

February 23, 2007

A Pilot Study to Inventory and Enhance Data Exchange for Physical, Chemical, and Biological Water-Quality Data in Watersheds, Estuaries, and Coastal areas of the Delaware River Basin in Support of the National Water Quality Monitoring Network for U.S. Coastal Waters and their Tributaries

1. Description of the proposed study area.

The Delaware River Basin (Fig. 1) encompasses 13,539 square miles (mi²) and contains one of the longest un-dammed rivers in the United States, extending 330 miles from the confluence of its East and West branches at Hancock, N.Y. to the mouth of Delaware Bay. Significant amounts of historical and current water-quality monitoring (physical, chemical, and biological) has been conducted in the watersheds, estuaries, near-shore, and off-shore parts of the basin by Federal, State, local, private, and academic entities. It is the intent of this effort to inventory, compare methods, and enhance data exchange in support of the National Monitoring Network.

Basin hydrologic features include:

- 216 tributaries within New York, Pennsylvania, New Jersey and Delaware;
- one the world's largest freshwater tidal estuaries;
- the 782 mi² Delaware Bay;
- parts of Coastal, Piedmont, New England, Valley and Ridge, Appalachian Plateau provinces;
- recent flooding on Delaware River main stem and tributaries.

Land use, population, and water use statistics:

- Includes about 9% urban, 24% agricultural, 60% forested, and 5% wetlands;
- Nearly 15 million people (about 5% of the nation's population) rely on the waters of the Basin for drinking water which includes about 7 million people in New York City and northern New Jersey who live outside the Basin.
- World's largest freshwater port complex and one of the Nation's largest oil/container ports.
- Recreation and beach activities especially on the Atlantic Coasts of NJ and DE.

Ecological features:

- The Delaware River and Estuary are national environmental assets, including a wide range of natural habitats and wildlife such as 185 vegetation community types and 35 ecological systems. Three-quarters of the non-tidal river (about 150 miles or 241 kilometers) has been included in the National Wild and Scenic Rivers System.
- The Delaware Estuary contains more that 405,000 acres of wetlands;
- The watershed is home to more than 200 fish species including important anadromous and euryhaline fishes such as the American shad, striped bass, and sturgeon.
- The watershed provides habitat for federally protected endangered species such as dwarf wedgemussels, short-nose sturgeon, bald eagles, and bog turtles.
- The Estuary is renowned for many signature species (e.g., horseshoe crabs) and habitats (e.g., tidal marshes) that provide critical goods and food services, such as functioning as a critical international stopover for shorebirds (e.g., red knot) and serving as the basis for designation as an international biosphere reserve.
- The lower estuary also contains extensive wildlife refuges, two estuarine research reserves, and supports moderate fishing industries for both finfish and shellfish including oysters.

