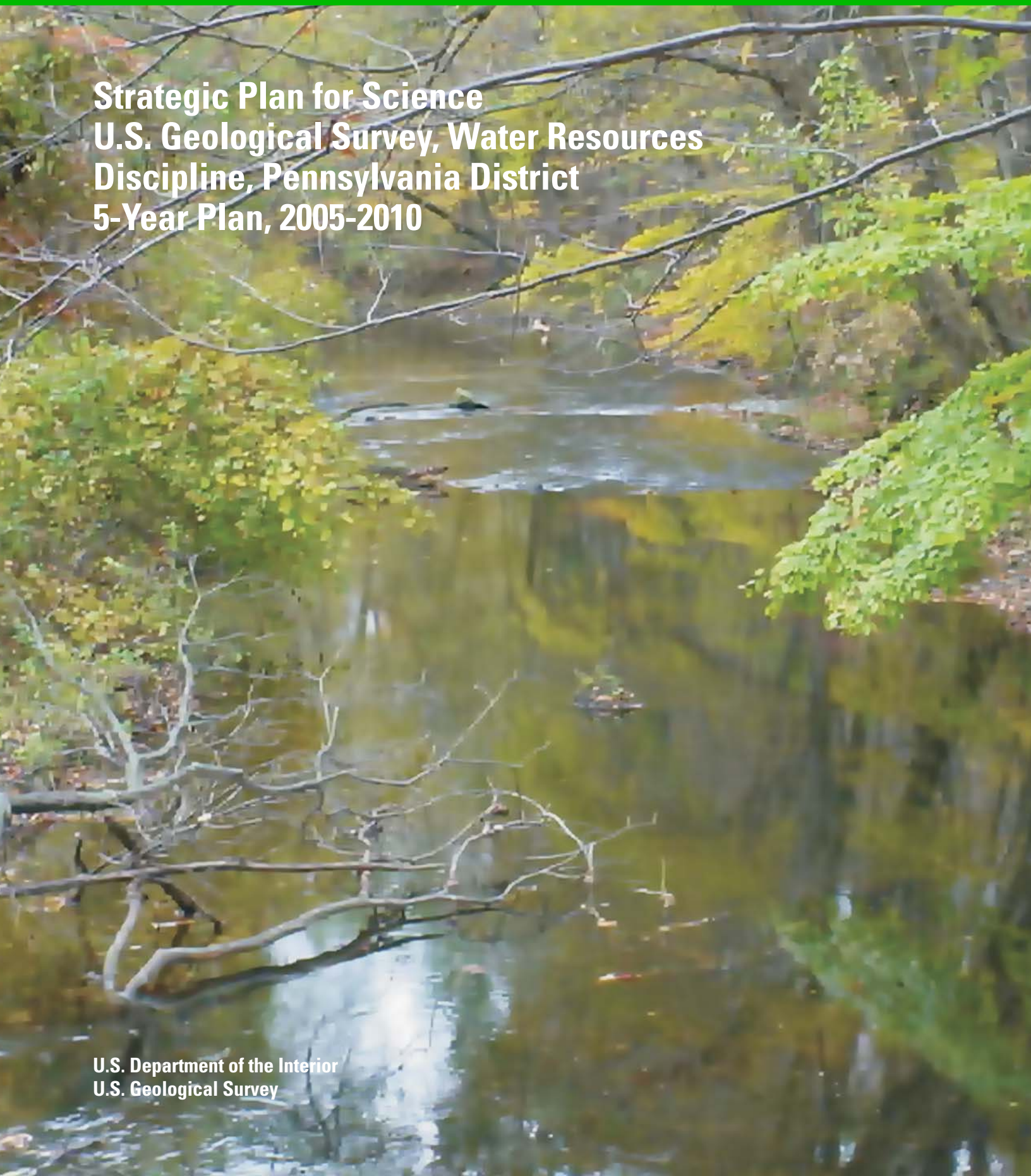
USGS
science for a changing world

Strategic Plan for Science
U.S. Geological Survey, Water Resources Discipline, Pennsylvania District
5-Year Plan, 2005-2010



U.S. Department of the Interior
U.S. Geological Survey

Strategic Plan for Science, U.S. Geological Survey, Water Resources Discipline, Pennsylvania District, 2005-2010

U.S. Department of the Interior
U.S. Geological Survey

U.S. Department of the Interior
Gale A. Norton, Secretary

U.S. Geological Survey
Charles G. Groat, Director

U.S. Geological Survey, New Cumberland, Pennsylvania: 2004

For more information about the USGS and its products:
Telephone: 1-888-ASK-USGS
World Wide Web: http://www.usgs.gov/

Contents

Strategic Plan for Science
U.S. Geological Survey, Water Resources Discipline, Pennsylvania District
5-year plan, 2005-2010

Introduction

The U.S. Geological Survey (USGS) Pennsylvania District Science Program is diverse and responsive to the scientific and technical needs of many constituencies in the Commonwealth as well as other Federal agencies. Primary factors that contribute to the diversity of the program are the range of natural-resource issues related to surface- and ground-water quantity and quality and a political system in which decisions are made at local, county, and state levels. The challenge to the District is to respond to the changing needs of our cooperators in a timely manner while maintaining a strong scientific program that best serves the Federal interest.

In order to accomplish these dual roles and remain financially viable, the District is implementing a Strategic Plan for Science that consists of two interrelated elements:

- Science Plan
- Guiding Principles

The overall Strategic Plan for Science guides the entire District program and outlines processes and actions needed for a successful technical program. The Strategic Plan is the result of a series of meetings with over 40 agency representatives convened between November 2003 and January 2004, where District customers, cooperators, and other agency representatives identified many scientific issues they felt the USGS could appropriately study to meet the USGS mission of advancing the science and developing new methodology while also meeting program goals and scientific needs of their agencies. Information from these meetings and input from USGS staff at the District, Regional, and Headquarters levels were used to develop the Strategic Plan for Science presented in this document.

The ***Science Plan*** identifies specific scientific and technical programmatic areas and issues important to Pennsylvanians and important nationally. It also identifies agencies with scientific interest in the program areas. The goal of the District Science Plan is to establish a multidisciplinary scientific and technical program that generates scientifically superior products meeting or exceeding our cooperator expectations while supporting the goals and initiatives of USGS. The Science Plan will be used to set the direction of new programs in the District and be used in future training and hiring decisions.

The current scientific and technical staff of the District has the skills needed for the successful implementation of the Science Plan. Continued training and strategic future hires in specific technical areas will enhance the current staff skills. The District staff is supplemented with USGS staff from the Geography (GeogD), Geology (GD), and Biological Resources (BRD) Disciplines, and other Water Districts (WRD) as needed to conduct multidisciplinary and regional studies. The locations of regional USGS offices are shown on the map on page 2. Additionally, when appropriate, the District staff will collaborate with scientists and water managers from other agencies, as well as academia and the private sector, to meet the objectives of the Science Plan.

The ***Guiding Principles*** identify elements needed to successfully meet our Science Plan goals and achieve the *District vision* of a technical program that addresses current and emerging water issues important to our customers. Although some issues may be controversial, the District program will remain unbiased and founded in accurate data collection and interpretation. The District vision is an interdisciplinary and broad-based program characterized by projects that are innovative and technically challenging. The District will produce high-quality products in user-friendly formats and in a timely manner.

