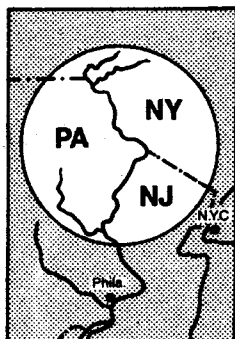


Water Quality Program Highlights

The Delaware River Cooperative Monitoring Program

The Delaware River forms the boundary between Pennsylvania, New York, and New Jersey, and water quality management in the area is the shared responsibility of a dozen or more State, local, and federal environmental and public health agencies. In addition to the States, the Delaware River Basin Commission (DRBC), a federal-interstate agency, has jurisdiction throughout the river basin, and the National Park Service (NPS) operates within the boundaries of two scenic river areas.



Location of Study Area

In 1984, the DRBC and the NPS initiated a cooperative water monitoring program focusing on the upper and middle sections of the Delaware River. These two sections include the Upper Delaware Scenic and Recreational River (UDSRR) and the Delaware Water Gap National Recreation Area (DWGNRA), both of which are part of the National Wild and Scenic Rivers system. Together these two reaches, administered by the NPS, span nearly 120 river miles in the three States and provide fishing, boating, and swimming recreation for over 300,000 visitors annually.

Prior to initiation of the monitoring program, water quality in both the Delaware and in most tributaries was thought to be good due to the rural nature of the area. However, this assumption was based on scattered, infrequent monitoring or on occasional special-purpose water quality studies. The three States maintained only four routine (fixed) monitoring stations along the upper and middle Delaware River, and only 6 out of 75 tributaries were monitored. Because of this, it was determined that a coordinated monitoring program was necessary to provide a consistent flow of water quality data.

DEVELOPING THE MONITORING PROGRAM

To make the best use of existing resources and skills, a water quality "screening" approach was developed with monitoring responsibilities shared between the DRBC and the NPS. The program uses a limited number of parameters, but relies on frequent sampling at numerous locations, and follow-up surveys (where necessary) to provide the greatest amount of useful information at the lowest cost.

The cooperative monitoring program was designed to expand monitoring activities in three ways:

- Sampling was to be extensive (rather than intensive), covering, to the extent possible, numerous Delaware River locations and all significant tributaries during the 3-month recreational season.
- Sampling was to be frequent (biweekly for many locations) because water quality can vary rapidly over time.
- Data turnaround was to be rapid so the program could respond quickly to potential public health problems.

MONITORING PARAMETERS

The parameters selected for screening water quality were fecal coliforms and fecal streptococci, water temperature, dissolved oxygen, pH, conductivity, and species diversity (macroinvertebrates). Rain-fall information is readily available from other agencies and was not collected by the program itself. Stream flow measurements are being phased in over time.

These eight parameters yield additional data when they are used together. The ratio of the two fecal bacterial parameters serves as an indicator of possible human sewage contamination. Water temperature and dissolved oxygen data are used to calculate the percent dissolved oxygen saturation. Saturation information, in conjunction with pH data, is used to assess aquatic plant activity. Finally, information obtained from macroinvertebrate analyses is converted to one or more biological indices that serve as a surrogate for measuring the presence of toxics.

Biological monitoring focuses on benthic macroinvertebrates. All river samples and several tributary samples are analyzed taxonomically; a computer program is then used to calculate the Species Diversity Index value and the equitability number for each sample. For other tributaries, the Sequential Comparison Index, a technique that is relatively simple, fast, and usable by nonbiologists, is applied.

LOCATION AND FREQUENCY OF SAMPLING

In 1984, the cooperative monitoring effort was implemented on a trial basis in the DWGNRA. This approach proved to be highly successful, and in 1985, a decision was made to expand the program into the UDSRR. During May through September 1985, a total of 88 locations were sampled (24 river stations, 64 tributaries). In almost all cases, tributary sampling stations were located near confluences with the Delaware River.

With the exception of three designated swimming areas, which were sampled weekly, nearly all stations were sampled every other week. During the 1985 sampling season, 550 station-visits were carried out by DRBC and NPS personnel. In addition, seven follow-up surveys were performed in response to data findings. Follow-up surveys, which generally involve more intensive sampling in a limited area, have been used to locate specific sources of agricultural and urban runoff and natural causes of water quality problems as well as point source problems.

USE OF PARAMETERS TO SCREEN WATER QUALITY

The primary purpose of the screening program is to determine the need for water quality management actions. These actions can be short-term (e.g., closing a bathing beach or initiating an intensive survey) or long-term (e.g., establishing pollution control priorities).

Although questions have been raised about their public health implications, fecal coliform (FC) and fecal streptococcus (FS) remain excellent indicators for screening pollution in a watershed. For example, completely undeveloped watersheds show bacteria levels that are very low. In other watersheds with varying levels of development, streams have correspondingly higher bacteria levels and FC/FS ratios. In this way mean fecal coliform and FC/FS values tend to "fingerprint" the level of development in a watershed. By sampling frequently for these parameters, it is possible to compare similar watersheds to screen for potential water quality problems. By contrast, monthly, quarterly, or even intensive surveys rarely "catch" the almost random nature of bacterial fluctuations or the "fingerprints" of typical watersheds.