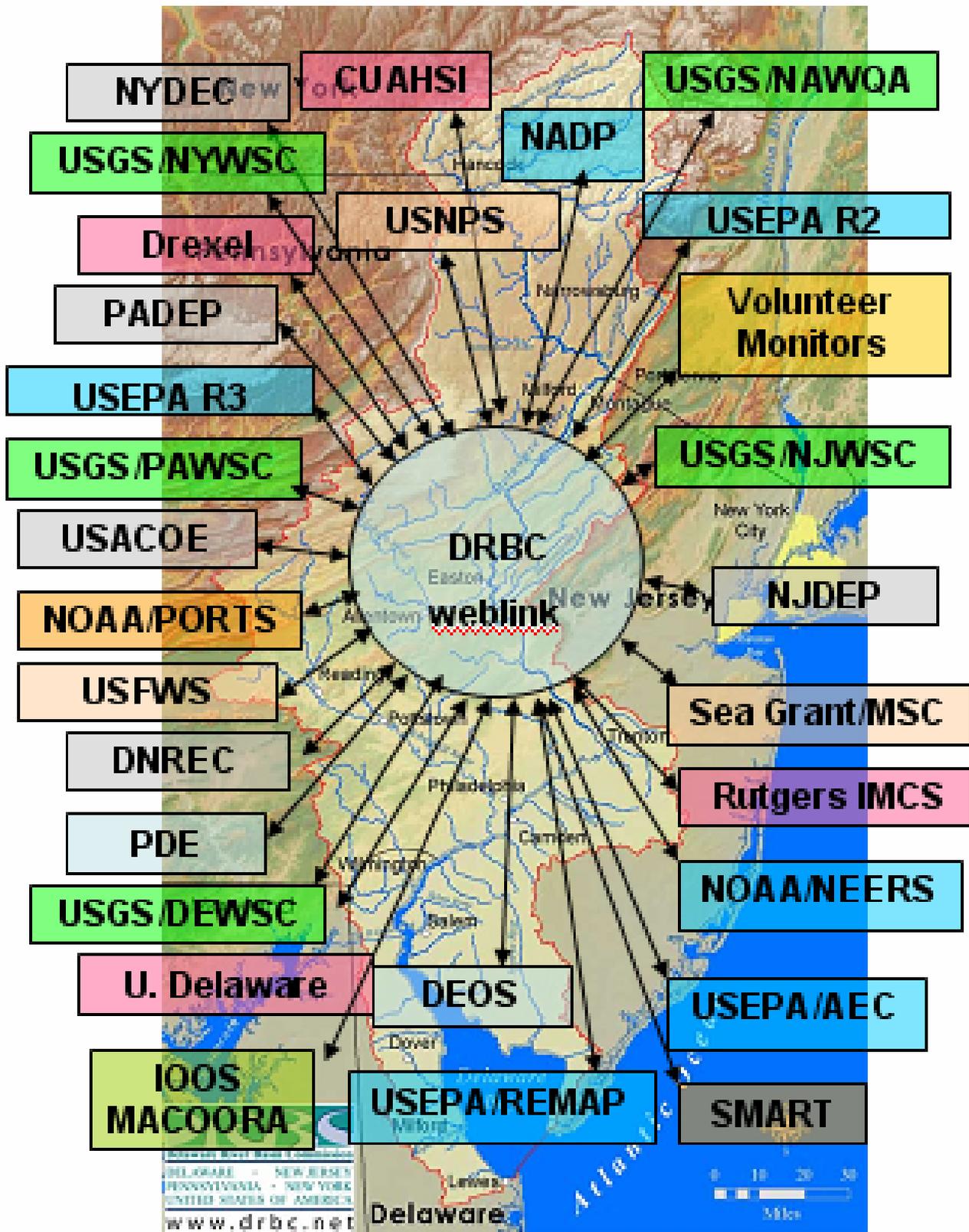


Figure 1. The Delaware River Basin Pilot Inventory project area showing Federal, State, local organizations that collect water-quality data and support the Pilot. (Names of organizations represented by acronyms are given in Table 3.)

2. Primary contact person:

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 PO Box 7360 25 State Police Drive, West Trenton, NJ 08628-0360

3. Key study partners (with institutional affiliations and clear statements of interest):

On 9/19-21/2005, a workshop convened at Rutgers University to address water-quality-monitoring and data-management issues in the Mid-Atlantic Ocean Observation Regional Association (MACOORA) with emphasis on the Delaware River Basin area. The workshop was attended by 51 invited scientists and managers (Federal/State/local/academia) with expertise in water-quality monitoring in the region. Those invited were carefully selected to cover expertise in monitoring in a 3 x 3 matrix related to (1) physical, (2) chemical, and (3) biological parameters in (1) watersheds above the head of tide, (2) estuaries, and (3) coastal areas.

Abstracts and results of facilitated breakout groups from the workshop are presented in the Proceedings from the NOAA-Supported Workshop Linking Elements of the Integrated Ocean Observing System (IOOS) with the Planned National Water Quality Monitoring Network (Rowe, Hameedi, and Weinstein, eds. in press). (<http://marine.rutgers.edu/cool/coolresults/2005/>) Recommendations of the workshop included: (1) a need for improved water-quality data exchange among the various groups; and (2) the DRB would serve as an ideal candidate for a Pilot study to test the design of the NMN.