The Pennsylvania District Science Plan

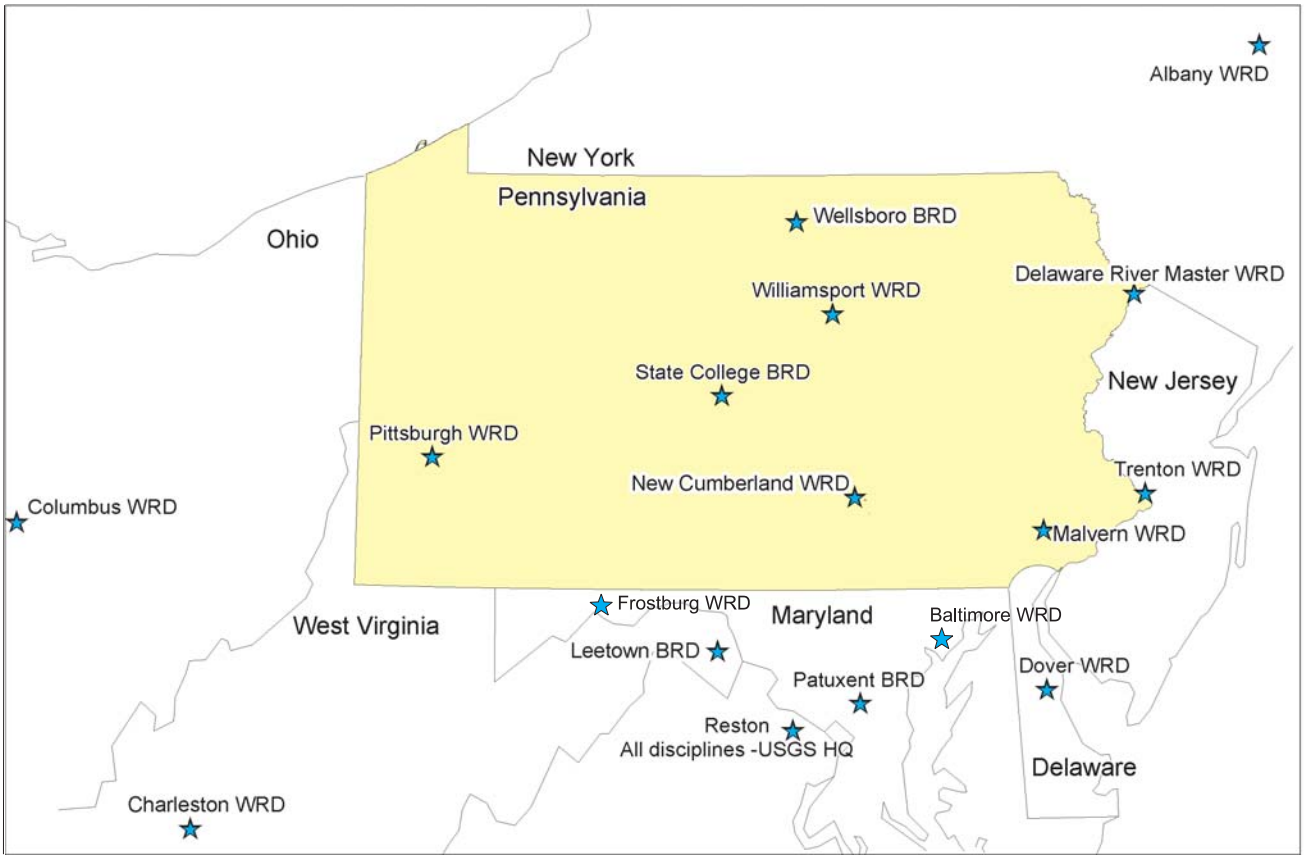
The Science Plan identifies specific scientific and technical programmatic areas and issues important to water managers in Pennsylvania, the surrounding areas, and the nation. The three broad programatic areas, with the recognition that all program areas are interrelated, are:

- Aquatic Ecosystems Program
- Hydrologic Systems Program
- Natural Hazards Program

Science Issues are identified within each of these Programs along with goals and strategies to help the District achieve the success envisioned for each program. A table of potential actions that could be taken to better meet specific scientific needs within the Commonwealth and important nationally also is included under each Science Issue.

Information gained through implementation of the Science Plan will be disseminated in a variety of ways. In addition to traditional written USGS reports and journal articles, a District goal is to develop tools and Web-based products that better allow others to readily use the knowledge gained through cooperative studies. The District also is dedicated to communicating our science to others through technical presentations, technical exchange, and training opportunities.

The Pennsylvania District Science Plan can only be successful through the cooperation and support of many others outside of the USGS. Agencies that may play a key role in helping the USGS achieve the goals of the Science Plan are identified within each Science Issue. Agency abbreviations used in this document can be found in Appendix 1.



Locations of Regional U.S. Geological Survey offices.

AQUATIC ECOSYSTEMS Science Program

The quality of aquatic ecosystems and factors that affect the quality

Background

An understanding of the health of aquatic ecosystems helps resource managers evaluate the suitability of Pennsylvania waters for public supply and recreational and other uses, which affects the lives of all Pennsylvanians. Aquatic ecosystems are stressed by resource extraction and utilization, suburban and rural development, agricultural activities, atmospheric deposition of contaminants, and industrial waste release or disposal. For example:

- Over 8,000 stream miles are on the Clean Water Act, Section 303(d) list of impaired waterways.
- Clean-up of streams degraded by the coal mining industry alone is estimated to cost $5 billion.
- Almost 40,000 acres of Pennsylvania lakes do not support designated uses.
- Once considered inexhaustible and pristine, ground-water availability has been insufficient in some local areas during recent droughts and ground-water contamination by anthropogenic activities is occurring.
- Precipitation in the Commonwealth is among the most acidic in the Nation and is a major source of mercury deposition to watersheds.
- Zebra mussels and other invasive species have caused profound effects on aquatic ecosystems.
- The Chesapeake Bay is on the verge of being declared "impaired" as a result of the inability of the water body to meet its designated uses.

Health officials and water-quality managers must make decisions to protect aquatic health and human health. Managers would like to have sound ecosystem science with a multi-discipline approach as a rationale for decision making.

Science Issues

The following Science Issues have been identified within the ***Aquatic Ecosystems Science Program*** and will be described in detail in later sections:

- **Chemical and biological indicators and community response**
- **Effects of anthropogenic activities on aquatic ecosystem health**
- **Understanding environmental processes**
- **Remediation effects and reuse of environmental contaminants**
- **Development of methods for assessing stream health**

Vision

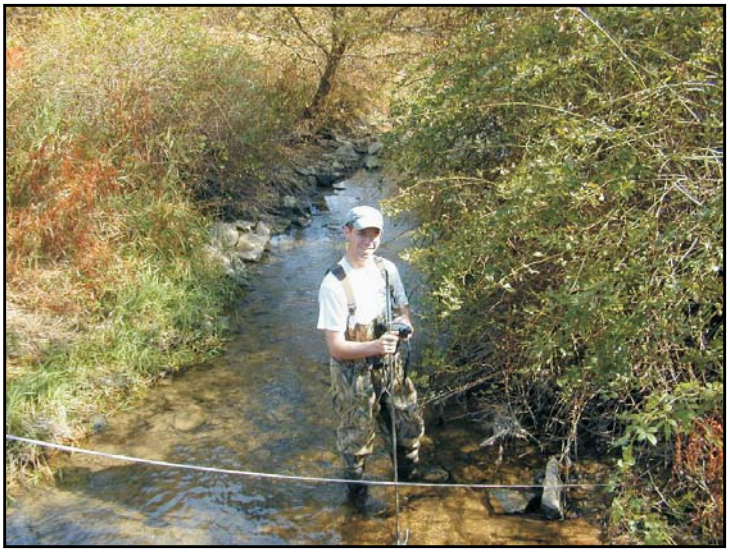
Within 5 years, the Pennsylvania District will be considered by our cooperators as the authority in Pennsylvania for aquatic ecosystem science information and analysis. Among other accomplishments, the District will have developed new tools for determining instream flow needs for warm-water and cold-water environments for small streams and large rivers. The District will have refined evaluations of BMP effectiveness for agricultural, mining, urban, and suburban settings. Innovative ideas for new BMPs will have been proposed and tested. The District will have offered refinements for existing rapid bioassessment protocols for evaluating the health of streams. Data-collection programs will be expanded, with an increased emphasis on contaminants relevant to human health, including more real-time data for a broader range of constituents. Staff expertise in abatement of contamination from mining activities will have spawned new treatment technologies. Ground-water experts will have contributed to a better understanding of the functioning of wetlands. The District will have partnered with other researchers and industry to develop new uses of environmental waste products. The staff will be knowledgeable about the effects of contaminants on aquatic and human life and capable of depicting interactions among various environmental compartments using computer models grounded in accurate simulation of key environmental processes. District projects will employ cutting-edge science and provide workable solutions to environmental problems.

