

# 50<sup>th</sup> Anniversary of the Delaware Water Resources Center

2015 Annual Meeting  
Newark, Del.  
April 17, 2015

Gerald J. Kauffman, Ph.D., Director  
University of Delaware  
Water Resources Center





Dr. J. Thomas Sims, Director  
Delaware Water Resources Center  
2000-2015



# LYNDON B. JOHNSON

XXXVI *President of the United States: 1963-1969*

## 461 - Statement by the President Upon Signing the Water Resources Research Act.

July 17, 1964

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 +1

THE Water Resources Research Act of 1964, which I have approved today, fills a vital need.

Abundant, good water is essential to continued economic growth and progress. The Congress has found that we have entered a period in which acute water shortages are hampering our industries, our agriculture, our recreation, and our individual health and happiness.

Assuming a continuation of current practices, by the year 2000 there will not be enough usable water to meet the water requirements of parts of the States of Arizona, California, Colorado, Delaware, Idaho, Illinois, Indiana, Iowa, Kansas, Louisiana, Michigan, Minnesota, Montana, Nebraska, Nevada, New Jersey, New Mexico, New York, North Dakota, Ohio, Oklahoma, Oregon, Pennsylvania, South Dakota, Texas, Utah, Wisconsin, and Wyoming.

This legislation will help us solve this problem. It will create local centers of water research. It will enlist the intellectual power of universities and research institutes in a nationwide effort to conserve and utilize our water resources for the common benefit. The new centers will be concerned with municipal and regional, as well as with national water problems. Their ready accessibility to State and local officials will permit each problem to be attacked on an individual basis, the only way in which the complex characteristics of each water deficiency can be resolved. The bill contemplates a high degree of interstate cooperation, and I urge that this be encouraged.

In large measure, this legislation is a tribute to the vision and wisdom of Senator Clinton P. Anderson of New Mexico. He has long recognized the problems. He developed the program. He guided it through Congress. He has been in the forefront of the effort to see that adequate supplies of water are available in all parts of the Nation.

COLLECTION:  
*Public Papers  
of the Presidents*



Lyndon B. Johnson  
1963-64; Book II

Font Size:





HELEN BARTON



DONALD OWEN BART



ELITE LINDLUND BART



PATRICIA ANN BRIDGES



FRANCIS D. BELL III



JAMES CHARLES  
BELLER



FREDERICK W. BIRK



CHRISTINA BISHOP



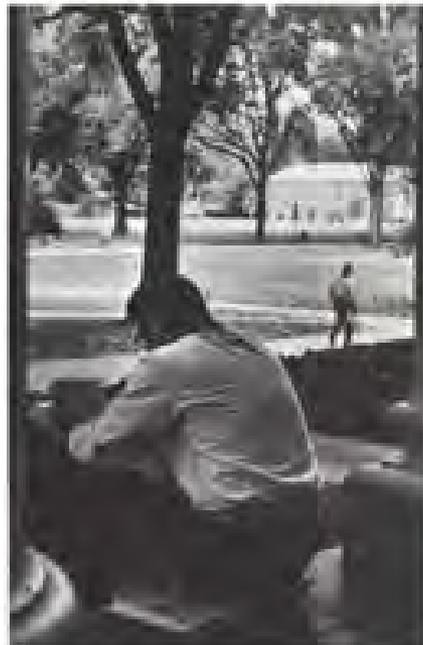
ROBERT D. BISHOP JR.



DAVID PAUL BISHOP



WALTER B. BULLOCK



A friend from the capital invited to  
walk up with my "best man."

*The Blue Hen. Newark, Del.: University of  
Delaware, 1965.*

CLOSE X

# Delaware Water Resources Center DWRC at the University of Delaware

## Undergraduate Internships In Water Resources 2015



UNIVERSITY OF DELAWARE | College of Agriculture & Natural Resources

*Delaware Water Resources Center (DWRC) Undergraduate Internships in Water Resources provide a unique opportunity for undergraduate students and faculty to become directly involved in research and education projects addressing water resource related issues of critical importance to Delaware and the Mid-Atlantic region.*

### Eligibility

All undergraduate students enrolled at an institution of higher learning in Delaware may apply, except for those graduating at the end of the spring semester. All students must have the active support of a faculty advisor and a minimum GPA of 3.0. (If a student applies for any other UD-sponsored summer research experience s/he must indicate this on the **DWRC** application. The **DWRC** intends to award internships to only those students who have not been awarded another internship within a calendar year.)

### Program Details and Deadline

The **DWRC** provides \$3500 in financial support for each undergraduate internship. Students typically work ten weeks full-time during the summer and additional hours during the fall and winter. Interns must submit a written report on their project and participate in a poster session at the UD spring undergraduate research conference. The application deadline for 2015 DWRC internships is March 27, 2015. See second page for more information. For details on past projects, current faculty advisors, application materials to submit, and requirements for reports and posters, visit the **DWRC** website: <http://ag.udel.edu/dwrc/>

### Delaware Water Resources Center (DWRC) interns

experience a complete research or education project. Students, in cooperation with faculty advisors, identify a topic of interest, develop the approach to accomplish their objectives, conduct the project, analyze the results, and share their findings and accomplishments with the academic and water resource communities. **DWRC** financial support helps students to apply classroom education in "hands on" projects addressing contemporary regional water quality concerns. Water Resources interns embark on a program of self-discovery permitting informed choices about future undergraduate research, graduate education opportunities, and careers in water science, policy, and management.

### The DWRC Internship Program

**All DWRC interns** conduct a project consistent with the **DWRC's** research and educational interests (listed below in the green box) with the support of a faculty advisor from one of our **co-sponsor organizations**. Internships may be available in sponsorship with the following:

**University of Delaware (UD) Water Resources Agency** (<http://www.wra.udel.edu/wra/>): Internships are supported which focus on water resource policy and management.

**UD College of Agriculture and Natural Resources** (<http://canr.udel.edu/>): Projects are supported to work with faculty in the departments of *Animal and Food Sciences, Entomology and Wildlife Ecology, Applied Economics and Statistics, or Plant and Soil Sciences*. For example, an internship in the Department of *Plant and Soil Sciences* could relate soils, plants, and land management to water use and quality.

**UD College of Arts and Sciences** (<http://www.cas.udel.edu/>): Students can conduct internship projects in *Biological Sciences, Chemistry, Political Science, Public Policy, or other subjects* closely related to water resources.

**UD College of Earth, Ocean, and Environment** (<http://www.ceoe.udel.edu/>): Internships are supported in the areas of *Geography, Geology, Marine Biology and Biochemistry, Marine Policy, Oceanography, or Physical Ocean Science and Engineering*.

**UD College of Engineering** (<http://www.engr.udel.edu/>): Projects can be developed in areas such as *Chemical Engineering, Civil and Environmental Engineering, or Mechanical Engineering*.

**Delaware Geological Survey** (<http://www.dgs.udel.edu/>): Researchers offer internships focusing on hydrogeology, ground water supply, and water quality.

**Delaware State University** (<http://cars.desu.edu/>): Faculty support internships in the areas of agriculture, natural resources, aquaculture, and aquatic ecology.

**Delaware Department of Natural Resources and Environmental Control** (<http://www.dnrec.delaware.gov/>): Staff in DNREC offices related to water resources occasionally offer internships on topics such as soil and water conservation, water quality, and climate change.

### Topics in water resources research and education of interest to the DWRC:

- Water pollutants - their sources, fate, cycling, and transport
- Water supply, demand, and conservation
- Groundwater identification and protection
- Nutrient management and water quality
- Management and control of storm water runoff
- Treatment and re-use of wastewaters
- Protection and restoration of wetlands
- Pathogens, public health, and water quality
- Water resources topics in marine studies
- Water resources policy issues

### How to Apply for a DWRC Internship

**Select your topic.** **DWRC** internships are for students from a wide variety of backgrounds and research interests. Titles of past projects can be found at <http://ag.udel.edu/dwrc/interns.html> and <http://ag.udel.edu/dwrc/publications/DWRCInternshipSpotlight2009.pdf> and include: *White Clay Creek Shad Restoration Project (Water Resources Agency); Developing Scientifically-Based Food Safety Metrics for Water Management and Irrigation Methods (Animal and Food Sciences); The Returns to Best Management Practices: Evidence from Early Proposals for Nutrient Trading in the Chesapeake Bay Watershed (Applied Economics and Statistics); Water Quality Management in Urban Ecosystems (Plant and Soil Sciences); The Impacts of Redefining Navigable Waters under the Clean Water Act (Political Science); Sediment Transport through Historic Mill Dams of the Christina River Basin (Geology); Characterization of Viral Diversity within the Mantel Fluid of the Eastern Oyster, Crassostrea virginica (Marine Biology); Preventing Formation of Toxic Chlorination Byproducts in Water Using Zerovalent Iron (Civil and Environmental Engineering); Hydraulic Properties of the Columbia Aquifer (Delaware Geological Survey); and Aquatic Health near Wastewater Discharge in Delaware Inland Bays Tidal Canal (Delaware State University).*

**Find a Faculty Advisor and Apply to the DWRC:** Faculty contacts and their research interests are also listed on the **DWRC** website, under "Faculty and Staff". Contact the **DWRC** program coordinator, Maria Pautler ([mpautler@udel.edu](mailto:mpautler@udel.edu); 302-831-0847), to say that you are interested. Students should contact potential faculty advisors to discuss and identify a project topic of mutual interest and then submit their application to the **DWRC** by the deadline (**March 27, 2015**). Faculty may not advise more than two interns concurrently and must provide matching funds consistent with **DWRC** guidelines, usually by committing a percentage of their time to the intern's project.



