# DELAWARE RIVER BASIN COMMISSION

## Annual Report 1988

*Front cover: The Delaware Aqueduct. Photo by Alan Schindler. An article on the bridge's history and restoration begins on page 16.*

*Report designed by Odette P. Taft, DRBC graphic artist/illustrator*

*A motorboat is bathed in the fleeting light of a setting sun as the craft heads south on the Delaware River near Delanco, New Jersey. (Photo by Seymour P. Gross)*

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# The Commission · 1988


Secretary Hodel


Mr. Kanuck

## United States

Secretary of the Interior
Donald P. Hodel
Chairman

George J. Kanuck, Jr.
Alternate

Lt. Col. G. William Quinby
Advisor


Governor Cuomo


Mr. Jorling

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Governor Mario M. Cuomo
Vice Chairman

Thomas C. Jorling*
Alternate

Harvey W. Schultz
Advisor


Governor Kean


Mr. Catania

## New Jersey

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Member

Michael F. Catania**
Alternate


Governor Castle


Mr. Ashbee

## Delaware

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Member

R. Wayne Ashbee***
Alternate


Governor Casey


Dr. Grace

## Pennsylvania

Governor Robert P. Casey
Member

James R. Grace****
Alternate

William J. Marrazzo
Advisor


Mr. Hansler

## Staff

Gerald M. Hansler
Executive Director

David J. Goldberg
General Counsel

Susan M. Weisman
Secretary

Christopher M. Roberts
Public Information Officer

Richard C. Gore
Chief Administrative Officer

### Engineering Division

David B. Everett
Chief Engineer

Jeffrey P. Featherstone
Policy Analyst

#### Branch Heads

David P. Pollison
Planning

George C. Elias
Project Review

Richard C. Tortoriello
Operations

*Irwin H. King served in Mr. Jorling's absence

**Dirk C. Hofman serves in Mr. Catania's absence

***Gerard L. Esposito serves in Mr. Ashbee's absence

****John E. McSparran serves in Dr. Grace's absence

## Chief Engineer, New York Alternate Named

Daniel M. Barolo, director of the Division of Water in New York State's Department of Environmental Conservation (NYDEC), was appointed an alternate commissioner to the DRBC on May 24, 1988 by Gov. Mario M. Cuomo. He succeeds Irwin H. King, who recently retired from NYDEC after serving as New York's alternate member to the Commission for five years and as chairman pro tem from July 1, 1984 to June 30, 1985.

Mr. Barolo attends Commission meetings in the absence of NYDEC Commissioner Thomas C. Jorling.

*Mr. Barolo*

A graduate of Vanderbilt University where he earned a bachelor's degree in civil engineering and a master's in sanitary engineering, Mr. Barolo is responsible for the overall management of New York State's water pollution control and water resource management programs, supervising some 500 employees.

He belongs to numerous professional organizations, including the American Academy of Environmental Engineers and the Association of State and Interstate Water Pollution Control Administrators.

* * *

George J. Kanuck Jr., appointed in 1981 by former President Ronald Reagan to serve as the federal government's alternate member on the Commission, resigned in the spring of 1988 for personal reasons. A successor had not been appointed by year's end.

* * *

William J. Marrazzo, for eight years advisor to the DRBC's Pennsylvania member, resigned as Commissioner of the Philadelphia Water Department on Nov. 28, 1988, to accept a job in the private sector. His successor at the Water Department is John Plonski, former head of Philadelphia's Bureau of Licenses and Inspections.

* * *

Commission members are the governors of the four basin states and a federal representative, traditionally the Secretary of the Interior. The members appoint alternates to represent them at Commission meetings and other functions.

Donald P. Hodel, Interior Secretary under Mr. Reagan, served as Commission chairman for most of fiscal year 1989, beginning his term on July 1, 1988. He succeeded Pennsylvania Gov. Robert P. Casey under the DRBC's rotating chairmanship policy.

Gov. Cuomo was elected vice-chairman and New Jersey Gov. Thomas H. Kean second vice-chairman.

* * *

Robert L. Goodell, who spent 32 years in water resources management

and was instrumental in shaping the basin's long-term water supply programs, retired as the DRBC's Chief Engineer in the spring of 1988. His successor is David B. Everett, who since 1975 headed the Commission's Project Review Branch.