Societal Relevance

- Knowledge of aquifer vulnerability and contaminant presence in ground-water supplies may lead to preservation and improvement of the quality of drinking-water sources.
- Continuous monitoring of source-water quality will allow for early warning in the case of intentional or accidental contamination.
- Determining the presence of pathogens in recreational waters (lakes and large rivers) on a periodic basis can be used to maintain safety for water-contact recreation.
- Evaluating the environmental impact of waste-effluent treatment and waste-stream recovery options may promote water recycling and effective research and development investments.
- Investigating emerging contaminants will provide baseline values and early warning of potential health or aquatic ecosystem problems.
- Examining bioaccumulation of chemicals in aquatic life will provide data to improve the safety of materials consumed along the food chain.
- Information derived from assessing and monitoring aquatic ecosystems will help water managers restore and promote sustainable fisheries.

Pennsylvania District ***Core Capabilities*** that support the ***Aquatic Ecosystem Science Program*** include but are not limited to:

- Fish community surveys
- Water-quality monitoring
- Water-quality modeling
- Benthic-invertebrate identification
- Hydraulic testing and simulation
- Evaluation of management practices
- Bacterial and pathogen assessments
- Regional assessments of water quality and ecology
- Environmental processing of contaminants
- Analysis of trends
- Fluvial geomorphology and stream-restoration monitoring
- Wetland delineation and monitoring
- Bed-sediment and soil coring



Science Issue – Chemical and Biological Indicators and Community Response

The link between water-quality standards and biological metrics and the response of the biological communities including humans

Background

Chemical and biological indicators of stream health have been in use for decades. For example, water-quality standards and biological metrics commonly are used as benchmarks for judging water quality. However, the link between those indicators and the response of the biological community usually is missing. Similarly, the human response to a water-quality condition is, in many cases, unknown.

Goal

In cooperation with members of the environmental and human-health communities, conduct studies that collect and analyze historical and current water chemistry and ecological assessment data and investigate their links to human health and aquatic-community response.

Strategies

- Train hydrologists in the Instream Flow Incremental Methodology (IFIM) or other techniques used to evaluate flow needs for aquatic organisms.
- Build technical associations with members of the environmental- and human-health communities such as Medical Center researchers, Pennsylvania Department of Health, and research groups at Pennsylvania institutions of higher learning.
- Build expertise in microbial and pathogen investigations—specifically microbial source tracking.
- Expand data-collection efforts on chemicals that effect human health.
- Build expertise in ground-water/surface-water relations; develop user-friendly tools to display study results.
- Continue to expand dialogue with BRD-Leetown researchers on potential areas of collaboration in relation to water and sediment chemistry and aquatic-ecosystem health.

Key Contacts[1]

CCWRA, CDC, CHD, DRBC, FHWA, F&WS, ICPRB, OSM, PaDCNR-Parks, PaDEP-BWSWM, PaDOH, PaDOT, PaF&BC, PSU-HMC, RC&D, USACE, US-DHS, US-DOD, USEPA, USGS-BRD

Potential actions
Investigate the link between environmental data and human health at local, regional, and state scales, through partnerships with health professionals.
Quantitatively link water chemistry to biological indices.
Relate geomorphic assessments to health of aquatic communities.
Evaluate the connection between instream flows, habitat, and aquatic communities.
Monitor and assess long-term variations in ambient temperature for aquatic habitats.
Determine effects of ground-water chemistry and temperature on resident stream aquatic species.
Evaluate effects of ground-water pumping on wetlands and the habitat of resident species (e.g. bog turtles).
Evaluate the effects of air-transmitted contaminants on stream health and aquatic community response.

[1]For a description of agency and interest group abbreviations, see Appendix 1.

Science Issue – Effects of Anthropogenic Activities on Aquatic Ecosystem Health

The potential effects of anthropogenic activities such as construction activities, resource extraction, and agricultural practices on ground-water and surface-water aquatic ecosystems

Background

Anthropogenic activities place a multitude of stresses on aquatic ecosystems. Among others, construction activities, resource extraction, agricultural practices, waste disposal, release of contaminants, and alteration of drainage patterns all come with potential effects to ground-water and surface-water aquatic ecosystems. The need for flow-path and traveltime data and the identification and magnitude of contaminant spills and plumes have become more urgent in terms of delivery and accuracy. Recent terroristic threats have made our communities aware that drinking water is easily polluted and is hard to protect.

Goals

1. Conduct studies to evaluate the impact of human activities but also support the development of a systematic methodology for determining the fate and transport of contaminants and other induced materials when they enter soils, ground water, and streams, including their impact on human and aquatic ecosystem health,
2. Be prepared to provide needed water-security assistance, and
3. Expand real-time streamflow and water-quality monitoring networks, especially in critical water-supply areas.

Strategies

- Develop increased expertise and use of tracer technologies.
- Expand surface-water, ground-water, and water-quality modeling capabilities.
- Expand expertise in environmental inorganic and organic chemistry and biogeochemistry.
- Increase understanding of aquatic ecosystem health by enhancing technical associations with regulatory agency program managers, government agency researchers, and other research groups.
- Actively promote the expansion, enhancement, and utilization of data being collected using our water-quality monitoring skills.
- Expand the use of state-of-the-art monitoring equipment and initiate the use of real-time trace-concentration detection equipment.
- Develop user-friendly tools to display contaminant-study results.
- Develop and provide user-friendly Web-based tools to display existing and enhanced streamflow and ground-water level network data.
- Expand limnological activity partnerships by increasing participation in professional organizations.
- Enhance our continuing dialogue with BRD-Leetown researchers on potential areas of research collaboration in relation to contaminants and aquatic ecosystem health.
- Develop plans for a rapid response to monitor contaminant spills or predict transport to water systems.

Key Contacts

ARS, CCWRA, CHD, DRBC, FEMA-R3, ICPRB, ORSANCO, OSM, PaDA, PaDCNR, PaDEP-BAMR, PaDEP-BWSWM, PaDOT, PaF&BC, PEMA, PWD, NRCS, RC&D, SRBC, USACE, US-DHS, USEPA, USEPA-CBP, USGS-BRD, WA&WS

Potential actions

Evaluate effects of changes in land-use practices on streamflow and chemistry of headwater and lower-order streams by evaluating short-term changes and long-term trends.

Evaluate the cumulative impacts of factory farms in a watershed.

Determine stream impact from long-wall mining in different gradient streams—effects on stream quantity and stream characteristics/structure (pools/riffles).

Determine how headwaters contribute to the hydrology and biology of a stream and how development pressures affect the dynamics.

Compute loads of contaminants to the Chesapeake Bay and determine trends in stream and river quality.

Potential actions—Continued

Develop or enhance Web-based application to provide real-time contaminant-transport predictions for the purpose of early warning to water suppliers.

Develop prediction tools for hydrologic impacts of environmental stressors.

Evaluate anthropogenic modification of biogeochemical processes in soils, sediment, the water column of lakes and streams, and ground water.

Explore surface- and ground-water interactions, in relation to abandoned-mine discharges, the urban/agricultural interface, and in relation to other land uses.