### Delaware Water Resources Center

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Newark, DE 19716  
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Photos by Danielle Quigley

<http://ag.udel.edu/dwrc/>

**DELAWARE WATER RESOURCES CENTER**  
**ADVISORY PANEL (APRIL 2014)**

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<http://www.ipa.udel.edu/directory/homepages/corrozi.html>

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Dover, DE 19901  
phone: (302) 734-2506 x. 244  
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<http://md.water.usgs.gov/profiles/reves.html>

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Soil Sciences  
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[http://www.dnrec.delaware.gov/swc/wa/Pages/Chesapeake\\_Wip.aspx](http://www.dnrec.delaware.gov/swc/wa/Pages/Chesapeake_Wip.aspx)



# NIWR & USGS A Model Partnership



## PARTNERSHIP WITH USGS

- The National Institutes for Water Resources (NIWR) partners with the U.S. Geological Survey (USGS) through the provisions of the Water Resources Research Act (WRRA) to address water-related concerns by providing a national platform for research, training and collaboration.
- USGS provides each institute with a grant to target local priorities, recruit researchers and leverage federal funds with state money and private funding.
- 54 NIWR member institutes are housed in the country's land-grant universities in all 50 states, three U.S. territories and the District of Columbia.
- NIWR is the only federally mandated research program that focuses on applied water resource research, education, training and outreach.

## MAXIMIZING FEDERAL IMPACT

NIWR's ability to attract and match non-federal funds to USGS grant-sponsored research multiplies the federal investment in local water projects. The NIWR-USGS partnership also strengthens USGS's own funding model, as NIWR institutes often allow funds to pass through the institutes to USGS State Water Science Centers. The NIWR institutes open doors for the USGS at the state-level to other funding sources that may require non-federal matching funds. In recent years, the USGS State Water Science Centers have benefitted from funds that have flowed through NIWR institutes from external sources for technical assistance and scientific expertise on large-scale, multi-partner projects that address emerging water research needs.

## IMPACT & COLLABORATION

- NIWR member institutes assist public and private sector groups in their mission to protect human health, environmental resources and economic sustainability.
- Last year, NIWR member institutes sponsored more than 1,200 groundbreaking research projects.
- Grants from USGS and other sponsors are awarded through a competitive, peer-reviewed process.
- NIWR member institutes collaborated on projects with over 200 universities, 150 state agencies, 180 federal agencies, departments and divisions, and more than 165 local and municipal offices.



Housed in the nation's leading research universities, NIWR

## WANTED: INTERNS

The USGS is encouraging NIWR institutes to take advantage of its nationwide internship program, details of which follow:

- The interns are hired by the NIWR institute but work with USGS Water Science Center researchers.



# What is NIWR?

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- Association of the Directors of the 54 Water Resources Research Institutes
- Dues from the institutes support it; volunteer led
- 50 states plus DC, Guam, Virgin Islands and Puerto Rico
- Representation in Washington, DC
- Van Scoyoc Associates – Jan Schoonmaker and Leslee Gilbert
- <https://niwr.net>

# The Network of Water Resources Research Institutes



# National Institutes for Water Resources (NIWR)

## Mid-Atlantic Water Resources Institutes



## California

<http://ciwr.ucanr.edu/>

California Institute for Water Resources  
University of California  
1111 Franklin Street, Rm. 10206  
Oakland, California 94607

Dr. Doug Parker, Director  
doug.parker@ucop.edu  
Phone: (510) 987-0036  
Fax: (510) 832-8612

## Colorado

<http://cwrr.colostate.edu/>

Colorado Water Institute  
Colorado State University  
E-102 Engineering Building  
Fort Collins, Colorado 80523-1033

Dr. Reagan M. Waskom, Director  
reagan.waskom@colostate.edu  
Phone: (970) 491-6308  
Fax: (970) 491-1636

## Connecticut

<http://www.ctiwr.uconn.edu/>

Connecticut Institute of Water Resources  
The University of Connecticut  
W. B. Young Building, Room 308  
1376 Storrs Road, U-18  
Storrs, Connecticut 06269-4018

Dr. Glenn Warner, Director  
glenn.warner@uconn.edu  
Phone: (860) 486-2840  
Fax: (860) 486-5408

## Delaware

<http://ag.udel.edu/dwrc/>

Water Resources Center  
University of Delaware  
113 Townsend Hall  
Newark, Delaware 19716-2103

Dr. Gerald J. Kauffman, Director  
jerryk@udel.edu  
Phone: (302) 831-4929

## Pennsylvania

<http://www.pawatercenter.psu.edu/>

Pennsylvania Water Resources Research Center  
The Pennsylvania State University  
304 Forest Resources Building  
University Park, Pennsylvania 16802

Dr. Elizabeth W. Boyer, Director  
ewb100@psu.edu  
Phone: (814) 865-8830  
Fax: (888) 865-8454

## Guam

<http://www.weriguam.org/>

Water and Environmental Research Institute of the  
Western Pacific  
University of Guam  
303 University Drive  
Mangilao, Guam 96923

Dr. Shahram Khosrowpanah, Director  
khosrow@uguam.uog.edu  
Phone: 011 (671) 735-2694  
Fax: 011 (671) 734-8890

## Hawaii

<http://www.wrrc.hawaii.edu/>

Water Resources Research Center  
University of Hawaii  
2540 Dole Street, Room 283  
Honolulu, Hawaii 96822

Dr. Darren T. Lemer, Interim Director  
lerner@hawaii.edu  
Phone: (808) 956-7031  
Fax: (808) 956-3014

Dr. Aly El-Kadi, Associate Director  
elkadi@hawaii.edu

## New York

<http://wri.eas.cornell.edu/>

New York State Water Resources Institute  
Department of Earth and Atmospheric Sciences  
Cornell University  
1123 Bradfield Hall  
Ithaca, New York 14853-1901

Dr. Susan Riha, Director  
nyswri@cornell.edu  
Phone: (607) 255-3034  
Fax: (607) 255-2106

## Vermont

<http://www.uvm.edu/snr/vtwater/>

Vermont Water Resources and Lake Studies Center  
George D. Aiken Center for Natural Resources  
The University of Vermont  
81 Carrigan Drive  
Burlington, Vermont 05405

Dr. Breck Bowden, Director  
breck.bowden@uvm.edu  
Phone: (802) 656-2513  
Fax: (802) 656-8683

## Virgin Islands

<http://www.uvi.edu/sites/uvi/Pages/WRRRI-Home.aspx>

Virgin Islands Water Resources Research Institute  
University of the Virgin Islands  
St. Thomas, Virgin Islands 00802

Dr. Henry H. Smith, Director  
hsmith@uvi.edu  
Phone: (340) 693-1062  
Fax: (340) 693-1205

# Water Resources Research Act Program Administration

## U.S. Geological Survey Water Resources Discipline

### Office of Chief of Research and Programs for Water

Jerad D. Bales  
Chief of Research and Science for Water  
MS 436, Water Resources Division  
U.S. Geological Survey  
12201 Sunrise Valley Drive  
Reston, Virginia 20192

jdbales@usgs.gov  
Phone: (703) 648-5048  
Fax: (703) 648-5002

### Office of External Research

Earl A. Greene  
Chief, Office of External Research  
U.S. Geological Survey  
5522 Research Park Drive  
Baltimore, MD 21228

eagreene@usgs.gov  
Phone: (443) 498-5505  
Fax: (703) 648-5002  
<http://water.usgs.gov/wrri/>

Karen Zackschewski, Secretary  
Chief of Research & Science for Water  
MS 436, Water Resources Division  
U.S. Geological Survey  
12201 Sunrise Valley Drive  
Reston, Virginia 20192

kzackschewski@usgs.gov  
Phone: (703) 648-5041  
Fax: (703) 648-5002

# Reauthorization of WRRRA

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## ➤ Last reauthorized 2007

- The authorization for appropriations expired at the end of FY 2012, but we have appropriated the last few years.
- Reauthorization relates to appropriations

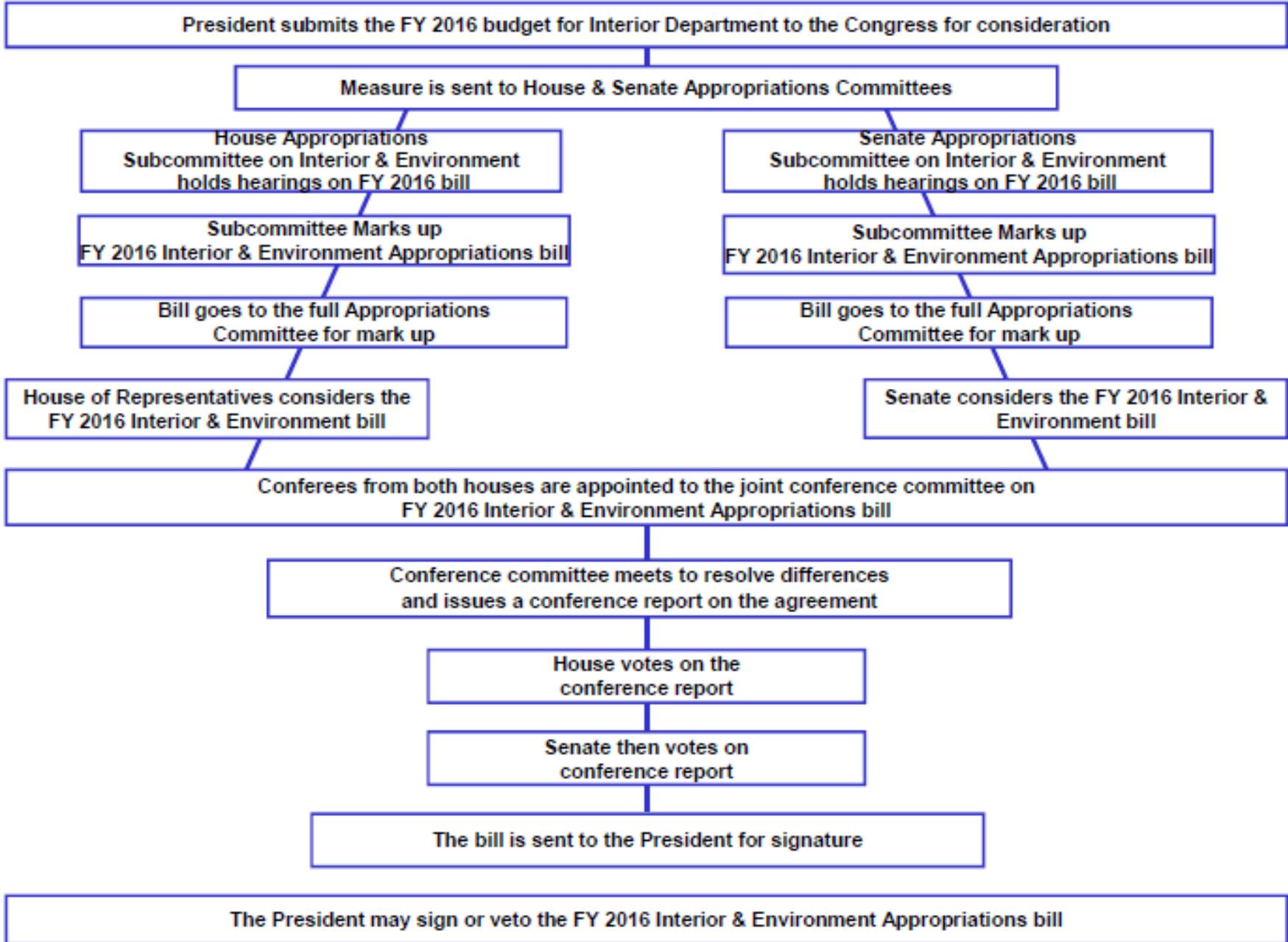
## ➤ Have been working on reauthorization