Mr. Goodell joined the Commission in 1963 after serving as Supervisory Civil Engineer in the Program Planning Branch of the U.S. Army Corps of Engineers, Philadelphia District.

He was named the DRBC's Chief Engineer in July of 1982. Prior to that

*Mr. Goodell*

he headed up the Commission's Operations Branch for 17 years.

A former U.S. Naval Officer, Mr. Goodell is a graduate of Penn State University and a member of the American Society of Civil Engineers.

Mr. Everett joined the Commission in 1967 as a water resources engineer in the Planning Branch, later transferring to the Project Review section.

He holds both bachelor's and master's degrees in civil engineering from the University of Pennsylvania and is a member of the National and New Jersey Society of Professional Engineers, the Water Pollution Control Federation, and the Trenton Engineers Club.

*Mr. Everett*

Succeeding Mr. Everett as Project Review Head is George C. Elias, a former DRBC employee who left the Commission for the private sector where he supervised major water resources projects.

While employed by the Commission between 1970 and 1975, Mr. Elias managed HUD-sponsored flood insurance studies and served on state and federal advisory committees examining regional wastewater and water supply issues and developing flood plain regulations for the non-tidal portions of the Delaware River Basin.

*Mr. Elias*

He holds a bachelor's degree in civil engineering from Drexel University and a master's degree, also in civil engineering, from Villanova University.

# Good Faith

## Lower Basin Drought Plan Adopted

One of the recommendations of the 1982 "Good Faith" agreement between the four basin state governors and the mayor of New York City called for the DRBC to develop a management plan to deal with a lower basin drought.

The "Good Faith" pact includes a basinwide drought plan which is geared to storage in New York City's three upper basin reservoirs, Pepacton, Cannonsville and Neversink. When that storage drops to certain levels, drought response measures are triggered. But what if a drought stalls over the lower basin, leaving the three New York reservoirs with storage above the drought triggers?

Under the basinwide plan no drought response measures would be activated, even though storage levels in impoundments below the New York State line might be falling rapidly.

To deal with such a situation, the Flow Management Technical Advisory Committee, an outgrowth of the "Good Faith" negotiations, began to develop a lower basin drought plan which would be acceptable to both the DRBC and the five "Good Faith" members, who also were parties to a 1954 U.S. Supreme Court decree apportioning the waters of the Delaware.

A draft version of the plan was completed in early 1988. The DRBC held public hearings on the proposal in March and April. Public information briefings followed, one in late April in Bethlehem, Pa., and another in May in Wilmington, Del. At the request of interested parties, the

*Merrill Creek Reservoir, another by-product of the "Good Faith" agreement, was completed in late 1987, then filled with water pumped from the Delaware River. The 650-acre impoundment is designed to release water back into the Delaware during low flow periods to compensate for depletive water use at electric generating plants owned by seven utilities.*

hearing record was extended twice, finally closing on July 1. The plan was modified in several areas as the result of public input and unanimously adopted by the Commission on August 3. It also was approved by the parties to the Supreme Court decree.

*Water spews from the base of Merrill Creek's inlet/outlet tower as filling of the 15 billion-gallon reservoir began in March of 1988.*

Basically, the Lower Basin Drought Operating Plan gears its drought triggers to storage levels in two lower basin reservoirs, Beltzville on the Lehigh River and Blue Marsh on the Schuylkill River. It also provides for emergency assistance, in the form of reservoir releases, from impoundments in the upper basin, including the three New York City reservoirs.

"This plan provides an added layer of protection in our drought management strategy," notes Gerald M. Hansler, the DRBC's executive director. "Should a drought move up from the South and stall in the lower basin, we are now in a position to move swiftly and decisively in marshalling our available resources and enacting water conservation measures."

Under the lower basin plan, the Delaware River Master Advisory Committee each spring assesses hydrologic conditions in the lower basin based on the storage levels in the Beltzville and Blue Marsh impoundments. The committee is comprised of the Delaware River Master and representatives from the decree parties.

Based on its findings, the committee determines whether to hold back the releasing of water from an "excess release bank" set aside in the three New York City reservoirs under terms of the decree. Storage in the bank in early 1988 was 7.4 billion gallons (bg).