Determine surface- and ground-water-quality and flow impacts of urban sprawl.

Evaluate the cumulative impacts on stream-water quality in areas under different geologic settings that are being highly developed with multiple stormwater facilities, focusing on the impact of stormwater runoff on basins of 10 mi^2 in size and smaller and in critical water planning areas.

Install more real-time data sensors and add probes such as turbidity or contaminant sensors tailored to particular needs such as sediment loading or homeland security issues.

Assess the impacts of dam removal on streamflow and quality and develop a historical database to assist with an overall environmental assessment of dam removal.

Evaluate stability of streambeds and banks near and adjacent to road and utility crossings within Pennsylvania. Determine bank-failure rates and sediment loss.

Evaluate the impact of acid-mine drainage on inhibition of bacterial growth.

Evaluate impact of toxic substance on aquatic species (bioaccumulation).

Determine bacteria and other pathogens levels in water and soil or beach material for use in recreational warnings.

Determine if locating public sewers and septic systems in carbonate terrain or other sensitive areas affects aquifers and ground-water quality.

Evaluate fish pathogens in hatchery environments and source of contaminants.

Determine environmental variables that affect the distribution of mussel species of concern in streams near bridges or utility crossings.

Develop nutrient budgets and evaluate the impact of increased nutrients from land-management practices on lakes.

Evaluate the effectiveness of implementing management practices based on Total Maximum Daily Loads on water and ecological quality of degraded streams.

Science Issue – Understanding Environmental Processes

The role of environmental processes, such as chemical and biological transformations, movement of contaminant transport, and bioaccumulation in the health of the aquatic ecosystem

Background

Managers of water resources want an understanding of environmental processes such as chemical and biological transformations, movement of contaminants into and out of sources and sinks, transport, and bioaccumulation. These processes govern levels of contaminants and toxic compounds in aquatic systems, and they form the basis for correcting environmental problems. The USGS desires to provide managers with the process science needed to address environmental problems.

Goals

1. Conduct cooperative studies to enhance the understanding of environmental processes, especially those related to the transformation and retardation of water-borne substances moving through various media and environmental conditions, and
2. Develop a dialogue with water-resource managers and provide continuing updates concerning the fate and transport of emerging contaminants.

Strategies

- Expand ground-water and water-quality modeling and water and sediment chemistry capabilities by promoting training and working with other USGS researchers.
- Build technical associations with regulatory agency and water-resource program managers, government agency researchers, and other research groups at Pennsylvania institutions of higher learning involved in studies of contaminant transport.
- Increase staff exposure to scientific literature and news reports with the idea of learning about emerging contaminants, their movement in the environment, and their relative importance to society.
- Support the proposed Pennsylvania Acid Drainage Technology Initiative by providing the necessary background environmental data and by providing an understanding of how new technologies work through field testing.

Key Contacts

ARS, CCWRA, CHD, DRBC, EPCAMR, ICPRB, NPS, NWS, OSM, PaDA, PaDCNR-Parks, PaDCNR-T&GS, PaDEP-BAMR, PaDEP-BWM, PaDEP-BWSWM, PaF&BC, PSU-WRRI, PWD, RC&D, SRBC, USACE, USEPA, USGS-BRD

Potential actions

Evaluate surface- and ground-water interactions under varying hydrologic and geologic conditions.

Evaluate large-river mass transport and the export of major and minor constituents to large water bodies (e.g. Chesapeake and Delaware Bays).

Develop models of processes for optimization of mine-drainage treatment (e.g. limestone drains and wetlands).

Explore the change in flow and quality of surface and ground water at the urban/agricultural interface.

Determine the source, fate, and transport of nutrients, sediment, pharmaceutical and pesticide compounds, and other hazardous substances in surface and ground water, their interrelation, and their effects on aquatic organisms.

Determine the fate and transport of pathogens from biosolids to the ground water or streams.

Evaluate arsenic sources and mobilization in the environment.

Determine radium and radon sources, activity, and pathways in aquifers.

Describe the hydrogeology and characterize ground-water-flow systems of regional settings at hazardous-waste sites.

Complete time-of-travel and contaminant-transport modeling in reaches of Pennsylvania streams used for public water supply.

Characterize lake water quality and processes affecting quality.

Science Issue – Remediation Effects and Reuse of Environmental Contaminants

The effectiveness of remediation practices on water quantity, quality, and aquatic species, and the beneficial reuse of environmental contaminants.

Background

Removing contaminants from the environment is often costly and time consuming. Frequently, the resources needed for clean-up are not available. However, in some fields, success has been attained in converting a contaminant burden into an economic resource. For example, re-mining abandoned coal-spoil piles provides coal for energy and mitigates an existing problem.

Goals

1. Conduct cooperative studies to investigate the effectiveness of remediation practices and technology and the beneficial reuse of environmental contaminants and to provide scientific support to economical engineering solutions, and
2. Assist agencies responsible for contaminant handling and disposition by providing technical assistance related to environmental consequences.

Strategies

- Expand our water-quality modeling and water-chemistry expertise.
- Become more familiar with cost-benefit analysis in an effort to provide better scientific support to engineering solutions.
- Increase understanding of environmental contaminant disposal issues by developing partnerships and technical associations with agencies responsible for those services.
- Encourage our scientists and engineers to search for innovative environmental solutions.
- Offer and apply our ground-water expertise to contaminant clean-up issues.

Key Contacts

ARS, CCWRA, ICPRB, NPS, OSM, PaDA, PaDEP-BAMR, PaDEP-BMR, PaDEP-BWM, PSU-WRRI, RC&D, USACE, US-DOE, USGS-BRD

Potential actions
Examine water-quality processes and evaluate the effectiveness of wastewater-disposal methods intended to recharge the ground water.
Evaluate effectiveness of treatment technology from agricultural, urban, and coal-mining sources on ground- and surface-water quality, such as evaluating quality and quantity of ground-water recharge from agricultural practices.
Suggest components for the design of new BMPs for agricultural and urban activities that exceed current efficiencies and promote re-use of materials.
Develop restoration monitoring programs for wetlands, riparian buffers, and abandoned-mine-drainage remediation sites.
Investigate phytoremediation and bioremediation of contaminants and their impacts on the environment.
Determine sediment sources to streams and reservoirs, mechanisms of instream transport, and implications for reduction strategies.
Evaluate disposal options and consequences for sediment removed from river channels, lakes, reservoirs, and behind dams.
Evaluate environmental effects of biosolids and agricultural by-products for restoration of mine lands.
Evaluate resource recovery and the use of metal-rich sediment/sludge for environmental improvement or manufacturing-product ingredients.
Evaluate existing methods and develop new ones to recover small quantities of trace elements from stream-bottom sediment.
Evaluate crumb rubber from recycled tires as an iron removal technology in the passive treatment of abandoned mine discharges.
Evaluate surface- and ground-water-quality and land-stabilization effects from use of coal-combustion by-products for underground or above-ground placement in mined areas.
Evaluate environmental impacts of beneficial reuse of treated wastewater or dredged material.
Evaluate effectiveness of existing hazardous-waste management practices on reducing contamination of aquifers.
Determine acid-generating capability of rock layers (acid/base accounting level) and how this may require remediation or be used to an environmental advantage.

Science Issue – Development of Methods for Assessing Stream Health

The creation or enhancement of field, laboratory, and data-analysis methods for assessment of stream health in a variety of hydrogeologic settings

Background

Many tools for assessing stream health currently are available. For example, a variety of water-quality models exist, biological metrics have been developed for some applications, and microbial standards for drinking and recreational waters are established. Yet, these tools are not adequate to answer all the questions. Current methods for biological assessments of large rivers are a force-fit of existing small stream technology. Projections for the aquatic response to droughts also need to be refined.