- Will have to work on legislation in this new Congress

# Appropriations to support 104b and 104g programs

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- FY15 -- \$6.5 Million in President Obama's Budget!
- FY14 – not in President's budget; \$6.5 million in Cromnibus Budget
- FY13: Not in President' s Budget  
Continuing Resolution & Sequestration  
USGS reduces programmatic funding
- (~\$55K/Institute and eliminated 104G)



# Key Dates and Activities

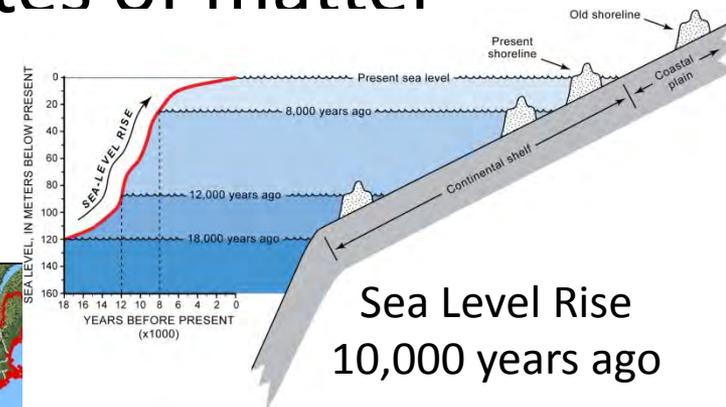
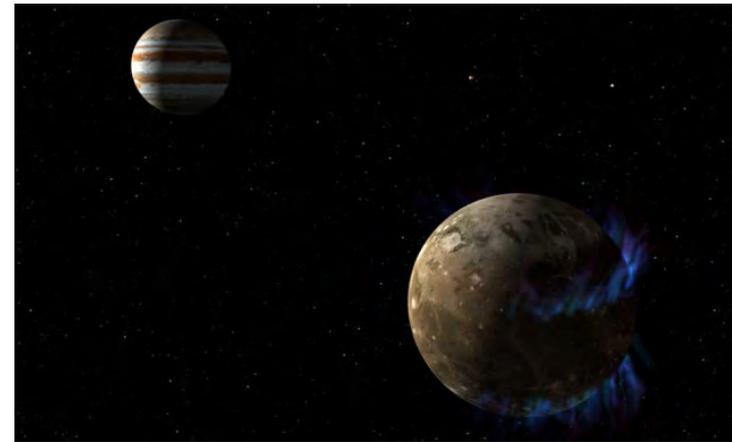
- **NIWR 104B Applications:** due mid-January
- **NIWR Annual Meeting:** usually mid-Feb
- **NIWR 104G Applications:**
  - National Competitive Grants Program
  - Proposals due are February 19, 2015, 5:00 PM ET
  - Institute approval by March 12, 2015, 5:00 PM ET
- **3-yr Review of Institutes conducted for 2008-2010 in 2014**
- **Institute Annual Report:** due annually June
- Reporting through online system available at all times through IPRS system

# Research Activities of the Delaware Water Resources Center

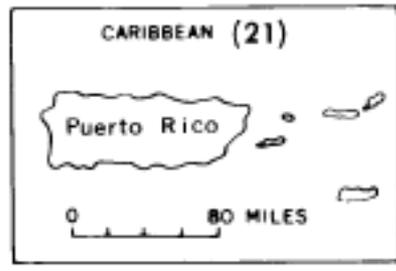
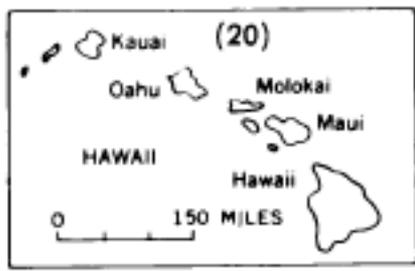
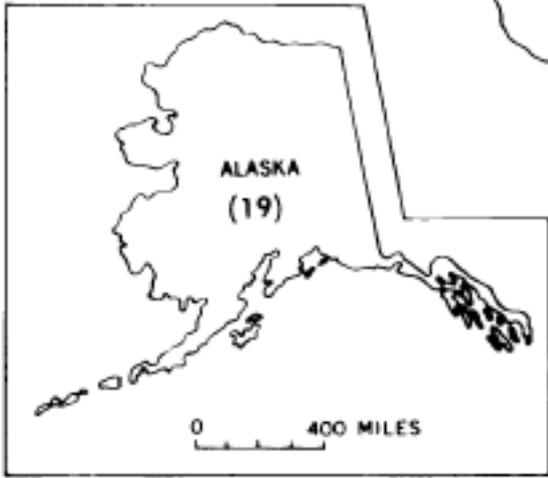
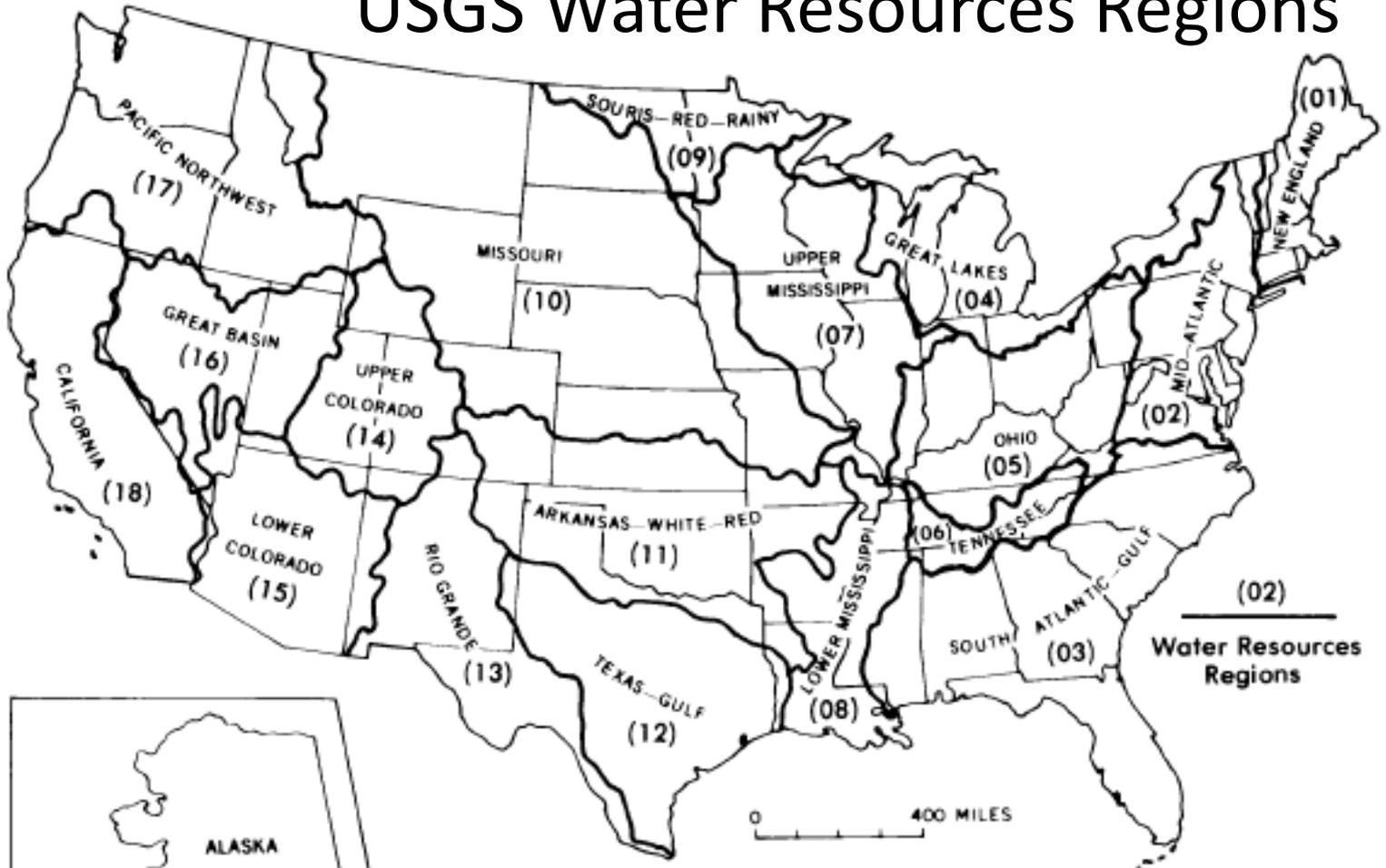


# Water

- 97-3-1
- Essential for life
- Most precious chemical ( $H_2O$ )
- Universal solvent
- Exists in nature as all three states of matter
- No economic substitute



# USGS Water Resources Regions



(02) **Water Resources Regions**



# Delaware River Basin



# Christina River Basin



The University of Delaware is fortuitously situated on campuses ideally suited by hydrology and geography to study water resources.