A Steering Committee (SC) consisting of representatives from DRBC, Federal, State, and academic entities decided to respond to the request for a Letter of Interest by the NWQMC for a Pilot Inventory study in support of the NMN. The SC decided that the DRBC should be the lead agency in the Pilot Study effort because it has jurisdiction over the entire basin and regulates water quality. The SC reached out to others—many who participated in the Rutgers Workshop—and came up with a plan to conduct a detailed inventory of water-quality monitoring in the DRB from April 2007 to January 2008.

Table 1. Steering Committee Members, Affiliations, and Commitment.

Member	Affiliation	Commitment
Robert Tudor	Delaware River Basin Commission (DRBC)	Chair
Rick Kropp	U.S. Geological Survey NJ Water Science Center (USGS)	USGS Liaison
Jeff Fischer	U.S. Geological Survey NAWQA (USGS)	NAWQA Liaison
Jon Kushwara	U.S. Environmental Protection Agency (USEPA)	USEPA Liaison
R. Scarborough	National Oceanographic and Atmospheric Association (NOAA) DE Dept. of Natural Resources and Env. Control (DNREC)	NERRS and DNREC Liaison
Ed Santoro	Delaware River Basin Commission (DRBC)	Inventory
Eric Vowinkel	NWQMC Methods and Data Comparability (MDCB)	Methods
Paul Morton	NJ Water Monitoring Coordination Council (NJWMCC)	Data Exchange
Danielle Kreeger	Partnership for the Delaware Estuary	Wetlands
Leslie McGeorge	NJ Depart. of Environmental Protection (NJDEP):	NJWMCC
Jonathan Sharp	U. Delaware (UDEL) College of Marine and Earth Studies	Estuaries, Acad.
Scott Glenn	Rutgers Univ. Institute of Marine & Coastal Sciences (IMCS)	Coastal, Academia
Lisa Totten	Rutgers University Cook College	Atmos., Academia

4. An approach and a detailed course of activities to accomplish the Pilot Study along with identification of anticipated milestones.

An objective of this effort is to ultimately develop a web-based interface to organize and provide access to environmental data from a range of observation systems in the Delaware River Basin (DRB) watershed including areas above the head-of- tide, estuary, and adjacent coastal ocean. This activity is viewed as a principal element of a planned Delaware Estuary, Watershed to Ocean Observing System (DEWOOS), which will integrate data from real-time sensor networks, periodically sampled discrete sites, and advanced numerical modeling to deliver user-specified environmental forecasts and prediction, and information services.

Eight tasks with timelines are identified as part of the activities of the Pilot Inventory (Table 2) for the DRB: (1) conduct monthly meetings; (2) inventory of water-quality (WQ) monitoring programs; (3) coordinate with ongoing Water Quality Data Exchange (WQX) activities; (4) evaluate the comparability of WQ data in the DRB; (5) compare current WQ network in the DRB to proposed NMN design; (6) identify WQ data gaps between the DRB and NMN; (7) assess available WQ data, data serving tools, and applicable models; and (8) produce a report.

One of the most difficult tasks will be to evaluate the comparability of water-quality data among the different monitoring organizations. Chapter 4 of the NMN report suggests methods of determining data comparability which include: (1) known and appropriate methods; (2) documented quality assurance and quality control; (3) metadata; and (4) access to data and related information. A case study of evaluating the comparability of data collected among 6 study areas in Delaware River Basin for nitrate data is presented in the NMN report (Fig. 2). The Delaware Pilot will conduct an assessment of data comparability using similar procedures.

Program		Sample Collection		Sample Processing / Analysis		QA/QC				Metadata		Data Reporting	
		Method available to public on Internet?	Method available to public on Internet?	Replicate samples?	Matrix spikes?	Reference sample?	Split samples?	Recommended metadata maintained?	Publicly available on Internet?	Data electronic?	Publicly available on Internet?	Ancillary data available?	
1	NJDEP		Orange		Green	Green		Green	Orange	Green		Green	
2	DNREC		Orange	Green	Green	Green	Green	Green				Green	
3	PADEP		Orange					Green		Green		Green	
4	DRBC #88		Orange	Green	Green	Green		Green	Green	Green		Green	
5	DRBC #36		Orange					Green				Green	
6	USGS	Green	Green	Green	Green	Green		Orange	Green	Green	Green	Green	

Note: NERR data meets all above except Split samples

Figure 2. Status of different monitoring elements, described under Section 4.2 in this chapter, for the major programs monitoring nitrate in the Delaware River. Green indicates that the program does meet the particular category. Orange indicates that the program does address the category as requested but that the information is not necessarily with the data on their web site (e.g., information may be in STORET on EPA’s Web site (need web site) or method information is on EPA’s Web site (URL)). A blank cell indicates that the program does not apparently address the category.