Goals

1. Conduct cooperative studies to develop new or improved methods for the assessment of stream health especially in large rivers and in all streams during drought conditions, and
2. Compile and maintain a library of newly developed assessment methods with the purpose of providing a toolbox that will allow easy access, selection, and use of available assessment methods and output of results.

Strategies

- Increase the number of positions and expertise within our ecological unit.
- Rely on USGS expertise in our research branch and laboratory system to develop new chemical laboratory methods as needed for emerging contaminants.
- Strengthen the technical associations with regulatory agency and water-resource program managers to increase our understanding of their issues of concern.
- Transfer knowledge of instrumentation from our Hydrologic Surveillance Program staff to staff in our Hydrologic Investigations Program.
- Examine technology available in the private sector to assess stream status and health.
- Develop user-friendly tools for the display and use of stream-health assessment methods and the analysis of assessment results.

Key Contacts

CCWRA, DRBC, ICPRB, PaDEP-BWE, PaDEP-BWM, PaDEP-BWSWM, USEPA, USGS-BRD, USGS-NAWQA, USGS-OSW

Potential actions
Develop methods for assessing bacteria and aquatic communities in large rivers.
Develop a fish-community assessment method with the same result as the Rapid-Bio-assessment-Protocol (RBP) currently in use for aquatic invertebrates.
Develop periphyton assessment methods for streams that are nutrient or sediment impaired.
Develop methods to use other aquatic community indexes along with the aquatic-invertebrate index for identification and quantification of effects from a diverse set of contaminants (e.g. organic compounds, metals, acidification, sedimentation, and thermal loading).
Develop aquatic community assessment methods for non-wadable and special-condition stream reaches.
Test and develop new methods for determining ecological flows and compare the results to IFIM data for warm- and cold-water streams in various environmental settings.
Develop a method for integrated stream assessment to support human health issues.
Develop analytical and monitoring methods for emerging contaminants and newly developed products in water and fish.
Develop methods to assess lakes, wetlands, and ground water for Clean Water Act, Section 305(b) reports.
Develop and test new methods for implementing and operating early warning systems.
Enhance the ability to quantify stream assessments by refining existing methods that use a geomorphic approach. Document the methods for the technical community and the general public through a user's manual.
Develop a model to prioritize discharges or contaminated water bodies for treatment based on flow, chemistry, contaminant load, and designated use.
Work with others to develop and test innovative equipment and instrumentation.
Develop databases to store and manage geomorphic assessment data.

HYDROLOGIC SYSTEMS Science Program

The evaluation of hydrologic systems and their response to stress

Background

A characterization and understanding of hydrologic systems based on current science is critical to support the management of water resources in the Commonwealth of Pennsylvania. As a result of urban sprawl and increasing residential development in rural areas, water managers across the state are increasingly tasked with decisions concerning water availability and sustainability. So that regulators and decision makers can make informed management decisions, hydrologic characterizations of watersheds, hydrologic system assessments, and analyses of hydrologic and water-use data must be conducted and presented in a manner that links the technical scientific analyses with easy-to-use tools, such as Web-based programs that incorporate Geographical Information Systems and hydrology.

Currently, an integrated approach combining hydrologic system assessments and analysis with water-use data is needed to support comprehensive water management and planning. Recent USGS activities with the water-management community include the ongoing development of a Web-based screening tool in support of Pennsylvania Act 220. The legislation was enacted in March 2003 and requires an update of the PaDEP State Water Plan and the identification of Critical Water Planning Areas. Several investigations characterizing surface-water runoff and ground-water recharge in Pennsylvania watersheds will be included in this effort. Results of these studies will support initial water-management decisions as well as the future of water management in PaDEP-designated Critical Water Planning Areas.

An increased knowledge base of hydrologic systems and watersheds and their response to precipitation will support the water-management community by providing scientific information that allows them to deal with hydrologic events such as droughts and floods in an informed manner. Excess runoff is especially prevalent in southeastern Pennsylvania and appears to be exacerbated by rapid changes in land-use practices. Knowledge of watershed responses to these extreme hydrologic events and the impacts of changing land practices on the responses will support efforts by water managers, risk managers, and emergency managers to respond to and plan for these hydrologic events.

Science Issues

The following Science Issues have been identified within the ***Hydrologic Systems Science Program*** and will be described in detail in later sections:

- ***Hydrologic characterization of watersheds***
- ***Hydrologic system analysis***

Vision

By 2010, The District staff will increase their collective understanding and knowledge of hydrologic systems with emphasis on characterizing the hydrologic cycle of watersheds by developing and building expertise in the most recent scientific methods and developments such as fully linked computer models. The District will focus on small watershed hydrologic systems by maintaining and expanding our basic hydrologic data-collection efforts in these settings. The District will strive to develop the link between the state-of-the-art science, hydrologic data collection, and interpretation by providing user-friendly Web-screening tools oriented towards the needs of water and risk managers. Water and risk managers will have at their fingertips Web-based tools that will display real-time data in combination with hydrologic analyses and interpretations of water availabilities and extreme hydrologic events such as droughts and floods.

Societal Relevance

- An integrated surface- and ground-water approach to water availability that combines hydrologic system assessments and analysis with water-use data will support comprehensive water management and planning.
- Hydrologic data derived from continuous assessment and monitoring of streamflow and ground-water levels will help to ensure water supplies during drought periods and will allow informed decisions when water-use increases are proposed.
- Improving knowledge and characterizing surface-water runoff and ground-water recharge in Pennsylvania watersheds will be useful to management agencies and research groups.
- An increased knowledge base of hydrologic systems and watersheds and their varied responses to precipitation will assist water- and emergency-management agencies plan for the future.
- An increased knowledge of the impacts of changing land-use practices on watershed responses will assist planners with decisions affecting future water availability.

Pennsylvania District ***Core Capabilities*** that support the ***Hydrologic Systems Science Program*** include but are not limited to:

- Rainfall-runoff modeling
- Monitoring ground-water levels and streamflow
- Interpretation and analysis of hydrologic conditions
- Regional and watershed assessments
- Hydraulic modeling
- Spatial data creation and analysis
- Database management

Science Issue – Hydrologic Characterization of Watersheds

The hydrology of surface and ground watersheds and their reaction to differing climatologic, topographic, and geologic settings and land-use practices

Background

Hydrologic characterization involves defining, explaining, and comparing the hydrology of surface and ground watersheds with differing climatologic, topographic, and geologic settings and land-use practices. An extensive database of images and Geographic Information System (GIS) data sets are required for this analysis. Studies and data collection to support this Science Issue will be focused on areas concerning small-basin hydrology, source-water location and protection, critical recharge areas, stormwater-runoff impacts, streamflow and base-flow statistics and trends, and maintenance and enhancement of long-term surface- and ground-water data-collection networks.

Goals

1. Conduct cooperative studies to enhance the scientific understanding of small-basin hydrology and provide an improved hydrologic characterization of small (less than 100 mi^2) watersheds,
2. Conduct studies to expand the knowledge of processes affecting hydrology of major river basins within and adjacent to Pennsylvania, and
3. Expand the basic data-collection networks into areas where water-resources data are sparse (e.g. small watersheds and areas with carbonate bedrock).

Strategies

- Actively promote expansion of the basic data-collection networks by identifying potential locations and requesting input from cooperators and partners.
- In partnership with the USGS Geography Discipline, acquire images to assist with analysis of watershed characteristics.
- Increase expertise and positions within the GIS unit.
- Assemble spatial data sets to assist with the analysis of runoff patterns in relation to climatic effects and changes in land-use practices.
- Increase understanding of watershed hydraulics by building technical associations with regulatory agency and water-resource program managers and research groups at Pennsylvania institutions of higher learning.
- Where possible, develop Web-based user-friendly tools to display study results and provide basin characteristics to the scientific and lay communities.