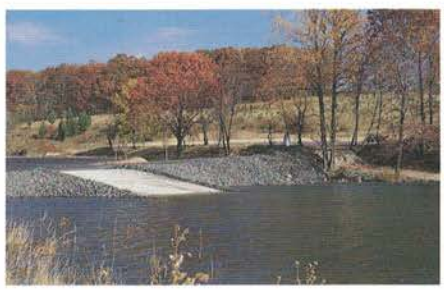
Normally, this excess water is released over a seasonal period. Should the committee decide to save the banked water to provide drought assistance, it would be released only when needed to meet a specific flow objective of 3,000 cubic feet per second (cfs) at Trenton, N.J. After exhausting the excess release quantity, releases from Blue Marsh and Beltzville would be made to maintain the Trenton flow objective and control movement of the salt wedge in the Delaware estuary until the reservoir's combined storage of 19.5 bg decreases by more than a third, or about 6.5 bg.

At this time a drought warning would be declared. The flow objective at Trenton would decrease depending upon the location of the salt front which could contaminate water supplies in southeastern Pennsylvania and southern New Jersey by advancing too far upstream. (The salt front is the location in the Delaware River where the concentration of chlorides in water is 250 parts per million.)

Voluntary conservation measures would be called for under the drought warning mode and the Delaware River diversion to New Jersey's Delaware and Raritan Canal would be reduced from 100 million gallons a day (mgd) to 70 mgd.

The parties to the Supreme Court decree and the DRBC would then meet to discuss appropriate drought emergency measures based on existing conditions. They would select a lower basin operating strategy from among six alternatives contained in the plan, or a modified plan if agreed to unanimously by the decree parties.

Factors to be considered would include the amount of storage in Blue Marsh and Beltzville, the amount of New York City storage, plus storage in Lake Nockamixon (located in Bucks County, Pennsylvania), Lake Wallenpaupack (located in Pennsylvania's Pocono Mountains),



*During the summer and fall of 1988, the New Jersey Division of Fish, Game and Wildlife stocked Merrill Creek Reservoir with 50,000 fish, including bass, rainbow and lake trout. A ramp was added for boaters.*

the up-basin Mongaup impoundments (located in Sullivan County, New York), and northern New Jersey's Lake Hopatcong.

A lower basin drought emergency would be declared when the combined storage in Beltzville and Blue Marsh falls another third, or about 6 bg, leaving only another 6 bg in the two reservoirs. Mandatory conser-

vation measures would be imposed on non-essential water use and storage in other lower basin reservoirs would be marshalled. The diversion to New Jersey via the Delaware and Raritan Canal would be further reduced, from 70 mgd to 65 mgd.

A lower basin drought would end when storage in Beltzville and Blue Marsh returns to normal levels for 30 consecutive days or either reservoir spills, unless the decree parties unanimously agree otherwise.

The lower basin is defined in the plan as the drainage area of the Delaware River and Bay below Montague, N.J. The plan will be reviewed periodically by the DRBC and the decree parties and will be subject to revision as conditions in the basin change.

The drought of record in the basin occurred during the 1960s, followed by droughts in 1980-81 and 1985. A wet May in 1988 filled major reservoirs in the basin, providing needed storage to get through the hot, dry weather in June and early July which severely stressed some farm crops and placed heavy demands on the delivery systems of some local water purveyors. Heavy rains during the latter part of July helped to replenish that storage. However, continued stretches of dry weather, especially in December, had the basin flirting with a basinwide drought warning at year's end.

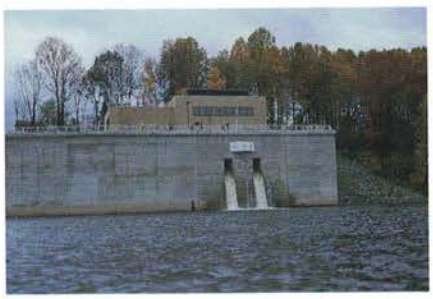
**F. E. Walter Reservoir**

In April of 1988, the DRBC released a report detailing recommendations for a system of water-use charges for both surface and ground-water withdrawals to finance expansion of the F. E. Walter Reservoir in Pennsylvania's Pocono Mountains.