(<http://acwi.gov/monitoring/network/index.html>)

Table. 2. Planned tasks, purpose, and timeline for Pilot inventory for the Delaware River Basin in relation to the National Monitoring Network.

DRB, Delaware River Basin; F/T/S/L/A/P, Federal/Tribal/State/Local/Academic/Private; P/C/B, Physical/Chemical/Biological; WQX, Water-Quality Data Exchange; NMN, National Monitoring Network; WQ, water quality.

For more information on the NMN document please visit <http://acwi.gov/monitoring/network/design/>.

#	Tasks	Purpose	Who ¹	Month																			
				A	M	J	J	A	S	O	N	D	J										
1	Conduct monthly meetings and/or webex conference calls	To organize ideas and track progress among DRB partners. Subcommittees will be formed where appropriate (Steering, Inventory, Data Management, and Comparability). Meetings will be coordinated with regional USEPA, USGS, and NOAA personnel.	All																				
2	Conduct an inventory of relevant WQ data in the DRB	To inventory relevant ongoing and recently concluded WQ monitoring project sites conducted by F/T/S/L/A/P entities that are available in a computerized format in the DRB. P/C/B WQ data from the 9-resource areas identified in NMN design will be inventoried with emphasis on watersheds, estuaries, near coastal, and ocean monitoring sites. The inventory will focus on selected parameters with emphasis will be on flow, sediment, dissolved oxygen, nutrients, VOCs, pesticides and other constituents identified in table 3-1 of the NMN.	All	W A T E R S H E D S	E S T U A R I E S	C O A S T A L	A T M O S P H E R E	W E T L A N D S	G R O U N D W A T	B E A C H E S	O T H E R												
3	Coordinate with ongoing WQX activities	To optimize current WQX activities among F/S/L/P entities to minimize redundancy, assist in comparability and data-gap analysis. Current projects by DENREC and NJDEP in parts of DRB and efforts by CUAHSI will be leveraged.	DRBC, NJDEP, CUAHSI																				
4	Evaluate the comparability of WQ data in the DRB	To evaluate the comparability of P/C/B WQ data collected among F/S/L/P entities in the DRB as identified in Chapter 4 of the NMN: (1) known and appropriate methods; (2) documented quality assurance and quality control; (3) metadata; and (4) access to data and related information as identified in Chapter 4 of the NMN document.	USGS, USEPA, NOAA,																				
5	Compare WQ data in the DRB to proposed NMN design	To determine if WQ network sites in the DRB are in place that provide comparable P/C/B analyses at sites identified in the NMN.	USGS, USEPA, NOAA																				
6	Identify WQ data gaps between the DRB and NMN	To determine data gaps (site and P/C/B WQ parameters) that are not currently collected in existing WQ networks that are recommended in the NMN. This information will be utilized in the design of a potential demonstration phase.	All, DRBC, USGS, USEPA, NOAA																				
7	Assess WQ data, data serving tools, and applicable models	To provide maps and tables of monitoring sites identifying P/C/B WQ parameters, and comparability of data in the DRB. In addition, tools for serving up the data and models developed to predict water-quality issues will be compiled.	USGS, USEPA, NOAA																				
8	Produce a final report and web based internet link	This report will summarize findings and provide maps, tables, and lists of data gaps (sites and WQ parameters) between existing WQ Networks in the DRB and those proposed in the NMN.	All, DRBC, USGS, USEPA, NOAA																				

¹Who: Identifies those agencies and personnel who will be involved and those agencies leading the effort for this task.

5. Description of any on-going collaboration among study partners such as data sharing efforts or cooperative data management efforts.