Key Contacts

DRBC, ICPRB, NWS, OSM, PaDEP-BWE, PaDEP-BWM, SRBC, USGS-FSP, USGS-GeogD, PaDCNR-T&GS

Potential actions
Expand and maintain streamflow and ground-water data-collection network statewide. Include a special emphasis to expand into watersheds where regional analysis is not fully supported by existing hydrologic data, and a special emphasis to expand into tributary and headwater watersheds ranging from 0.5–100 mi^2 in drainage area.
Determine and maintain small-basin streamflow statistics.
Characterize hydrology of small basins in different environmental settings.
Explore small headwater watershed dynamics (quantity and quality) and impacts on downstream segments.
Coordinate multi-state water-use data collection, entry, and management within large river basins.
Develop restoration monitoring programs for stream channels by expanding data-collection efforts during routine streamgaging visits.
Conduct long-term and short-term water-quality monitoring of surface and ground water.
Expand continuous-record water-quality monitoring networks. Install chemical sensors in continuous gages.
Develop applications of ground-water and surface-water models that include remote-sensing data.
Develop and use ground-water models to understand hydrologic systems in a variety of Karst environments.
Support efforts by other agencies to collect Light Detection And Ranging (LIDAR) data to assist analyses requiring enhanced elevation data sets.
Develop detailed geologic mapping for sinkholes and closed depressions.
Create high-resolution DEMs though partnership with USGS Geography Discipline.
Develop integrated watershed models and innovative methods to present the results.

Science Issue – Hydrologic System Analysis

The interaction of hydrologic systems, demands for water use, and the impacts of artificial stressors

Background

Hydrologic system analysis generally will be performed on a regional scale and will focus on how the existing hydrologic system can best be used to support current water-use demands and the plans necessary to address concerns for future water-availability. Studies and data collection to support this Science Issue will focus on areas concerning water availability, water-supply sustainability, consumptive and non-consumptive water use, hydrologic budgets, ground-water recharge, stormwater infiltration, and impacts of land-use practices on recharge and stormwater runoff. Spatial data sets will be used to facilitate these analyses.

Goals

1. Through cooperative studies, develop and maintain a hydrologic database and a set of screening tools to support water availability and water-supply sustainability issues,
2. Conduct studies to enhance the scientific understanding of environmental issues affecting ground-water recharge, stormwater runoff, streamflow, and ground-water discharge, and
3. Develop user-friendly tools to display and use the study results.

Strategies

- Maintain the existing USGS corporate hydrologic database—the National Water Information System (NWIS and NWIS-Web) and continue to quality assure historical data and computed values.
- Increase the expertise necessary to analyze spatial data sets.
- Develop an alternate, but complimentary, GIS and hydrologic database to store the ancillary environmental information needed by researchers and managers to study and address water-availability issues.
- Build technical associations with regulatory agency and water-resource program managers to increase our understanding of their concerns relating to ground-water recharge, stormwater runoff, and water availability.
- Develop the expertise necessary to prepare Web-based tools.

Key Contacts

DRBC, F&WS, ICPRB, NRCS, NWS, PaCD, PaDCNR-Parks, PaDCNR-T&GS, PaDEP-BWM, SRBC, USGS-FSP, USGS-GeogD, WA&WS

Potential actions
Provide ongoing statistical evaluations of existing base-flow, streamflow, and ground-water-level data and tools to assist planners with water availability determinations.
Develop protocol for water-budget computations and develop a tool for computations that is accessible through the web.
Develop a statewide map of recharge with seasonal variability.
Delineate aquifers for water-use mapping.
Determine the impact of water availability, in relation to water use, on water supplies and recreational resources.
Develop hydrologic budgets and mass-balance estimates for water-supply sources and mine pools.
Evaluate the regional impacts of land-use practices and climate change on evapotranspiration, ground-water recharge, and stormwater runoff in different environmental settings.
Develop geochemical models/techniques to evaluate aquifer recharge, storage, age, and recovery.
Conduct time-of-travel studies to support protection of water supplies.
Determine and predict flows in warm- and cold-water streams that sustain natural ecological conditions.
Develop models to predict the quality and quantity of abandoned mine discharges associated with stream restoration, ground-water withdrawals, or changes in mine-pool elevations.
Examine the environmental impacts of induced infiltration of stormwater runoff for the purposes of increasing ground-water recharge.
Examine effects of reduced infiltration associated with stream restoration and increased ground-water withdrawals associated with development in mined areas.
Develop and maintain an aerial-photograph and satellite-image database in a scale desirable for application to small-watershed analysis.

NATURAL HAZARDS Science Program

Natural physical and chemical hazards that impact human health and the environment

Background

An understanding and characterization of the natural hazards that occur in Pennsylvania are critical to the support and maintenance of our infrastructure, economy, water resources, and for the prevention of injury and loss of life to its citizens. Floods, droughts, landslides, and earthquakes are examples of physical hazards that have impacts on human and environmental health. Chemical hazards include naturally occurring trace metals that are released to the environment under certain conditions. Additionally, the recovery cost for future disasters will increase with urbanization and other land-use practice changes that require our infrastructure to become more integrated to support power-supply, communication, transportation, and water-delivery systems.

The USGS has a major role in the Federal response to natural disasters, and with recent reminders of terrorist acts and threats, the USGS also can play a major role in time-of-travel estimates to assist with emergency preparedness for the potential contamination of our water resources from terrorism. The District provides science in response to present and anticipated needs to assess and monitor hazardous events and to conduct risk assessments and mitigate loses. The USGS has unique capabilities for integrating hazard information with hydrogeologic, geospatial, and imagery data to rapidly assess the effects of naturally induced hazards.

An increased knowledge base of hydrologic systems and watersheds and their response to an excess or a deficit of precipitation will support the water- and risk-management agencies that routinely deal with hydrologic events such as droughts and floods. Extended periods of below-normal precipitation have required water-management agencies to take drastic measures and declare regional or statewide drought emergencies. Conversely, large amounts of excess precipitation, generally brought to the Commonwealth by the remnants of tropical storms and hurricanes, have created regional flood events at least once per year over the last several years. The flooding has been especially prevalent in southeastern Pennsylvania and appears to be exacerbated by rapid changes in land-use practices. Knowledge of watershed responses to these extreme hydrologic events and the impacts of changing land-use practices on the responses will support efforts by water managers, risk managers, and emergency managers to respond to and plan for these hydrologic events. Recent USGS activities with these managers include the drought conditions monitoring Web page and participation in large-basin flood-forecasting systems.

Science Issues

The following Science Issues have been identified within the ***Natural Hazards Science Program*** and will be described in detail in later sections:

- ***Hydrologic extreme monitoring, assessment, and analysis***
- ***Hydrogeologic hazard assessment and analysis***
- ***Natural geochemical hazard***

Vision

By 2010, the Pennsylvania District will be leading a statewide effort to integrate USGS hydrologic and earth-science data into the Emergency-Management Infrastructure for the Commonwealth and the Upper Ohio Valley, Lake Erie, and Mid-Atlantic Regions. Major Initiatives will be (1) “river and stream time-of-travel determination project” for 8-14 digit Hydrologic Unit Code (HUC) watersheds at base flow and high (2-year recurrence interval) flow, (2) “flood inundation mapping project” for 50-, 100-, and 500-year recurrence interval events, (3) “landscape stability and change analysis project” for slopes, stream channels, and other geomorphic features, and (4) “geochemical atlas for Pennsylvania project” that provides background and hot-spot concentrations of elements in soils, sediment, and water.