# DRBC Compact 1961 AD



# HOUSE APPROVES DELAWARE PACT

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**Federal - State Agreement  
on Basin Development  
Passes After Debate**

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## POWER ISSUE IS RAISED

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**Action by Senate Is Only  
Remaining Obstacle  
to New Agency**

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*Special to The New York Times.*

WASHINGTON, June 29—

## DELAWARE COMPACT APPROVED IN SENATE

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WASHINGTON, Sept. 15 (AP)—The Senate unanimously passed today a bill to create a four-state compact for the development of Delaware River Basin water resources. Differences with the House bill, passed on June 29, were expected to be ironed out promptly.

The only major change in the Senate version stipulates that any project undertaken by the interstate agency to be set up by the compact must have authorization of Congress if Federal funds are involved.

After House and Senate agreement the measure will go to President Kennedy for signing, ending a generation of study, negotiation and planning for the compact.

# FOUR STATES SIGN DELAWARE PACT

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**President Joins in Approving  
Vast Program for Basin  
Backed by Governors**

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## COMMISSION IS SET UP

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**Developing of River Valley  
Will Use, Conserve and  
Protect Vital Supply**

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By **RUSSELL BAKER**

*Special to The New York Times.*

FRIDAY, NOVEMBER 3, 1961.

# The New York Times.



Chesapeake, Delaware, and Hudson Basins

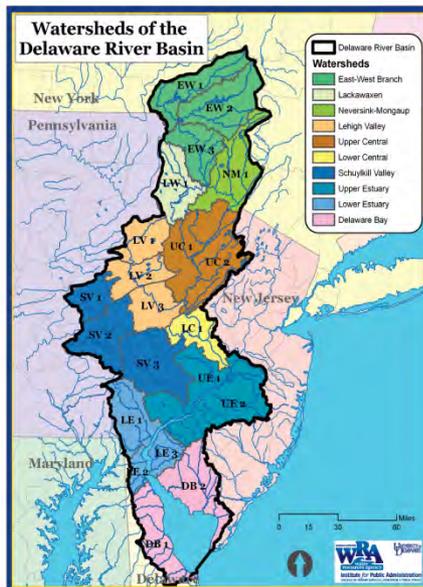
# C-D-H Basin

- 2% of US land mass
- 10% of U.S. population,
- 1<sup>st</sup> and 6<sup>th</sup> largest cities in US, 6 state capitals, US Capitol
- 42<sup>nd</sup>, 55<sup>th</sup>, and 85<sup>th</sup> longest rivers in the US.
- Chesapeake longest navigable estuary in US (194 miles)
- Hudson (194 mi) and Delaware (96 mi), 3<sup>rd</sup> and 5<sup>th</sup> longest navigable tidal rivers.
- All 3 estuaries are drowned river systems
- Hudson is a fjord once carved by glaciers

# Technical Summary

## State of the Delaware River Basin Report

A Report on the Health of the 13,539-square-mile Delaware River Basin  
in Delaware, New Jersey, New York, and Pennsylvania



July 4, 2008



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[www.ipa.udel.edu](http://www.ipa.udel.edu)

The University of Delaware's Institute for Public Administration (IPA) addresses the policy, planning, and management needs of its partners through the integration of applied research, professional development and the education of tomorrow's leaders.