Historically, successful cooperation exists among the four states in the drainage basin through the Delaware River Basin Commission and coordinated management among the three estuary region states and EPA through the Delaware Estuary Program. Through this program, a Comprehensive Conservation and Management Plan (CCMP) and a Monitoring Action Plan were prepared for the Delaware Estuary (<http://www.delawareestuary.org/>). Development of this pilot would significantly advance Action Items M4, M5 and M6 of that CCMP. The DRBC with its member States have set up advisory committees for the Basin such as: Flood, Information Management, Monitoring, Regulated Flow, Toxics, Water Management and Water Quality Advisory Committees. The Monitoring Advisory Committee of DRBC member States, the Federal government and other stakeholders will be a key coordinating entity for this project.

The Estuary Program (PDE) also operates the 21-member Science and Technical Committee (STAC) which includes representatives from DRBC, USGS, NOAA, and the states. The STAC provides broad-based peer review and technical support for CCMP implementation (www.DelawareEstuary.org) and ensures overall science and management activities are well-coordinated and informed by the latest science.

On 7/20/06, Major General Grisoli (Federal DRBC Commissioner) convened a Federal Coordination Summit attended by high level representatives of FEMA, NPS, NWS, USDA, NRCS, USACOE, USEPA, USFWS, USGS, Office of Surface Mining, FERC and States. Monitoring coordination was one of three priority focus areas, with specific objectives of evolving from discrete to increased real-time monitoring, effecting improved comparability among methods and using modeling and other tools to better target monitoring efforts.

The Delaware River Basin NAWQA Study (<http://nj.usgs.gov/nawqa/delr/>) has recently completed a water quality assessment of the Delaware River Basin which included stream, sediment, and ecological monitoring. In addition to the data collected as part of this study, NAWQA compiled data from different State and Federal agencies within the basin. NAWQA will share data and assist in compilation and analysis of this and other data. Past collaborative efforts with the USDA Forest Service and the National Park Service have been highly successful

The Mid-Atlantic Coastal Ocean Observing Regional Association (MACOORA) is one of eleven such associations around the country that make up the Integrated Coastal Ocean Observing System (ICOOS) (<http://www.macoora.org/>). MACOORA ranges from Cape Cod to Cape Hatteras, covering five sub-regions (Massachusetts and Rhode Island Bays, Long Island Sound, New York Bight, Delaware Bay, and Chesapeake Bay) in nine states and the District of Columbia. MACOORA is a consortium of data providers and users from both private and public sectors that use, depend on, study and manage coastal environments and their resources. MACOORA was formed to ensure that all major stakeholders are involved in the design of the observing systems and the periodic evaluation of the system's performance.

The DRBC in cooperation with Rutgers University's Department of Environmental Sciences and Center for Environmental Prediction currently operate three air deposition monitoring stations located at Lums's Pond, DE, Camden, NJ and New Brunswick, NJ. Samples are collected to determine the flux of gaseous phase pollutants particularly PCBs and pesticides between surface waters and the atmosphere, dry and wet deposition. This network is being used as part of efforts to refine and implement TMDLs for PCBs in the Delaware River and Bay as well as for long-term trend monitoring of toxic pollutants.

New Jersey Water Monitoring Coordination Council (NJWMCC), a consortium of State, Federal, local, and private monitoring entities (<http://www.nj.gov/dep/wms/>) was formed to address monitoring issues in NJ. NJDEP has a grant from the USEPA for \$750K to develop a Water Data Exchange (WQX) to: (1) integrate water-quality data; (2) streamline/simplify data transfer; (3) provide timely access to water-quality data between NDEP, USEPA/STORET and USGS/NWIS. NJDEP is working closely with the Consortium of University for the Advancement of Hydrological Sciences (CUAHSI) (<http://www.cuahsi.org/>) and USEPA/ESAR programs to optimize WQX schema architectures. CUAHSI has funding from and National Science Foundation grant to link Federal databases into a common portal. To the extent possible, the DRB Pilot study will coordinate and WQX activities with WaterOneFlow web services and graphical water assessment products.

6. A list of already-planned regional meetings or events that can serve to aid in coordination and communication during the Pilot Studies.