The proposal calls upon both pre-Compact and post-Compact water users who currently benefit from two existing water-supply impoundments, Blue Marsh and Beltzville, and who stand to benefit from the Walter expansion, to pay on a fair and equitable basis.

Public information briefings were held on the proposal during the latter part of May in Allentown, Pa.; Wilmington, Del.; and Cherry Hill, N.J.

To supplement water-use fees, the three down-basin states, Delaware,



*Water flows from the Merrill Creek pumphouse into the Delaware River during a test release in October of 1988.*

New Jersey and Pennsylvania, have agreed to provide $20.8 million to reduce the amount the Commission will have to borrow to fund the project.

Currently, pre-Compact water users (those legally entitled to withdraw water without charge when the Delaware River Basin Compact became law on Oct. 27, 1961) are exempted from paying water-user fees under a Federal Reservation which was inserted in the Compact by Congress.

It is the DRBC's intent to have Congress amend the Compact, thus allowing for the implementation of the proposed charging system which would spread costs equitably among both pre- and post-Compact users.

The federal budget for fiscal year 1989 contained $4.2 million for the project, but only $1 million was released. Construction would start six to nine months after financing is arranged for the local cost share and the required agreements are signed.

The F. E. Walter Reservoir, named for a Pennsylvania congressman, was completed in 1961. The dam is located on the Lehigh River some 77 miles above the Lehigh's confluence with the Delaware River. The dam controls 288 square miles of drainage area.

The proposed modification calls for the spillway to be raised 31 feet. The reservoir would have a maximum depth of 185 feet and extend about seven miles up the Lehigh and about four miles up Bear Creek. Authorized flood control benefits would not be impaired by the modification, which is needed to increase water storage in the basin for augmented streamflows, protection against salinity intrusion in the Delaware estuary, and future depletive water use.

# Water Quality

## Delaware Estuary Attracts National Attention

On July 22, 1988, the Delaware Bay and tidal reach of the Delaware River were added to the National Estuary Program, a project set up to protect estuarine systems of national signifi-fance with priority management strategies.

Estuaries are fragile waterways where fresh and salt waters mix, creating some of the earth's richest and most productive habitats.

The three down-basin state governors, Michael N. Castle of Delaware, Thomas H. Kean of New Jersey, and Robert P. Casey of Pennsylvania, joined forces in the successful effort to have the Delaware Estuary included in the national program.

"The preeminent unifying force in the greater Delaware Valley region is the Delaware Estuary itself," they said in a May 31, 1988 letter to Lee M. Thomas, then head of the U.S. Environmental Protection Agency (EPA). "The estuary is an environmental treasure, whose beauty and continued vitality uplifts and enriches the people of Delaware, Pennsylvania and New Jersey. It is also an avenue of commerce unmatched on the eastern coast of the United States."

The National Estuary Program was established as part of the Water Quality Act of 1987. It was designed to identify nationally significant estuaries, protect and improve their water quality, and enhance their living resources.

Funding comes from two EPA sources: money authorized under Section 320 of the Water Act with an annual authorization ceiling of $12 million, and an allocation of one-third of one percent of construction grants appropriations. Total funding for fiscal 1988 totaled $12.7 million, according to EPA officials. Before leaving office, President Reagan requested an allocation of $12.3 million for fiscal 1989. The federal funds are channeled through EPA with affected states providing a 25 percent matching share.

At year's end, 12 estuaries had been included in the program. In addition to the Delaware Estuary, they are: Albemarle/Pamlico Sounds, Buzzards Bay, Long Island Sound, Narragansett Bay, Puget Sound, San Francisco Bay, Delaware Inland Bays, Galveston Bay, New York/New Jersey Harbor, Sarasota Bay, and Santa Monica Bay.

Under the program, management conferences are convened to develop conservation plans for each estuary. These five-year plans focus on pollution control and resource management strategies as well as on corrective actions. In addition, a series of eight local workshops were to be held in Pennsylvania, New Jersey and Delaware during early 1989 to solicit public input and participation in the program.

In the Delaware Estuary, much of this new work will build upon existing programs which currently are being conducted by the DRBC, the basin states, and an assortment of federal agencies. Water quality in the estuary has improved significantly in recent years, but there are still problems to be solved, especially involving toxics. Inclusion of the Delaware Estuary in the national program is an important step in meeting these future challenges.