### Delaware River Basin Partners

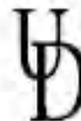


Cornell University



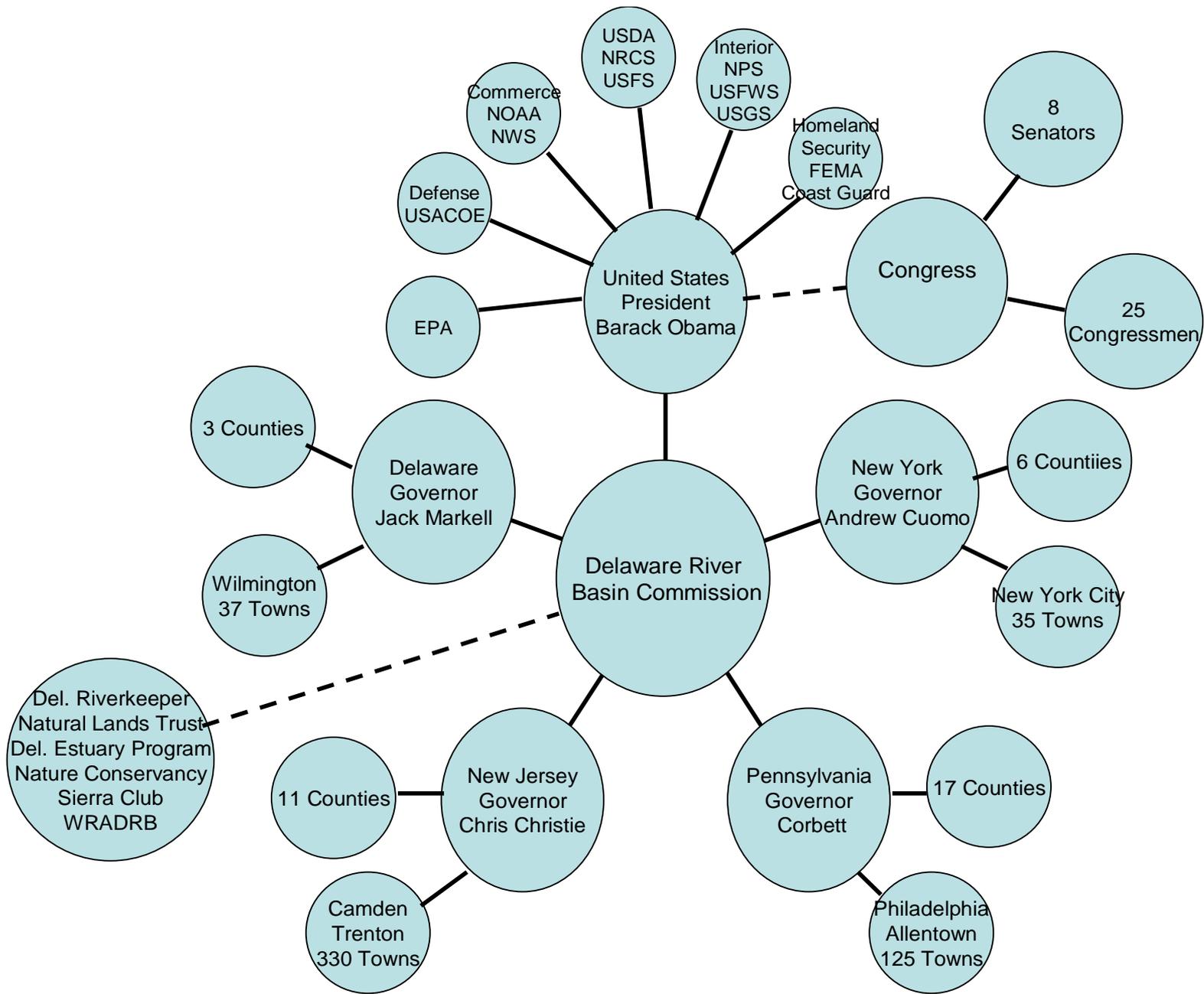
RUTGERS

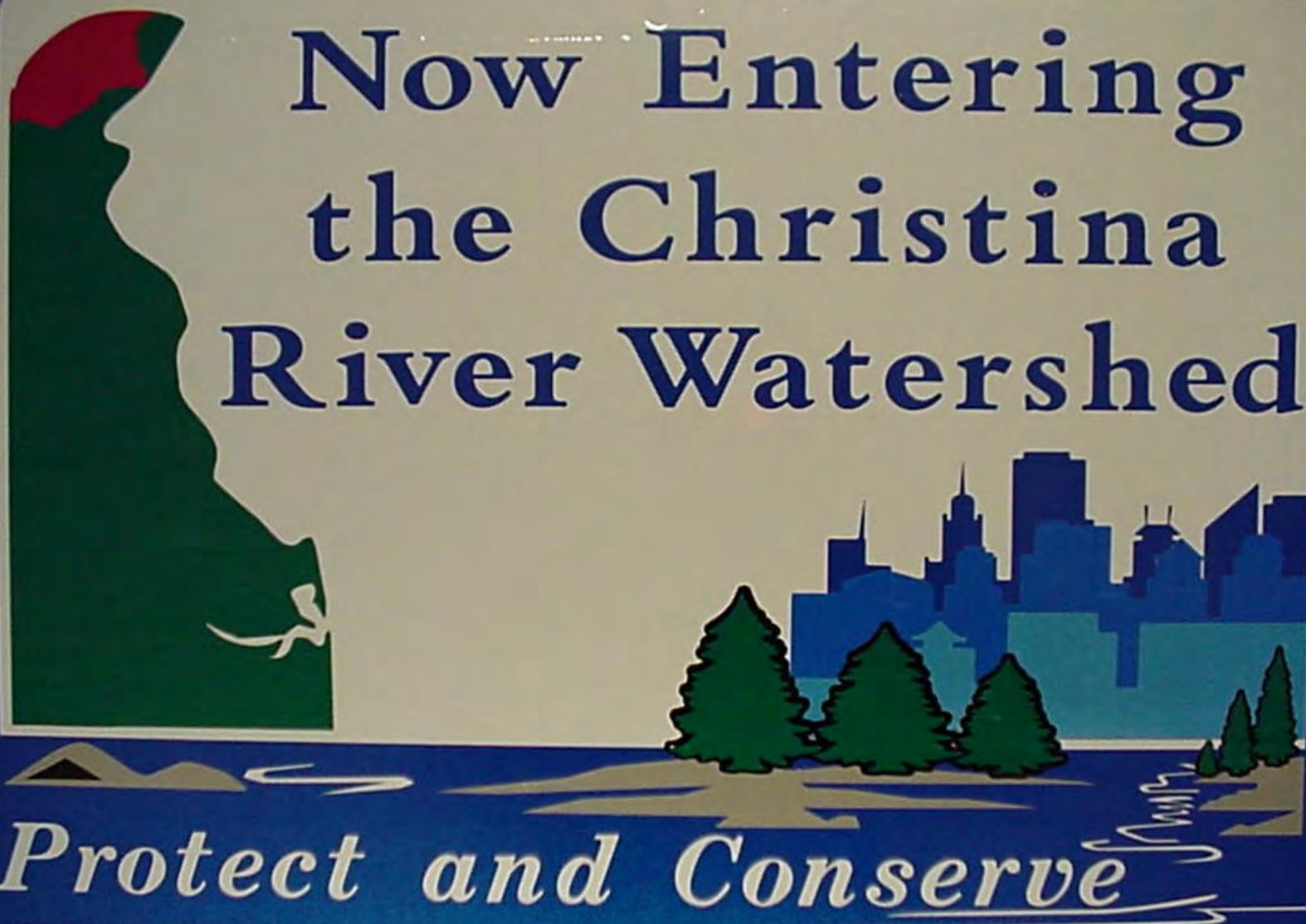
PENNSTATE



#### An Equal Opportunity/Affirmative Action Employer

The University of Delaware is committed to assuring equal opportunity to all persons and does not discriminate on the basis of race, creed, color, gender, age, religion, national origin, veterans or handicapped status, or sexual orientation in its educational programs, activities, admissions or employment practices as required by Title IX of the Educational Amendments of 1972, Section 504 of the Rehabilitation Act of 1973, Title VII of the Civil Rights Act of 1964, and other applicable statutes. Inquiries concerning Section 504 compliance and information regarding campus accessibility should be referred to the Americans with Disabilities Act (ADA) Coordinator, 621-4643, located at 417 Academy Street. Inquiries concerning Title VI and Title IX should be referred to the Office of the Assistant Vice President for Affirmative Action, 621-6716, located at 124 Hollins Hall.



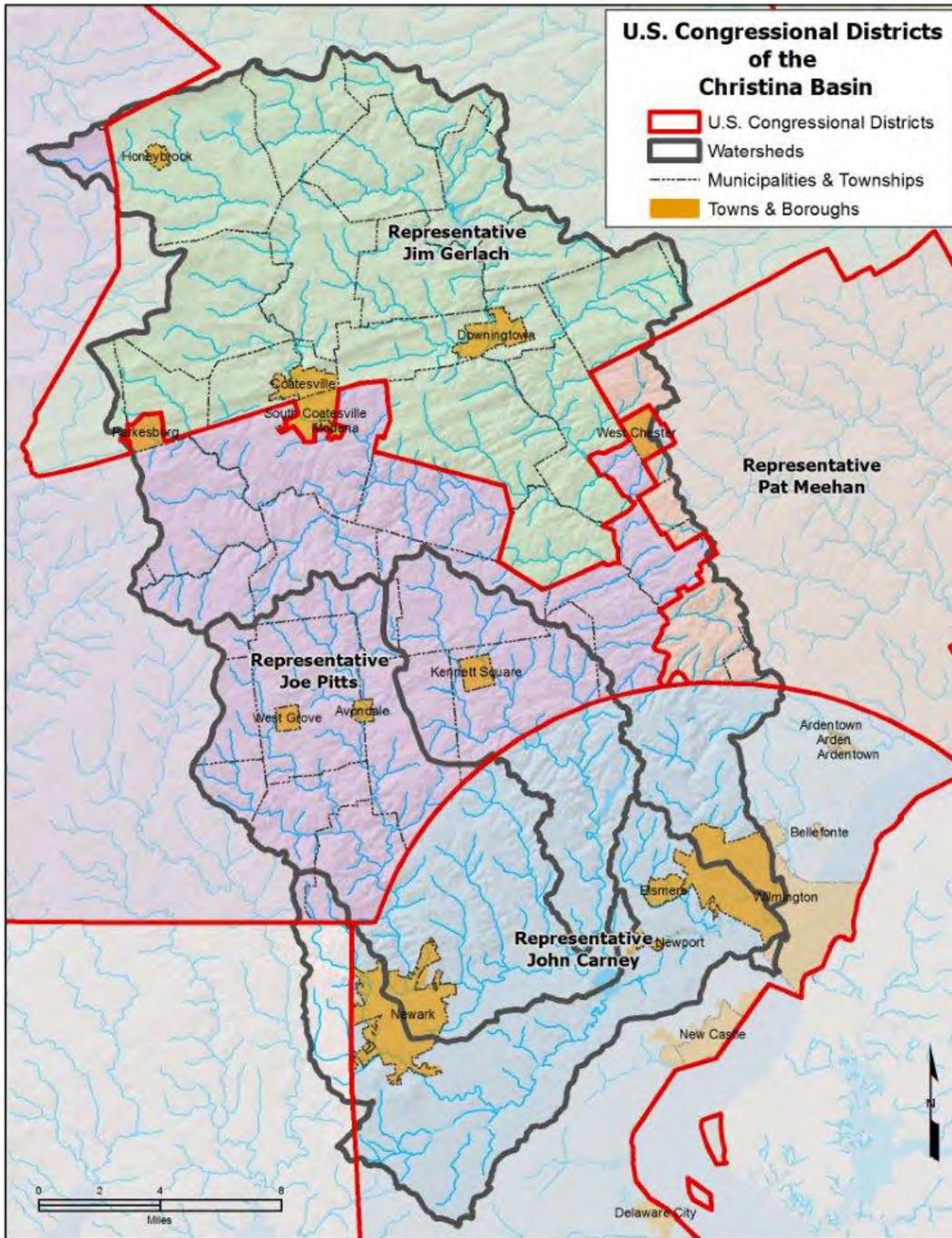


Now Entering  
the Christina  
River Watershed

*Protect and Conserve*

# U.S. Congressional Districts of the Christina Basin

-  U.S. Congressional Districts
-  Watersheds
-  Municipalities & Townships
-  Towns & Boroughs



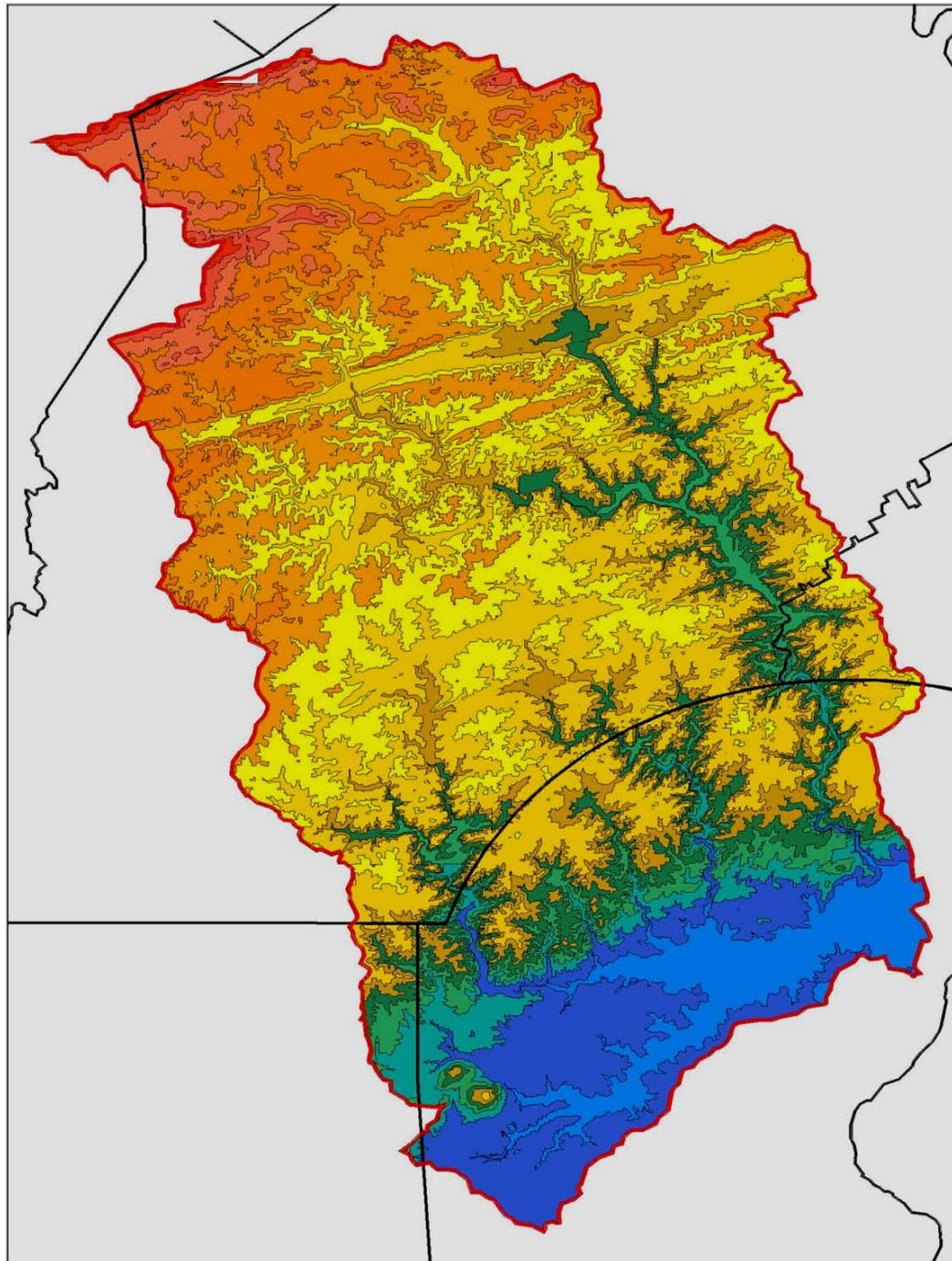




Figure 1. Map of Newark and environs (source: Water Resources Agency, Institute for Public Administration, University of Delaware\*, 2008)