Table 3. Planned meetings or events for Delaware River Basin Pilot Inventory

Date	Agenda emphasis
Planned Delaware Basin Pilot Inventory Monthly Meetings	
April	Steering Committee Plan of Action
May	Inventory: Watersheds
June	Inventory: Estuaries
July	Inventory: Near shore and offshore Coastal. Data exchange
August	Inventory: Atmosphere. Data exchange
September	Inventory: Wetlands. Methods comparability
October	Inventory: Methods comparability
November	Inventory: Compare with NMN and data gaps
December	Data and modeling—tools assessment
January	Final report
New Jersey Water Monitoring Coordinating Council	
May 28th	New Jersey Monitoring Efforts in the Delaware Basin
September 5	NJDEP WQX Progress
December	Final results of NJ /DRB effort
MACOORA Meetings	
April	Mid-Atlantic IOOS Development
September	Mid-Atlantic IOOS Development
PDE STAC Meetings	
March 29	Delaware Science Conference De-Brief
DRBC Monitoring Advisory Committee	
February 20	Nutrient Criteria Coordination
June	Nutrient Criteria Coordination (cont.)
September	Inventory: Vet Steering Committee Results

7. Brief description of major Federal and non-Federal monitoring programs active in the Delaware River Basin.

The Delaware Estuary, with its 50-mile long tidal freshwater Delaware River and the Delaware Bay, is one of the most important estuaries in the Nation. The Delaware River watershed is one of the largest drinking water supplies in the US serving both New York City and Philadelphia; thus, it is well-protected and monitored. The urban region of the tidal river consists of the greater Philadelphia municipal area, the fourth largest in the country. This urban region was, by most standards, one of the “most-polluted” rivers in the country in the past and has undergone a very successful water quality improvement over the last few decades. Highlights of some monitoring efforts are highlighted to show the extent of monitoring in the Delaware Basin.

There is a good, consistent, monitoring database extending almost 40 years that helps document the past improvements and provides metrics for assessing future changes. Since the Delaware Estuary is dominated by a single major river, with the second largest water input also coming into the freshwater region, it is possible to monitor much of the physical control of the estuary with two well-established gauging stations. New Jersey, Pennsylvania, and Delaware, as the three states along the estuary, have a long-standing record of cooperative management of the estuarine resources. Academic research efforts in the river and bay have been relative modest in breadth but studies of river conditions, estuarine microbial biogeochemistry, and bay oyster and fish populations have long time consistent histories. We feel that we can combine past monitoring and research efforts, new ongoing activities, and future additions for an outstanding demonstration project of effective watershed to coastal ocean monitoring.

Currently there are over 90 major Federal, State, Interstate, private, and academic monitoring activities within the Delaware Basin (fig.1 and table 4). These activities focus on physical, chemical, and biological water-quality monitoring in watersheds, estuaries, coastal areas (nearshore, offshore), atmosphere, wetlands, and ground water. These monitoring networks are related to: (1) freshwater inflow; (2) water use; (3) dissolved oxygen; (4) nutrients and biogeochemical processes; (5) contaminants; (6) estuarine sediments and beach processes; (7) transportation and port security; and (7) impact of climate change on sea-level rise.

Some examples of monitoring in the Delaware Basin area are noted below:

- Recent studies of the sedimentology of the estuary by the University of Delaware and the Delaware River Basin Commission have provided valuable insights on sediment transport and the impact of dredging. These cooperative studies will continue in the next two years with extensive sediment coring in the saltwater and freshwater marshes fringing the system.
- The University of Delaware and the DRBC have collected significant historical data to determine trends over time for dissolved oxygen and nutrients in the Delaware Estuary “Boat Run” monitoring stations below Philadelphia sampled regularly since 1967. Results show the increase in dissolved oxygen (Fig. 3A) over time as a result of the improvements in point source discharges in the basin. (<http://www.ocean.udel.edu/cms/jsharp/CruiseDatabase.htm>)
- Recently, new technologies have allowed for continuous monitoring of water-quality characteristics at various locations in the basin. The USGS operates over 20 continuous real-time water-quality monitoring stations (<http://waterdata.usgs.gov/nwis/current/?type=quality>) in the Delaware Basin (pH, temperature, conductance, density, dissolved oxygen, turbidity) for at least part of the year and all year at the Delaware River at Trenton (fig. 4). Here changes in dissolved oxygen (Fig. 3B) can be evaluated at diurnal, tidal, and seasonal scales.

