous Regional AMD Treatment - Bennett Branch Sinnemahoning Creek Watershed: An Example

Figure 19. Bennett Branch of the Sinnemahoning Creek, a Tributary to the Susquehanna River. Source: DEP Bennett Branch Study

Bennett Branch is located in northwestern Pennsylvania and the Susquehanna River's West Branch watershed. Many of its tributaries hold wild populations of brook trout, the state fish. It's mostly surrounded by public lands in the heart of elk country. The only problem was that, until recently, the lower 33 miles of the stream were dead from uncontrolled, untreated AMD. Prior to the project this water ran red (Figure 19).

It took a public-private partnership to restore the 33 miles impacted by untreated AMD. The state, private groups, and coal companies forged a partnership to address the situation. As part of this effort, a Total Maximum Daily Load (TMDL) was developed for the watershed. The United States Army Corp of Engineers was involved in operation and maintenance plans for two large vertical flow passive treatment systems for Dents Run (3888 and 3893). A third passive treatment system was also installed in Dents Run (3895). In addition, a dosing unit (to provide calcium to help neutralize surface water) was located on David's Run.

The most critical facility constructed was the state-of-the-art Hollywood Treatment Plant. The Hollywood Treatment Plant was a centralized plant to treat AMD from over 21 sources. Pipelines (totaling nearly 3.5 miles) were constructed to convey 21 discharges to the Hollywood Treatment Plant.

There were at least 37 different projects involved in this effort, including removal of coal refuse from the watershed to be used as fuel in a waste coal power plant, surface reclamation by coal companies, and the installation of four passive treatment facilities and one plant (Hollywood Treatment Plant) designed to chemically treat AMD.

The Future

The future is the unknown. The consolidation of the coal industry, the bankruptcies of coal companies that have occurred, are occurring, and will probably occur in the future, with the push to produce a *"net decarbonization of the grid"*, all place increasing economic strains on the coal industry. Of note is the G7[92] resolution to stop funding coal fired power plants. Companies that provided insurance coverage to the coal industry or who underwrote surety bonds are leaving the marketplace and finding companies to provide the insurance or the surety bonds is becoming more difficult. In many cases, companies are having to use their lines of credit or use cash to provide bond coverage.

[92] The Group of Seven (G7) is an inter-governmental political forum consisting of Canada, France, Germany, Italy, Japan, the United Kingdom, and the United States
https://en.wikipedia.org/wiki/Group_of_Seven

Pennsylvania has seen a steady decline in the amount of coal being mined annually. One major reason for this decline is tied to the closing of coal fired power plants. There are several reasons for this decline:

A. The Shale Gas Revolution (For Pennsylvania, its availability and costs are now making it more competitive than coal).

B. The Shale Gas Revolution has led to the development, construction, and operations of large gas combined cycle power plants (more economical to build and operate).

C. The environmental regulations related to air, water, and residual waste increase the operating costs of a coal fired facility. (Further Title V fees related to emissions are also impacting coal plants.)

D. The efforts to develop renewable energy projects take away capacity from coal plants.

E. Greenhouse gas emissions and potential carbon taxes are also having an impact.

As such, the coal industry is undergoing a major shift with its marketplace for power generation steadily declining and the use of gas in Electric Generating Units (EGUs) switching to gas by non-EGU industrials.

Nationally, there has been an increase in bankruptcy filings by coal companies. Companies are selling off their coal related assets and exiting the coal business. This is further impacting the underwriting of insurance and surety bonds for coal companies. The lack of sureties has resulted in many companies having to use more capital for bonding.

There are several areas of concerns relative to the future. First, companies are no longer viable and stop doing the reclamation, resulting in DEP forfeiting the reclamation bonds. While this may be a problem, Pennsylvania's Full Cost Bonding Program should result in the required amount of bonding needed to reclaim the sites.