# Water in Environmental Planning

Thomas Dunne and Luna B. Leopold

30  
Introduction

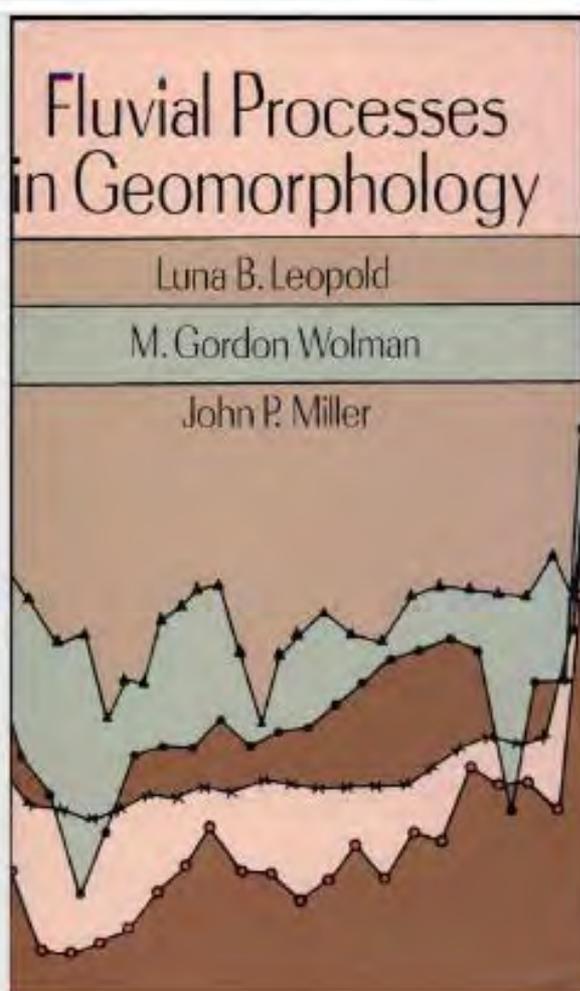
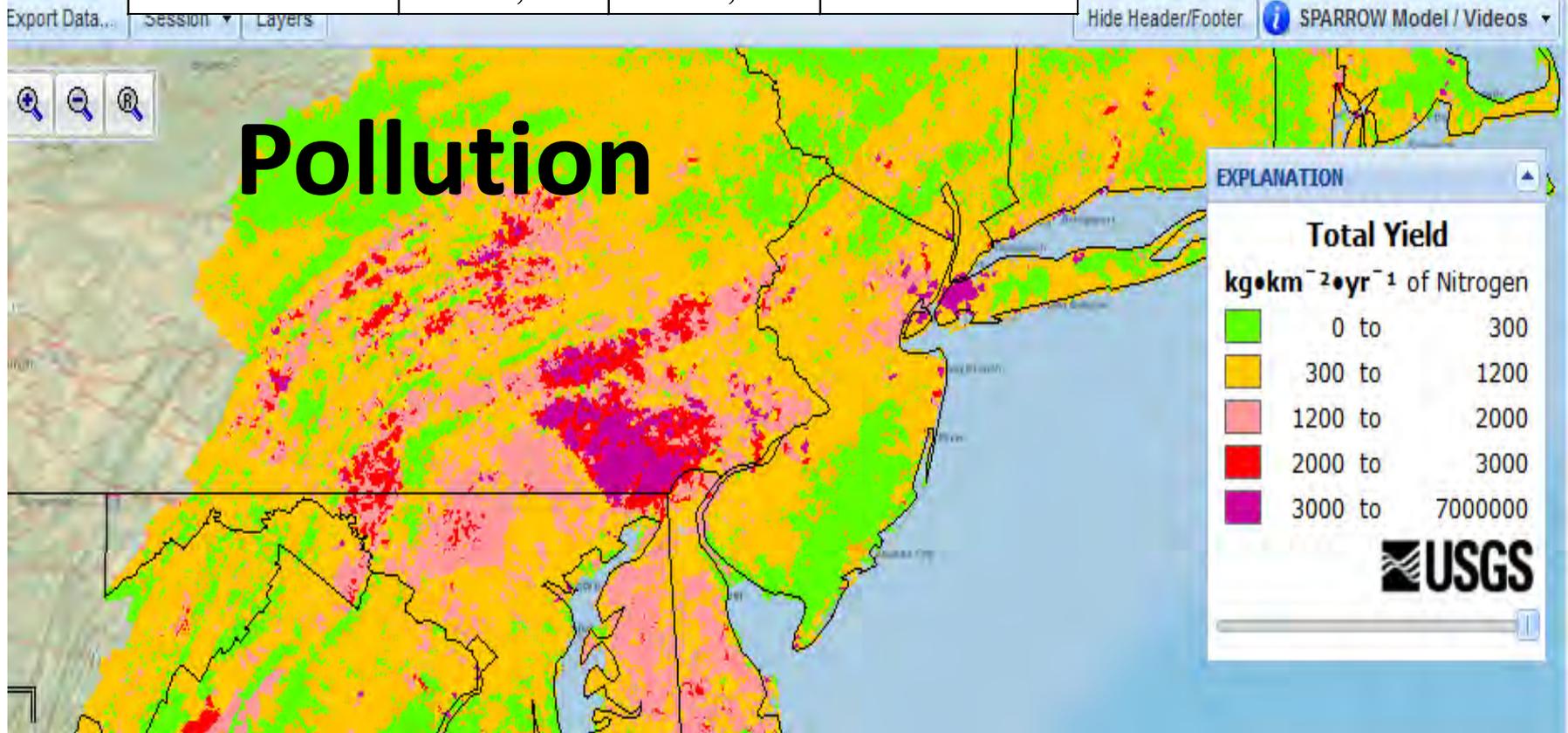


Figure 1-17 Load of soluble and insoluble phosphorus passing stations on the East Branch of the Brandywine Creek, August 13-14, 1973. Numbers are in kilograms of phosphorus per day. Hatched areas are towns and villages. (Modified after Colwell et al. 1975.)

River Basin	Drainage Area (mi <sup>2</sup> )	Nitrogen Load (ton/yr)	Unit N Load (ton/mi <sup>2</sup> /yr)
Susquehanna	27,490	73,040	2.7
Delaware	11,819	50,525	4.3
Potomac	14,658	44,707	3.0
Hudson	13,363	28,711	2.1
James	10,339	17,482	1.7
Connecticut	11,261	17,236	1.5



# 1999

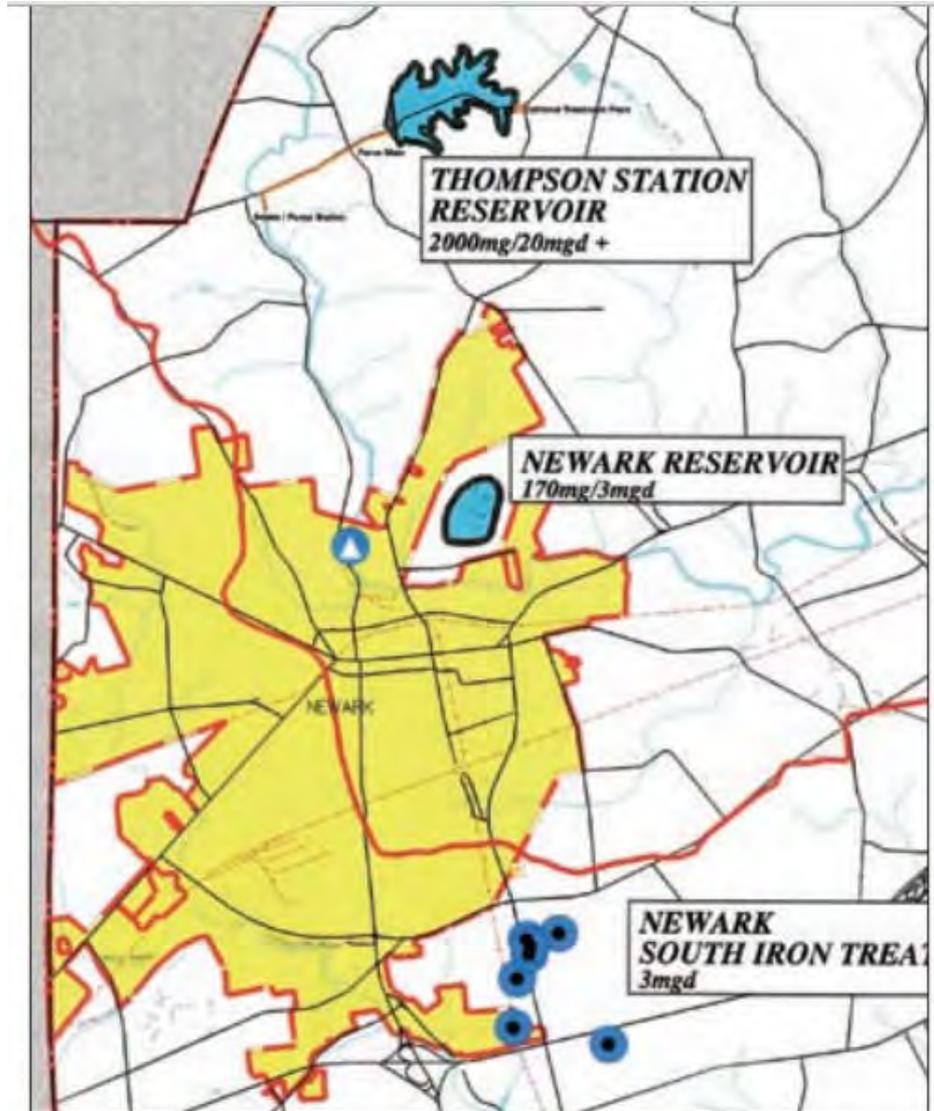


Figure 9. Map depicting the proposed Thompson Station Reservoir, Newark Reservoir, and Newark South Wellfield Iron Treatment Plant (source: WRA, 1999)