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The riverine portion of the Delaware Estuary extends 85 miles from the head of tide at Trenton, N.J., to Liston Point, Del. The bay runs from Liston Point to Cape May, N.J., and Cape Henlopen, Del., a distance of 48 miles.

Although over 40 percent of the nation's population is located within a day's ride of the Delaware Bay, it remains a haven for wildlife, harboring an abundance of endangered and threatened species — sea turtles, bald eagles, peregrine falcons, ospries, grebes, and short-eared owls.

The Delaware Bay is the second largest spring staging site for shorebirds in North America; only the vast Cooper River Delta in Alaska hosts more. Plovers, dowitchers, sandpipers and numerous other species gorge on an estimated 320 tons of horseshoe crab eggs that are laid on the bay's tidal flats and beaches. By June, most of the estimated 420,000 birds have left on the next leg of their journey — a 3,000-mile, non-stop flight to their Arctic breeding grounds.

**Protecting a Scenic River**

Rapid growth in the Delaware Water Gap National Recreation area has prompted the National Park Service and the Delaware River Basin Commission to initiate a program aimed at protecting water quality in the area.

A cooperative agreement between the two agencies calls for the completion of a draft plan during 1989 which is expected to contain recommendations pertaining to antidegradation policies, possible new water quality standards, new wastewater disposal regulations and other management actions.

The DRBC/NPS effort is an outgrowth of their cooperative scenic river monitoring activity which has been operational since 1984. Both agencies jointly monitor the water quality of the Upper and Middle Delaware Scenic and Recreational Rivers and tributaries during the recreational season. During 1988, more than 480 baseline data collections were made at 78 sites with chemical, physical, biological and bacterial data collected. In addition, several special studies were conducted in the Delaware Water Gap National Recreation Area in which data from nine sites along a 40-mile stretch of river, plus all major tributaries, were collected over a 24-hour period. These diurnal surveys involved hundreds of man-hours, yielding a tremendous amount of information on water quality, river flows and other related subjects.

A report on the 1988 findings was being prepared at year's end.

*DRBC employee Todd Kratzer (right) and summer staffer Scott Bowen take dissolved oxygen and conductivity readings on the Delaware River near Smithfield Beach, Pa. (Photo by Richard Albert)*

In an effort to further coordinate management efforts in the Upper Delaware region, the DRBC and NPS co-sponsored a "Scenic Rivers Water Quality Workshop" on March 8, 1988 at the Pocono Environmental Education Center. Attendees included representatives from the U.S. Environmental Protection Agency, the U.S. Geological Survey, the New York Department of Environmental Conservation, the New Jersey Department of Environmental Protection, the Pennsylvania Department of Environmental Resources, the Lake Wallenpaupack Watershed Management District, and various counties and townships.

The workshop proceedings have been published and are available from the DRBC.

**A Decrease in Pollution Loadings**

The federal Clean Water Act requires that state environmental agencies prepare and submit water quality assessments, or 305(b) Reports, to the U.S. Environmental Protection Agency every other year. EPA uses these submittals to prepare a national report which is then presented to Congress.

In addition, the DRBC prepares a separate report detailing water quality in the Delaware River and Bay. It, too, is sent to the EPA.

The Commission completed its tenth report in March of 1988, covering the two preceding years. Not only does the report detail water quality during that period, but it traces the environmental history of the Delaware, focusing on clean-up efforts during the latter part of this century.

The report was compiled a year after the new Camden County (N.J.) wastewater pollution control plant came on-line, an event that essentially signalled the completion of the sewage-treatment plant upgrading required under the Commission's historic estuary wasteload allocation program.

The report notes that there is a direct correlation between improvement in Delaware River water quality and rebounding fish populations and the decrease in pollution loadings which resulted from the program.

Forty-nine percent of the 339 river miles assessed had excellent water quality, according to the report. Thirty-two percent had good water quality, 7% good to fair water quality, 3% fair water quality, 5% fair to

poor water quality, and 4% poor water quality.

It is interesting to note, however, that the water quality in those reaches of the river classified as "poor" is vastly improved today from previous decades. As water quality gets better, our perceptions of good or bad water quality change.

On the downside: 13% of the 339 river miles assessed were believed to have known or potential toxics problems and 9% were thought to be severely impacted by point and non-point sources of pollution.