The second area of concern is ensuring that the long-term treatment trust funds are used specifically for the treatment of AMD. While the water treatment trusts were funded by companies, the funding was to be used to pay for the post-mining treatment operations with the funds being made available to the company funding the trust, a successor to that company, the commonwealth, or to a third party hired to treat the water. Water treatment trusts are designed to ensure moneys are available for long-term water treatment. The specific purpose of the water treatment trust funds is to provide a funding mechanism for the treatment of the discharges. The funds were not designed to pay for administrative costs to process permits. Further, expenditures of moneys from the trust are approved by DEP.

The third area of concern relates to the treatment facilities that DEP placed into operation or the passive treatment systems established by Good Samaritans (i.e., EPACAMR, WPCAMR, watershed associations and other non-profits). In many instances, the passive treatment systems have been paid for by the commonwealth through grants to the non-profit organizations or from fund raisers of the non-profits. The problem here is ultimately taking steps to ensure long-term funding while funds are available. Funding is a concern if federal funds are no longer available.

AML Funding

With demand for coal being reduced, coal sales are dropping. As coal sales drop, the revenues to the AML Trust Fund through reclamation fees is decreasing making less money available to the AML Program.

AML grants have been critical to Pennsylvania being able to address its pre-1977 AML problems. Industry, through remining, has played a major role in addressing part of the problem. However, from a water quality perspective, it is the AMD set-aside of 30 percent of the AML grant moneys to the state that is used to address AMD problems. In addressing the AMD problems, the moneys have been used to design construct and operate passive and active (chemical) treatment systems.

AML Funding Concerns

The extension of the AML Trust Fund, along with continuing the reclamation fees tied to coal production is a necessity. Further, an additional appropriation of $11,293,000,000 authorized under the 2021 bipartisan Infrastructure Investment and Jobs Act will be made into the AML Trust Fund by 2022[93]. This is in addition to moneys presently in the fund and revenues from future payment of reclamation fees.

DEP along with the watershed associations, EPCAMR and WPCAMR, the Legislature, conservation districts and others should continue to work to achieve reauthorization of the fund now but also in the future.

Treatment Facilities Designed, Constructed and Operated using AML Funds

The funding of these facilities for operation, maintenance, and capital replacement is a critical element. There needs to be moneys set aside and invested for each facility (including the facilities developed by Good Samaritans) to ensure long-term treatment. Ideally, the funds would be invested in a manner like the long-term treatment trusts of the active coal companies. When looking at the facilities identified in datashed.org regarding AMD treatment plants (passive and active), over $270 million will be needed over the next 20 years. Finding a long-term source of funding for operation, maintenance and repair is critical to ensure long-term water quality improvements continue after other funding sources disappear.

Active Coal Industry

Pennsylvania's bonding program is basically two bonding programs tied together. The physical reclamation of the site is covered by its full cost bonding program which is constantly being evaluated to ensure that the fee rates for bonds being charged to ensure reclamation is adequate on a unit basis. For sites that may have or will have a polluted discharge, DEP has established an alternative bonding system that relies on the coal company fully funding a water treatment trust where the revenues to the trust can be used to provide payment for the treatment of AMD. DEP has integrated key checks and balances in the trust to cover the annual treatment costs. The trustee for the water treatment trust that is fully funded for a specific site invests the moneys to obtain a return on investment and ensures the balance is 116 percent of the trust calculation for operation, maintenance, and capitalization of future plant replacement and upgrades. Further, DEP is in control of the fund as they are the only party who can authorize expenditures from the fund per the agreements used to establish the funds.

[93] 30 USC Ch.25: SURFACE MINING CONTROL AND RECLAMATION, From title 30- MINERAL LANDS AND MINING https://uscode.house.gov/view.xhtml?path=/prelim@title30/chapter25&edition=prelim