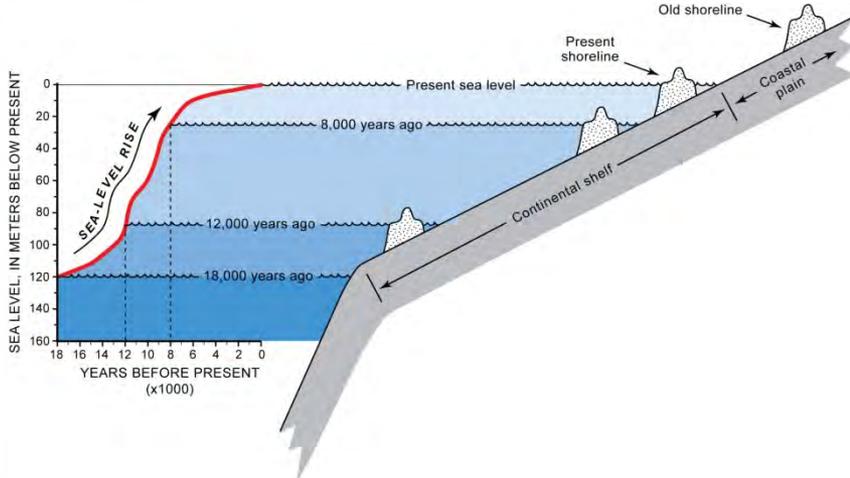
# Newark Reservoir

## 2004



# Sea Level Rise

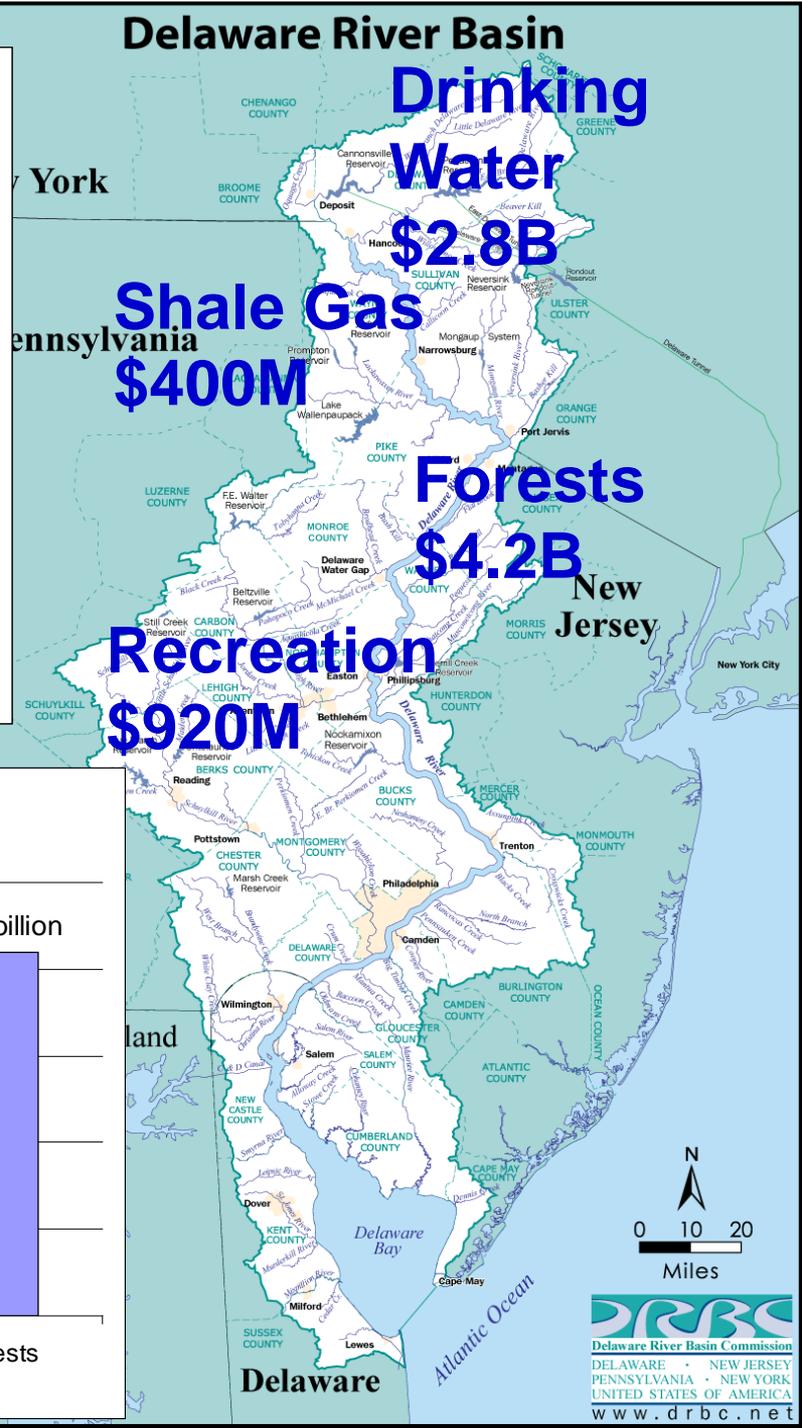
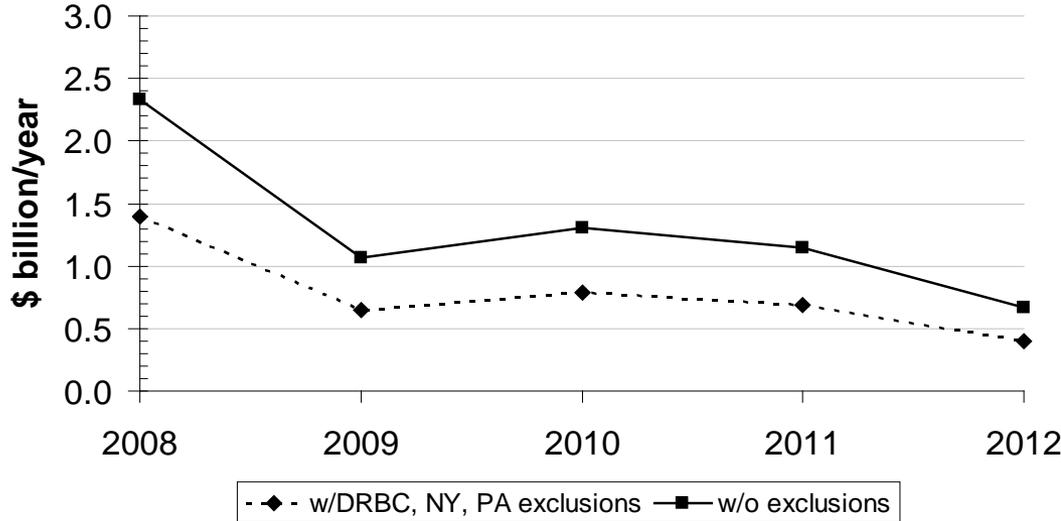
Delaware  
Mean elev. 60 ft msl



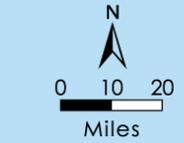
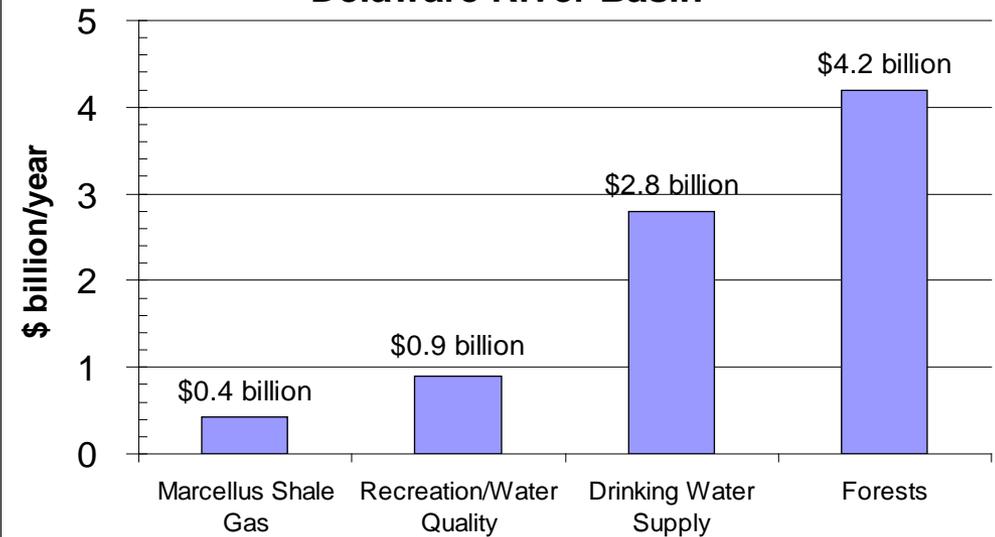
10,000 years ago

Figure 1. Sea level rise and coastal flooding impacts in Delaware (NOAA Coastal Services Center)

### Annual Wellhead Value Marcellus Shale Natural Gas Delaware River Basin



### Annual Economic Value Delaware River Basin













Dr. Jerome Lewis, Director  
IPA



**President-elect Martha B. Narvaez  
American Water Resources Association**





**Governor Jack Markell  
and  
DNREC Secretary Collin O'Mara**

**Invite you to the event announcing:**

## **Clean Water for Delaware's Future**

**A plan for protecting public health and cleaning up our bays, rivers  
and streams while creating jobs and building a stronger economy**