Frequent data collection under varying dry and wet conditions also serves to pinpoint problems. For example, two impaired tributaries

in the study area are Brodhead and Cherry Creeks. Brodhead Creek receives discharges from two overloaded sewage treatment plants, a combined storm and sanitary sewer system, and several industries. Its watershed also contains large second home and resort developments. Data from Brodhead Creek show that bacterial levels and FC/FS ratios increase dramatically following rainfall, indicating that these pollutants may originate from nonpoint sources and/or bypasses of untreated sewage. Conversely, Cherry Creek's bacterial levels and FC/FS ratios increase during low flows, indicating a chronic problem caused by raw sewage discharges (there is one municipality located in this watershed).

Based on DRBC-NPS fecal bacterial data, wastewater treatment improvement projects have been accelerated in both the Cherry and Brodhead Creek watersheds. The DRBC-NPS cooperative monitoring program continues to alert State and local jurisdictions when problems arise, particularly problems resulting from point source discharges that may require intensive analyses including effluent sampling and toxicity testing. The New York State Department of Environmental Conservation, for example, is planning a survey of Callicoon Creek in 1986 as a result of screening data that showed higher-than-expected levels of bacteria.

Dissolved oxygen measurements are most valuable when used in conjunction with water temperature to calculate percent saturation, which is generally a measure of aquatic plant activity (photosynthesis). This is verified by corollary increases in pH values. During 1985, drought management activities led to drastic reductions in reservoir releases and resulting flows downstream. Monitoring data demonstrated that a major impact of the altered reservoir operations was increased aquatic plant activity and violations of the pH standard (above pH 9) during daylight hours. In response to these observations, measurements were conducted at night to determine if increased plant respiration during the night was causing violations of dissolved oxygen standards. The data showed large drops in dissolved oxygen levels, but standards were not violated.

Conductivity is another parameter that appears to "fingerprint" the amount of development in a watershed. Generally, conductivity values increase with the degree of human activity in a watershed. Monitoring in one DWGNRA stream, White Brook (a mostly undeveloped watershed), showed consistently high conductivity compared to streams with similar levels of development and physical characteristics. It was speculated that a landfill might have been located in the watershed during clearing operations for a recreation area in the early 1970's. A follow-up investigation was completed that determined that the cause of the high conductivity was natural—a small limestone formation traversed the basin in the headwaters. Still, the ability to identify potential water quality problems and to determine their origins is evident.

DETERMINATION OF MONITORING PRIORITIES

An important initial objective of the cooperative monitoring program was to collect baseline water quality for as many tributaries and river locations as possible. To accomplish this, many stations were sampled five or more times during the 1984 and 1985 sampling seasons—a level that could not be sustained over the long run given available resources. To define a more efficient monitoring strategy for 1986, the DRBC developed a method for determining reach-by-reach priorities.

The method selected divides the 120-mile study area into 10 segments, varying from 8 to 20 miles in length. The 10 segments were determined by evaluating hydrology, land use, extent of urbanization, known or suspected problems, and access points along the river. Then, the segments were ranked in order of priority using the rating system shown in Figure 1.

Based on the distribution of the scores, segments scoring greater than 4 are considered highest priority. Three segments qualified as high priority segments and, along with significant tributaries, will be the

A WATER QUALITY IMPACTS	
• Potential for problems	(1 point)
• Problems known	(2 points)
• Possible problem warrants investigation	(3 points)
B DEGREE OF URBANIZATION	
• No significant urbanization	(no points)
• Small town type of urbanization	(1 point)
• Significant urbanization	(2 points)
C PUBLIC BATHING OR WATER RECREATION AREA	
• Yes	(1 point)
D AVERAGE NUMBER OF TRIBUTARIES PER MILE	
	(fraction)

Figure 1. Criteria for rating monitoring priorities on designated segments of the Delaware River.

subject of intensive surveys, and macroinvertebrate studies will be conducted in two locations in each segment. Four segments scored between 2 and 4 and are considered second priority; these will be sampled biweekly to monthly, with one location subject to biomonitoring. Low-priority segments (with scores below 2) are to be sampled only once, with other monitoring to be conducted as time and resources permit.

PROGRAM ADMINISTRATION

While the cooperative monitoring program is administered without the use of formal interagency agreements, the DRBC and NPS staff work together closely and solicit assistance from other governmental agencies as necessary. Although most of the sampling and analysis is carried out by the two principal agencies, State and county officials are involved in program planning, along with representatives from EPA Regional Offices and the U.S. Geological Survey.

When monitoring results indicate an immediate problem, follow-up actions are initiated by State or local agencies. All monitoring data are entered into EPA's water quality data system, STORET. At the end of each sampling season, a report of findings and recommendations is prepared and distributed to local government agencies, the public, and the press.

During the 1986 sampling season, monitoring staff will study river foam found at various locations along the Delaware. Although possibly natural in origin, foam currently is perceived as a pollution problem in the region. Longer-range objectives for the program include establishment of a scenic rivers research center with a water laboratory and the institution of a land-use monitoring system, possibly using high-altitude and remote-sensing data.

Material for this report was furnished by Richard C. Albert of the Delaware River Basin Commission, John Karish of the National Park Service, and Charles Sapp, U.S. EPA Region III.

This report is produced by EPA to highlight monitoring and wasteload allocation activities. Contributions of information for similar reports are invited. Please contact E. F. Drabkowski, EPA, MDSD, WH-553, 401 M Street S.W., Washington, DC 20460 (202) 382-7056.