Societal Relevance

- Understanding and characterizing the natural hazards that have the potential to occur in Pennsylvania will allow the development of an informed plan to support and maintain the water resources and infrastructure of the Commonwealth and promote the prevention of loss of life and injury of its citizens.
- Providing historical and on-demand hydrologic and geologic data will support early-warning and flood-forecasting systems and serve an integral role in the mandated Federal response to natural disasters and assistance with emergency preparedness.
- Integrating hazard-location information with hydrogeologic, geospatial, and imagery data that are readily available to the USGS to determine the potential causes and unseen effects of naturally induced hazards, and providing the results of these rapid assessments to emergency-management agencies, will allow more efficient and targeted disaster assessment and response.
- An increased knowledge of natural watershed responses to extreme hydrologic events and the impacts of changes in land cover will support efforts by water and emergency managers to develop informed risk-assessment and action plans.
- Streamflow measurement and monitoring under extreme conditions

The Pennsylvania ***Core Capabilities*** that support the ***Natural Hazards Science Program*** include but are not limited to:

- Real-time monitoring and web display
- Geophysical and seismic analysis
- Interpretation and analysis of geochemical data
- Floodplain delineation
- Fractured-rock modeling

Science Issue – Hydrologic Extreme Monitoring, Assessment, and Analysis

Real-time delivery and analysis of surface- and ground-water data during floods and droughts

Background

Pennsylvania has many flood-prone areas in which residences, businesses, and public assets are located. Historically and through the current year, many lives have been lost and much damage has been done in Pennsylvania because of little warning prior to flooding. As a result of a variable climate and increased water usage, drought conditions also are a concern of the Commonwealth's water-resource managers and citizens. Hydrologic data collection from streams and wells, real-time delivery, and presentation of the data in a meaningful manner are critical to flood response and drought monitoring. Flood modeling and flood forecasting improvement are important scientific aspects of flood recovery.

Hydrologic extreme-event assessment and analysis is highly dependent on the collection of the proper hydrologic data at the proper locations within the Commonwealth. Assessment and analysis go beyond documenting hydrologic extremes and focus on causes and expectations for both the low- and high-flow extremes so that planners and emergency responders can make informed proactive and reactive decisions. Studies and data collection to support this Science Issue will be focused on areas concerning hydrologic events, including droughts and floods. Statistical presentations of observed data will be used to develop regional characteristics and risk analyses for low- and high-flow events affecting surface and ground water.

Goals

1. Conduct cooperative studies to model hydrologic response, characterize traveltime in streams, document and validate hydrologic extremes, and advance the science of flood and drought modeling and forecasting, and
2. Develop a set of tools to support agencies responsible for drought and flood management and response.

Strategies

- Actively promote the expansion of the statewide cooperative streamgage network.
- Maintain and enhance our ability to deliver real-time streamflow information in a nationally consistent and organized manner.
- Maintain the existing USGS corporate hydrologic database—the National Water Information System (NWIS and NWIS-Web) and continue to quality assure historical data and computed values.
- Continue to maintain a database of hydrologic extreme data and analyses.
- Increase technical associations with government agencies and research groups to promote the scientific understanding of the relation between environmental and climatic conditions and to raise awareness about water-resources management issues.
- Through training and experience, maintain and enhance the expertise of our hydrologists, engineers, and hydrographers in collecting and analyzing surface- and ground-water data.
- Encourage USGS technical support staff to continue the enhancement and development of standard analytical tools available to evaluate hydrologic extremes, estimate traveltimes and recession rates, predict the probable depths of flood peaks, and statistically analyze streamflows and ground-water levels.
- Maintain readiness and expertise to support post-event activities following floods.
- Develop the expertise necessary to prepare Web-based tools.

Key Contacts

FEMA-R3, NWS, PaDCED, PaDEP-BWM, PEMA, USACE, US-DHS, US-DOD, USGS-GeogD, USGS-NSIP, USGS-OSW, USGS-StreamStats

Potential actions

Expand and maintain the low-flow, peak-flow (crest-stage gage), and ground-water observation well statewide data-collection networks.

Use additional hydrologic extreme data to expand the understanding of hydrologic regions within Pennsylvania and improve regional equations for low and flood flows.

Provide ongoing statistical evaluations of existing low-flow and low ground-water-level data and provide tools to assist drought-management and emergency-response agencies.

Provide ongoing statistical evaluations of peak-flow data as they are collected and provide tools to assist flood-forecasting and emergency response agencies.

Potential actions—Continued

Develop methods to provide reliable real-time streamflow data during unsteady flow conditions (e.g. backwater from ice formation and ice and debris jams).

Develop methods and tools to display risk-analysis determinations for extreme hydrologic events.

Develop a comprehensive Web-based tool to monitor and document drought and flood conditions and present their preliminary percentile ranking or frequency, along with links to other agency Web pages for predictive hydrologic information.

Be prepared to provide rapid response to changing flow conditions due to storms, environmental contamination, etc.

Identify historical hot spots for flooding.

Develop flood-warning systems to allow 4-5 hours of early warning in basins of 200-300 square miles.

Provide ongoing support of flood-plain delineation and mapping statewide. Incorporate in National Map.

Develop real-time flood-forecasting map.

Science Issue – Hydrogeologic Hazard Assessment and Analysis

The effect of natural seismic events on ground-water levels and availability and the analysis of channel instability resulting from extreme hydrologic events or changes in runoff patterns

Background

Regions in western Pennsylvania are prone to landslides and rock falls. Although generally not life-threatening, the economic cost to repair these failures can be excessive. Earthquakes occasionally occur in the Commonwealth. In addition to the damage to the infrastructure of the Commonwealth, earthquakes have been known to adversely affect ground-water levels and ground-water availability.

Channel instability resulting from extreme hydrologic events or changes in runoff patterns has become an environmental issue in Pennsylvania. Several current studies are evaluating the effects of recurring low-level flooding events on channel stability. Enhanced studies of stability in stream channels near road crossings, using seismic applications, and the development of a geomorphic database will enhance past and current studies and provide those managers and engineers responsible for the waterways and bridge crossings with critical information to protect public and private property and lives. Having these data available may initiate more detailed, process-oriented investigations and allow for determinations of the safety and integrity of bridges in our transportation network. Data collected statewide also could be analyzed to determine if regional patterns of scour and stability at bridge locations exist.

Sinkhole development and subsidence in areas underlain by carbonate rock (karst) and underground mines (industrial karst) can have catastrophic consequences. Investigations of potential instabilities can help land-use planners consider restrictions in problem areas.

Goals

Develop scientific partnerships and conduct studies to:

1. Identify geographic areas susceptible to natural hazards that may affect water resources,
2. Provide analyses, characterization, and potential of occurrence for natural hazards to support emergency and water-management decisions, and
3. Provide a Web-based display for hazard identification and probability critical to management decisions.

Strategies

- Compile previous prioritizations of those areas most susceptible to natural hazards.
- Compile or develop a library of existing natural-hazard information—images, GIS data sets, and scientific study results—with links to existing geologic, hydrologic, soil, and natural hazard (e.g. landslides and earthquakes) data compilations.
- Develop partnerships and technical associations with scientific experts involved in natural hazard research to promote the incorporation of hydrologic impacts and to increase the understanding of the issues facing environmental managers.
- Promote partnerships to provide analyses and characterization of slope stability and potential terrestrial and hydrologic effects due to earthquakes in Pennsylvania.
- Develop the expertise to perform seismic assessments in and near stream channels.
- Develop methods to provide user-friendly Web-based tools to disseminate data and analytical results.
- Use training and field experience opportunities to increase scientific understanding of streambed and bank stability in various hydrogeologic settings.

Key Contacts

FHWA, ICPRB, NWS, PaDEP-BWE, PaDOT, PEMA, USACE, USGS-GD, USGS-OSW, PaDCNR-T&GS

Potential actions

Map areas susceptible to landslide and earthquake hazards within Pennsylvania. Study and evaluate their impacts on our infrastructure and natural resources.