Concerns Regarding the Water Treatment Trust Funds

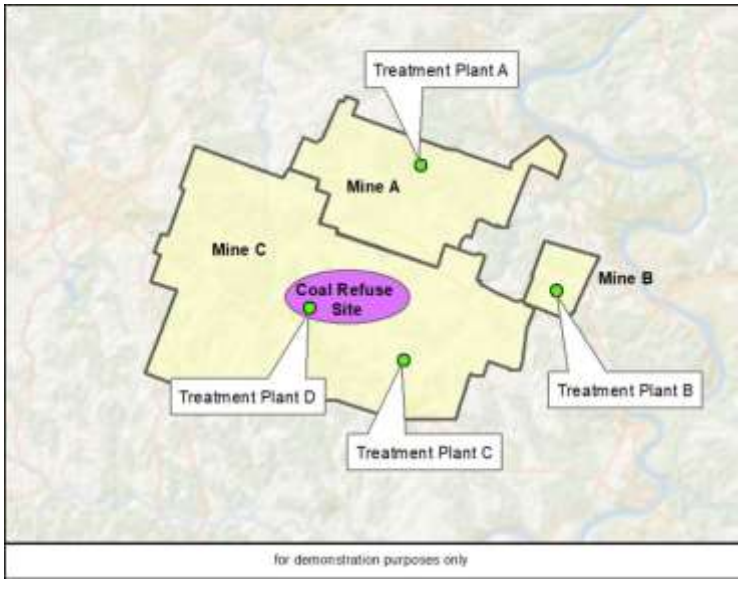
As the coal industry continues to downsize and companies disappear, the water treatment trust funds will be expected to continue to cover the costs of water treatment. As such, there are several action items that DEP should undertake to protect the trust fund assets and their expenditures. The funds need to be used for water treatment and not for administrative costs of the National Pollutant Discharge Elimination System (NPDES) permitting program. Further, DEP should set the long-term treatment obligations, which are generally set forth in the Consent Order and Agreement.

Integrating AMD Treatment of Discharges Associated with Trust Funds into Regional Treatment Facilities

Treatment trust funds provide long-term revenue to operate AMD treatment facilities where a party has been deemed responsible for the discharge. The trusts are designed such that the return on investments are greater than the cost of treatment increased by inflation. Language in the trusts anticipate that a company that funded a trust will still be around and viable, but in today's anti-carbon/anti-fossil fuel climate, this may not be the case.

It is recommended that DEP look at areas where there are multiple trust funds associated geographically in the same area as the mines (especially where underground mines are located). By interconnecting these mines and discharges hydrologically, the water pumped and being treated would ensure that multiple polluting discharges would be controlled by pumping from a centralized point and treated. The key is that the approach is technically viable and offers a long-term economic solution. The economic solution achieved is through consolidating the revenues from the multiple trust funds and extending the life of the trust fund by increasing the overall revenues and having the overall costs reduced. Assuming the economic and technical aspects of the regionalization works, then legal concerns may need to be addressed. The key is ensuring that there are revenues to provide for continued long-term treatment when there is no source of new contributions to the trust funds.

Figure 20. Example for Centralized Treatment Plant



Example

Consider an example for which there are several underground mines and coal refuse sites overlying these mines (see Figure 20). Each of these mines and coal refuse sites have fully funded trusts. The mines are hydrologically connected, and one can design a low cost system to move the water from one mine to another where it can be treated as a single point (via breaching the barriers to allow for more easier flow, install siphons to move water from one mine to another, or to pump from one mine to another). The mines extend across multiple drainage basins. The drainage from the coal refuse sites can be injected into the underground mine beneath it. This mine water would flow to the centralized treatment plant. While the map shows a limited number of mines, it could be less or more.

Also, this approach in conjunction with AMD from mines that have no responsible party for treatment, could allow AML and trust fund moneys to be used to provide even more effective long-term treatment strategies and lower overall costs of treatment. Also, there may be cases where mines are being treated resulting from an issue not associated with the past mining but where coal ash and other related waste may have been discharged into the mine.

This example illustrates a condition where establishing the concept of regional AMD treatment plants may be realistically applied. At actual sites, conditions should be fully evaluated. Ensuring adequate funding is paramount for long-term water treatment, especially when a company is no longer economically viable and no longer in the coal mining business. An approach would be to first determine the technical and economic viability of such projects. If viable, then work through any legal concerns without impacting prior legal precedents. It may prove beneficial in providing long-term water treatment including adding other abandoned mines along with a trust fund to maintain.