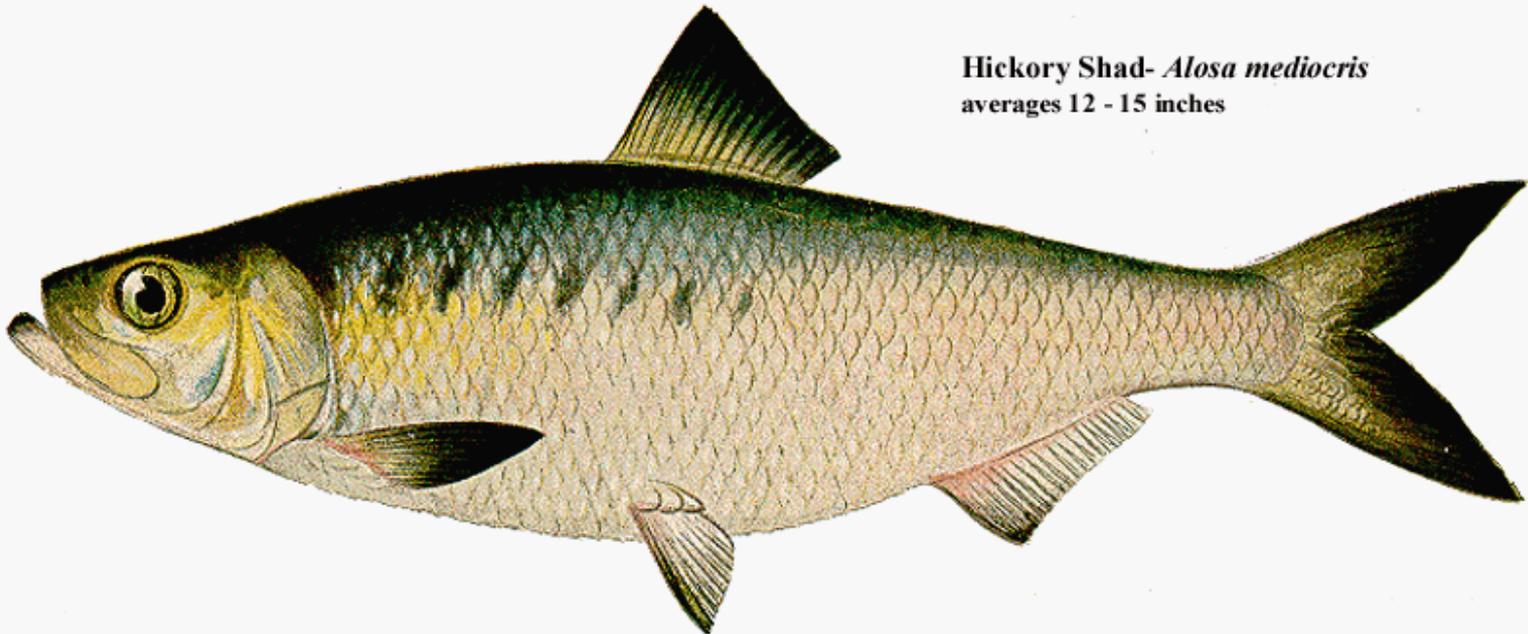
**Tuesday, March 4, 2014, 9 a.m.  
DuPont Environmental Education Center  
Wilmington Riverfront  
1400 Delmarva Lane  
Wilmington, DE 19806**

# Fishery Restoration



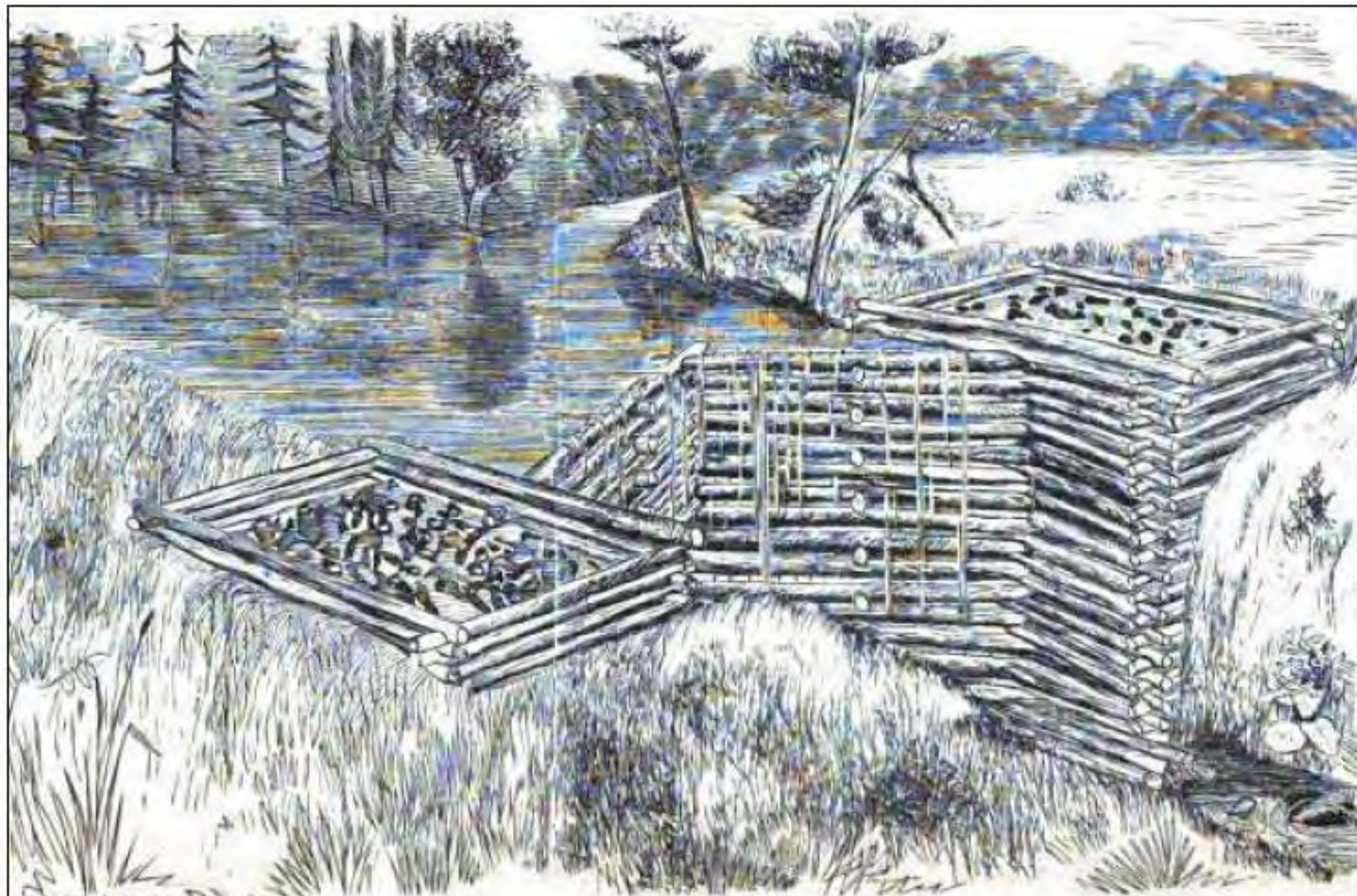
American shad - *Alosa sapidissima*  
averages 14-29 inches

## America's Founding Fish



Hickory Shad- *Alosa mediocris*  
averages 12 - 15 inches





ERARD D.L.

A CRIB DAM.





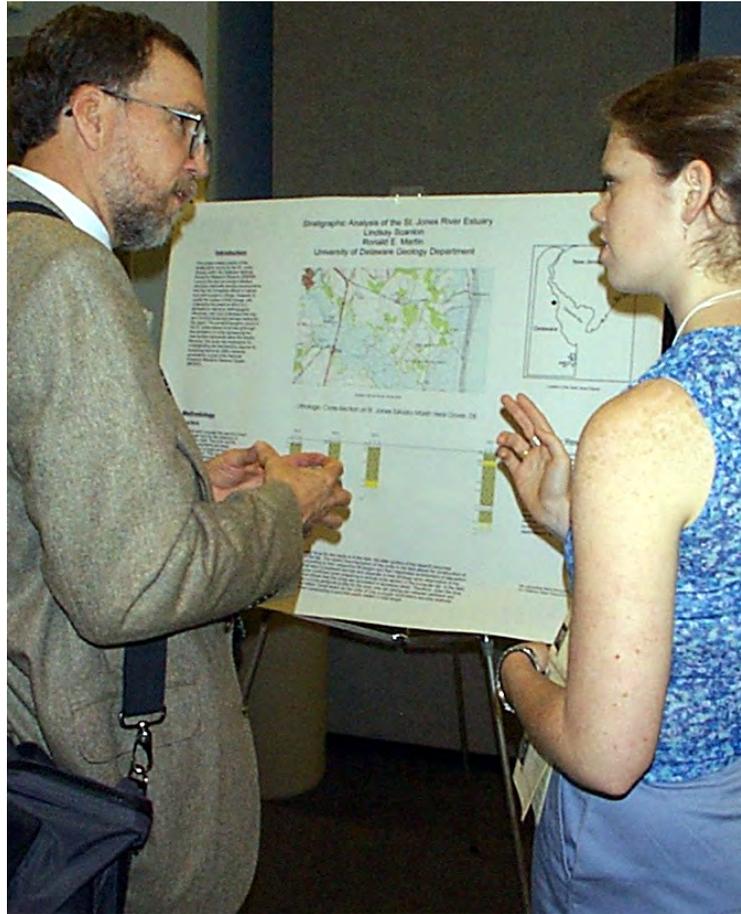
National Park Service  
U. S. Department of the Interior

# First State National Monument



# Thank you Dr. J. Thomas Sims!

Second Director of the Delaware Water Resources Center (2000-2015)



Deputy Dean

T. A. Baker Professor of Soil and Environmental Chemistry  
College of Agriculture and Natural Resources  
University of Delaware

# UD Water Conservation Campaign

## 1980s AD