Table 4. Federal and non-Federal monitoring programs active in the Delaware River Basin.

Agency (Abbreviation)		Web address	Contact	Letter of Support
Federal Monitoring Programs				
U.S. Geological Survey Water Science Centers	USGS-NJWSC USGS-PAWSC USGS-NYWSC	http://nj.usgs.gov/ http://pa.water.usgs.gov/ http://ny.water.usgs.gov/	Richard Kropp Patricia Lietman Willie Rodriguez	Y Y Y
USGS National Water Quality Assessment Program (NAWQA)		http://nj.usgs.gov/nawqa/delr/	Jeff Fischer	Y
U.S. Environmental Protection Agency Ecology Division (AED)		http://www.epa.gov/aed/	John Garber	Y
USEPA National Estuary Program (NEP) Center for Inland Bays		http://www.inlandbays.org/		
U.S. Environmental Protection Agency Region 2 (USEPA-R2)		http://www.epa.gov/region2/	John Kushwara	Y
U.S. Environmental Protection Agency Region 3 (USEPA-R3)		http://www.epa.gov/region03/	Larry Miller	Y
USEPA Atlantic Ecology Division/ORD (USEPA-AED)		http://www.epa.gov/aed/index.html	Henry Walker	Y
DE and Nat. Oceanographic and Atmospheric Admin (NOAA/NEERS)		http://nerrs.noaa.gov/	R. Scarborough	Y
NOAA PORTS Delaware River/Bay		http://co-ops.nos.noaa.gov/dbports/		
National Park Service (NPS)		http://www.nps.gov/upde/	Joseph DiBello	Y
Natural Resources Conservation Service (NRCS-NJ)		http://www.nj.nrcs.usda.gov/	Tom Drewes	Y
U.S. Fish and Wildlife Service (USFWS)		http://www.fws.gov/northeast/njfieldoffice/	Clifford Day	
U.S. Army Corps of Engineers Philadelphia District		http://www.nap.usace.army.mil/		
National Atmospheric Deposition Program (NADP)		http://nadp.sws.uiuc.edu/		
Non Federal Monitoring Programs				
Delaware River Basin Commission (DRBC)		http://www.state.nj.us/drbc/	Robert Tudor	Y
New Jersey Department of Environmental Protection (NJDEP)		http://www.state.nj.us/dep/	Leslie McGeorge Robert Connell	Y
New Jersey Water Monitoring Coordinating Council (NJWMCC)		http://www.state.nj.us/dep/wms/wmcc/home.html		Y
Delaware Depart of Natural Resources and Environmental Control (DENREC)		http://www.dnrec.delaware.gov/	R. Scarborough	
Partnership for the Delaware Estuary (PDE)		http://www.delawareestuary.org/	Danielle Kreeger	Y
Pennsylvania Department of Environmental Protection (PADEP)		http://www.depweb.state.pa.us/dep/	James Newbolt	
Delaware Environmental Ocean Observing System (DEOS)		http://www.deos.udel.edu/		
Rutgers University Institute of Marine and Coastal Sciences (IMCS)		http://marine.rutgers.edu/cool	Scott Glenn	Y
Univ. of Delaware		http://www.ocean.udel.edu/cms/jsharp/CruiseDatabase.htm	Jonathan Sharp	Y
Sea Grant and Marine Sciences Consortium		http://www.njmsc.org/Sea_Grant http://www.njmsc.org/	Mike Weinstein	
Drexel University			Mike Piasecki	Y

- The Rutgers University Institute of Marine and Coastal Sciences (ICMS) operates a fleet of autonomous underwater vehicles (AUVs) that collect water-quality data (temperature, salinity, density) in real-time in several sites offshore of the Atlantic Coast and world-wide (<http://marine.rutgers.edu/cool/auvs/>). Two dimensional patterns of water density (Fig. 3C) provide insight as to the variability of water quality with depth and distance away from shore.