Appendix D-2 Overview of the Oil and Gas Industry – The Legacy Well

History

Brine Wells (with undesirable byproducts)

Brine seeps in Pennsylvania and surrounding areas have been used as a source of salts since prehistoric times. Brine was utilized by the white settlers from the second half of the eighteenth century on.

In the early 1800's, wells were dug and later drilled for brine production. In 1802, a 58-foot well was drilled using a spring pole in the Kanawha Valley of West Virginia by the brothers David and Joseph Ruffner to produce brine. The well took 18-months to drill. In 1815, a brine well in West Virginia first started to exploit natural gas.

In 1815, oil is produced in the United States as an undesirable byproduct from brine wells in Pennsylvania. Seeping petroleum plagued salt well operators as it frequently came to the surface with salt brine. In 1852, Samuel Kier and his father owned salt wells near Tarentum, PA, which produced a large quantity of oil along with the desired brine. Kier found that the oil associated with the brine from his operations was like "American Medicinal Oil" and marketed it as medicinal oil under the name of Keir's Petroleum and Rock Oil. The amount of oil produced from his brine operations was more than he could market the oil as medicinal. Working with Professor James Curtis Booth, Franklin Institute of Pennsylvania, they built a distillery to produce "carbon oil" to be marketed in the region[94].

Drilling for Oil

The Drake Well

In 1859, Colonel Edwin Drake drilled the first domestic commercial oil well, which was located in Cherry Tree Township, Venango County, Pennsylvania. The well was located along the banks of Oil Creek and was drilled to a depth of 69.5 feet.

Pithole (aka Pithole City) is another historic oil and gas location in the commonwealth. Currently a ghost town located in Cornplanter Township, Venango County, Pennsylvania, the area is about six miles from the Drake Well. Pithole's sudden rapid growth and rapid decline was tied to it being a proving ground for a new petroleum industry, making it one of the most famous oil boomtowns.

After the Drake Well

Since the first commercial oil well was drilled in Pennsylvania in 1859, it is estimated that as many as 300,000 to 760,000 oil and gas wells have been drilled in the state. A significant number of these wells were drilled prior to modern well permitting and plugging requirements, and it is estimated that somewhere between 100,000 and 560,000 oil and gas wells remain unaccounted for in state records. Historical plugging practices and materials used have not always been adequate to ensure protection of the commonwealth's water resources. As a result, a significant number of wells still pose a potential threat to human health and the environment.

The following photo provides an example of numerous historical wells drilled in a close area (Figure 21).

[94] American Chemical Society, Development of the Pennsylvania Oil Industry
https://www.acs.org/content/acs/en/education/whatischemistry/landmarks/pennsylvaniaoilindustry.html

Figure 21. Example of Historical Wells -Frick/Carnegie Library of Pittsburgh

Oil and Gas Well Permitting

From 1859 through the early 1950s, there were limited regulations addressing drilling, location and decommissioning/plugging of wells. As a result of the Gas Operations Well-Drilling Program Petroleum and Coal Mining Act (1955 Act), the Oil and Gas Division was organized within the Pennsylvania Department of Mines and Mineral Industries on February 1, 1956.The division tracked wells being drilled throughout the commonwealth and required permits for wells drilled in coal areas. Also, the Oil and Gas Conservation Act of 1961 (Act of 1961) promoted spacing of wells penetrating the Onondaga Horizon to a depth of 3,800 feet. This resulted in wells affected by the Act of 1961 to be permitted. As well as permitting and tracking wells, the Oil and Gas Division carried out inspections of wells being drilled.

The Oil and Gas Act of 1984 required well operators to register all known oil and gas wells, which had not been registered under previous law. A 1992 amendment to the Oil and Gas Act allowed the Department of Environmental Resources (now the Department of Environmental Protection (DEP)) to designate an abandoned well, with no identifiable owner/operator in the recent past and from which no economic benefit was earned after April 18, 1979, as an "orphan well."