Conduct seismic analyses under and near road and utility crossings over streams.

Use borehole and surface geophysical tools to enhance stream-stability analyses.

Perform geophysical investigations of subsidence in karst or mined areas to identify specific areas of susceptibility and their associated hydrological and geological factors.

Assist with hazard mitigation evaluations.

Analyze existing stream-channel assessment data collected by the Cooperative PaDOT/USGS Channel Stability Project.

Science Issue – Natural Geochemical Hazards

The occurrence and distribution of natural constituents released from rocks that are detrimental to aquatic organisms and human health

Background

Chemical constituents can be released naturally from soils and rocks in concentrations that are potentially detrimental to property, aquatic organisms, and human health. These natural geochemical hazards include trace metals, radioactive elements, and gasses.

Natural geochemical hazards have wide-ranging impacts that often are not recognized. A lack of buffering capacity or abundance of acid-forming minerals in the naturally occurring rock and soil in many parts of Pennsylvania can cause corrosive ground water, which damages water-supply systems. Aquatic organisms are sensitive to high concentrations of naturally occurring aluminum from forest soils during the seasonal flush of acidic snowmelt. Hazards to human health are caused by ingestion or inhalation of natural trace metals and radioactive elements and gasses. USEPA regulations for radium, arsenic, and radon in public drinking-water supplies have been set at levels that commonly are encountered in natural waters from certain hydrogeologic settings in Pennsylvania.

Goals

1. Identify the occurrence and distribution of geochemical hazards that may affect human health and the environment, and
2. Develop an understanding of the controlling geochemical processes that allow mobilization of naturally occurring contaminants.

Strategies

- Promote partnerships to coordinate efforts for investigating the occurrence and distribution of natural geochemical hazards.
- Compile available chemical data on selected geochemical constituents to denote problem areas or highlight the lack of available information.
- Develop partnerships and technical associations with geologists and research geochemists to obtain expertise on geochemical processes.
- Compile or develop a library with links to existing geology, hydrology, and soils that could help explain the occurrence and distribution of geochemical hazards in Pennsylvania.
- Develop methods to provide user-friendly Web-based tools to disseminate data and analytical results.

Key Contacts

PaDCNR-T&GS, PaDEP-BWSWM, PaDOH, CHD, PSU, USGS-GD, WA&WS

Potential actions
Determine the extent of naturally occurring trace elements (arsenic, radon, radium, mercury, and lead) in surface and ground water regionally or statewide.
Integrate results of a new USGS effort to examine metal concentrations in soils and relate to possible water-quality problems for aquatic resources and human health.
Determine the presence of radionuclides in ground water.

Guiding Principles

District Vision Statement

We envision a technical program for the Pennsylvania District that addresses current and emerging water issues important to our water-resources partners. Although some issues may be controversial, the Science Program will remain unbiased and founded in accurate data collection and interpretation. Our vision is an interdisciplinary and broad-based program characterized by projects that are innovative and technically challenging. The District will strive to produce high-quality products in user-friendly formats and in a timely manner.

Guiding Principles and Strategic Objectives

The following are viewed as being necessary for a successful technical program:

Guiding Principle #1: Know customers issues and needs.

Strategic Objective #1: Identify current and potential external customers.

Strategic Objective #2: Determine program goals and technical needs of external customers. Develop mechanisms to communicate that information to USGS staff.

Strategic Objective #3: Develop and maintain awareness of National and Regional USGS programs relevant to Pennsylvania's environmental issues.

Guiding Principle #2: Maintain a strong Federal focus and promote a high level of science in the District.

Strategic Objective #1: Develop and implement a program plan that includes integrated science.

Strategic Objective #2: Increase customer awareness of USGS capabilities.

Strategic Objective #3: Participate in challenging cooperative and other Federal agency projects

Strategic Objective #4: Obtain USGS funding for initiatives relevant to Pennsylvania's environmental issues.

Guiding Principle #3: Hire and maintain a technically superior staff.

Strategic Objective #1: Keep staff at scientifically superior skill level in core disciplines.

Strategic Objective #2: Acquire staff and skills based on Program issues and needs.

Strategic Objective #3: Utilize skills of USGS staff from other disciplines and Districts.

Guiding Principle #4: Communicate information to customers in an easily understood and readily accessible format

Strategic Objective #1: Create tools for use by others in portable formats.

Strategic Objective #2: Provide written reports to document findings.

Strategic Objective #3: Present results at scientific and water-management meetings.

Appendix 1. Index of Agency Abbreviations

Throughout this document, the following abbreviations were used for water-resources agencies and interest groups:

CCWRA – Chester County Water Resources Authority

DRBC – Delaware River Basin Commission

EPCAMR – Eastern Pennsylvania Coalition for Abandoned Mine Reclamation

FEMA-R3 – Federal Emergency Management Agency, Region III

ICPRB – Interstate Commission of the Potomac River Basin

ORSANCO – Ohio River Valley Water Sanitation Commission

PaCD – Pennsylvania Association of Conservation Districts

PaDA – Pennsylvania Department of Agriculture

PaDCED – Pennsylvania Department of Community & Economic Development

PaDCNR – Pennsylvania Department of Conservation and Natural Resources

- **PaDCNR-Parks** – Bureau of State Parks
- **PaDCNR-T&GS** – Bureau of Topographic & Geologic Survey

PaDEP – Pennsylvania Department of Environmental Protection

- **PaDEP-BAMR** – Bureau of Abandoned Mine Reclamation
- **PaDEP-BMR** – Bureau of Mining and Reclamation
- **PaDEP-BWE** – Bureau of Waterways Engineering
- **PaDEP-BWM** – Bureau of Watershed Management
- **PaDEP-BWSWM** – Bureau of Water Supply & Wastewater Management

PaDOH – Pennsylvania Department of Health

- **CHD** – County Health Departments (Unnamed)

PaDOT – Pennsylvania Department of Transportation

PaF&BC – Pennsylvania Fish & Boat Commission

PEMA – Pennsylvania Emergency Management Agency

PWD – Water Department, City of Philadelphia

PSU – Pennsylvania State University

- **PSU-HMC** – Hershey Medical Center
- **PSU-WRRI** – Water Resources Research Institute

SRBC – Susquehanna River Basin Commission

USACE – U.S. Army Corps of Engineers

USDA – U.S. Department of Agriculture

- **ARS** – Agricultural Research Service
- **NRCS** – Natural Resources Conservation Service
- **RC&D** – Resource Conservation and Development

US-DH&HS – U.S. Dept. of Health & Human Services

- **CDC** – Center for Disease Control

US-DHS – U.S. Department of Homeland Security

US-DOC – U.S. Department of Commerce

- **NWS** – NOAA, National Weather Service

US-DOD – U.S. Department of Defense (various Military Branches)

US-DOE – U.S. Department of Energy

US-DOI – U.S. Department of Interior

- **F&WS** – Fish & Wildlife Service
- **NPS** – National Park Service
- **OSM** – Office of Surface Mining
- **USGS** – U.S. Geological Survey
  - **USGS-BRD** – Biological Resources Discipline
  - **USGS-FSP** – Federal Science Programs (generalized)
  - **USGS-GD** – Geologic Discipline
  - **USGS-GeogD** – Geography Discipline
  - **USGS-NAWQA** – National Water Quality Assessment Program
  - **USGS-OSW** – Office of Surface Water
    - **USGS-NSIP** – National Streamflow Information Program
    - **USGS-StreamStats** – Streamflow Statistical Program

US-DOT – U.S. Department of Transportation

- **FHWA** – Federal Highways Administration

USEPA – U.S. Environmental Protection Agency

- **USEPA-CBP** – Chesapeake Bay Program

WA&WS – Water Authorities and Water Suppliers (Public & Private, unspecified)