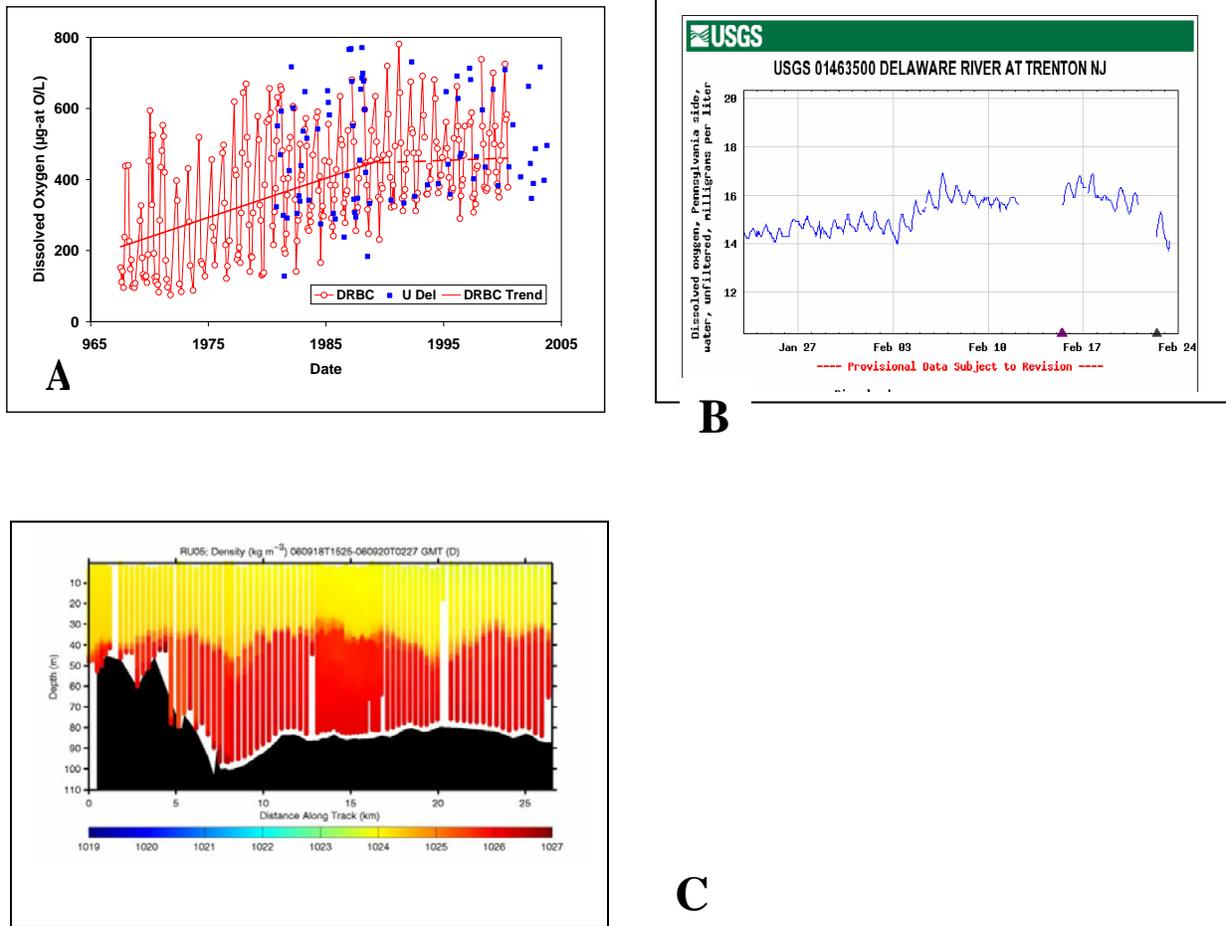


Figure 3. Examples of monitoring in the Delaware River Basin area: (A) dissolved oxygen measured in the “Boat Run” network from 1967 to 2006; (B) real-time continuous dissolved oxygen monitoring at the Delaware River at West Trenton; and (C) continuous monitoring of water density offshore by Rutgers AUV fleet.