"Legacy Well" is a general term used to describe a well which was drilled and abandoned historically and for which there is no current responsible party. The number of the legacy wells are estimated to be in the hundreds of thousands and have been drilled across the commonwealth. These wells were abandoned without being properly decommissioned. Without proper abandonment, wells have the potential to contribute to health, safety, environmental, and financial impacts. As such, as soon as a well is discovered, it is important to notify DEP. Upon discovery, it is also important not to touch or make any modifications to any component of the well, as doing so may increase the risk of environmental impact and ownership responsibilities at stake.

Addressing legacy wells is a growing concern. While there has been a recognition of water quality problems and public safety risks associated with some legacy wells, other more recent concerns are tied to climate change resulting from the methane emissions and potential economic impacts as part of efforts to address climate change.

There are three critical elements regarding legacy wells as well as active or inactive wells. They are:

1. Accurately identify the locations of the wells.
2. Define any impacts to human health and safety, and the environment, to prioritize actions needed to correct the problem and/or properly managed (decommission/plug) the well; and
3. Take the appropriate corrective action on a timely basis.

The fundamental issue is supporting sustainable funding to support these activities for legacy wells where there is no associated responsible party.

Identification of Legacy Wells

Pennsylvania's oil and gas regulations require that operators identify existing wells within a 1,000-foot buffer zone surrounding unconventional wells. The rule requires operators to consult state well databases, company records, historic maps and photos, and landowner recollections to identify active wells, inactive wells, orphan wells, abandoned wells, and plugged wells within the 1,000-foot buffer zone. This effort will help contribute to knowledge regarding previously unidentified legacy wells. However, due to the footprint of current unconventional resource development, implementing these provisions may not successfully allow every well historically drilled in the commonwealth to be identified. Further, research conducted by the National Energy Technology Laboratory has found the following in relationship to historical oil and gas well drilling:

1. Well databases are nearly complete for wells drilled after 1955 (the year well locations started being recorded as part of the permitting process).
2. Location records for wells drilled before 1955 are less complete.
3. Airborne magnetic surveys for locating existing wells with steel casings is referred to as the gold standard – the technique's applicability to older wells is limited for a variety of reasons:
4. The casing is non-magnetic (wood) or weakly magnetic (cast iron).
5. The casing has been removed.
    a. Removed and used at another well site.
    b. Removed and the scrap metal was used to support war needs in the United States during World War 2.
    c. Coal mining activities could have resulted in known wells being mined through as well as abandoned unknown wells.

Today, additional concerns associated with the permitting aspects of unconventional wells are being driven by the leakage of methane and climate change. In concert with this, more attention is being directed to identifying abandoned, inactive, and orphan wells leaking methane gas. Active wells are or will be regulated for natural gas emissions going forward based on United States Environmental Protection Agency regulations.

Programs designed to locate oil and gas wells (active, inactive, abandoned, and orphan) are critical for managing risk. The wells have the potential to allow for the vertical migration of fluids (gas, oil, and brine) that can impact water quality and contribute to greenhouse gas emissions.

Numerous contemporary sensor technologies are being used to locate unmarked or unknown abandoned wells. Common tools include the use of airborne magnetic surveys (including drone deployment), LiDAR (Light Detection and Range-Remote) surveys and use of FLIR Technology (Forward Looking Infrared Technology). It should be recognized that if the wells are covered over, these technologies may only allow one to identify potential sites, but more on the ground investigation may be required to better define the actual well site. In the case of methane emissions associated with legacy wells, airborne surveys have also been challenged by the relatively low emission rates.

Prioritization

DEP has developed a matrix regarding prioritization of the environmental impacts caused by abandoned/orphan wells. In establishing prioritization for actions needed, the weighting of criteria to support these actions will most likely be dictated by the sources and amount of funding available to address the issue of decommissioning/plugging any given well.

This is an evolving issue and will most likely require input from various DEP programs.

Appropriate Corrective Actions

DEP should continue to take appropriate corrective actions addressing legacy wells based on their ongoing effort to properly manage/decommission/plug these wells. However, the magnitude of the potential problems (due to the sheer number of potential legacy wells) is very large in scope. The moneys available to take the appropriate corrective actions is small compared to what will ultimately be needed.