**New Standards Considered**

The Delaware Estuary Use Attainability (or DEL USA) Project, which is examining water quality goals in the tidal reach of the Delaware River, neared completion as 1988 ended. In the 85-mile long reach from Trenton, N.J. to below Wilmington, Del., approximately 40 miles are currently classified for uses which do not meet the national "fishable" water quality goal, and 58 miles have designated uses which do not meet the national "swimmable" goal.

At the project's conclusion, recommendations will be made addressing possible changes in water quality standards, new pollution controls, and management system modifications. Areas to be considered will include water quality management programs, combined sewer overflow correction programs, and new waste-load allocations and other point source control measures.

It is anticipated that the Final DEL USA Project Report will be completed in 1989. Following review by the DRBC's Water Quality Advisory Committee, recommendations will be forwarded to the Commission, followed by public hearings and actions by the DRBC, the states of New Jersey, Pennsylvania and Delaware and the U.S. Environmental Protection Agency.

While action on the DEL USA pollution control plan awaits the project's completion, it is interesting to note that various DEL USA technical studies already have had an impact on water quality management activities.

Based on findings in the DEL USA Fish Health and Contamination Study, Pennsylvania issued an advisory on the consumption of channel catfish due to elevated PCB levels found in the Pennsylvania

*Wetting a line on the Upper Delaware (Courtesy NPS)*

and New Jersey portion of the estuary. These findings prompted Delaware officials to launch their own fish contamination study of their portion of the estuary and Delaware Bay. The U.S. Fish and Wildlife Service also was involved in this effort.

Meanwhile, the results of DEL USA water and sediment studies were being put to good use by the Academy of Natural Sciences which is conducting a state-of-the-art toxics study of the Delaware estuary. At the same time, Pennsylvania and EPA officials were using the results of a DEL USA combined sewer overflow study to examine needed pollution abatement actions for this serious water-quality problem.

The extensive data base generated by the DEL USA Project also proved invaluable during the preparation of reports and other materials which led to inclusion of the Delaware Estuary into the National Estuary Program.

The following DEL USA reports had been completed at year's end:

— Zone 2 and Upper Zone 3 Bacterial Study (March 1987)

— Report on the Delaware Estuary Bacterial Study (Chester, Pa., to New Castle, Del.) and other 1987 data collection activities (May 1988)

— Combined Sewer Overflow Report (January 1988)

— Toxics Review of the Delaware Estuary (July 1987)

— Chronic Toxicity Bioassay Report (December 1986)

— Fish Health and Contamination Study (March 1988)

— Fish Population Study (February 1987)

— Sediment Oxygen Demand Study (March 1987)

— Recalibration/Verification of the Dynamic Estuary Model for Current Conditions in the Delaware Estuary (July 1987)

— Preliminary Report on the Attainability of Fishable Water Quality (October 1987)

— Plan of Study, Delaware Estuary Use Attainability Project (May 1986)

— Delaware River Water Quality Assessment, 1986-87 305(b) Report (supplants DEL USA Data Atlas, March 1988).

Copies of the reports are available from the Commission.

# Conservation

## Saving Water Makes Cents

The DRBC's Water Conservation Advisory Committee saw one of its major draft proposals adopted by the Commission during 1988.

The committee, meanwhile, was busy conducting seminars on ways to cut down on industrial water use, reviewing the effectiveness of state and DRBC drought management policies, and developing an article about the basin for publication in the four state conservation magazines.

On Jan. 13, 1988, the Commission took up the committee's recommendation, formally adopting a regulation which establishes water-saving performance standards for water closets, faucets, showerheads, and urinals. The regulation applies to fixtures installed in new construction or renovations and does not involve retrofitting.

The regulation stipulates that all water conservation performance standards for plumbing fixtures and fittings adopted by any signatory state (Delaware, New York, New Jersey and Pennsylvania) or political subdivision within the basin shall comply with the following minimum standards:

— Maximum flow for sink and lavatory faucets and shower heads shall not exceed three gallons of water per minute.

— Maximum flow for water closets (toilets) and associated flushing mechanisms shall not exceed an average of three and one-half gallons of water per flush; maximum flow for urinals and associated flushing devices shall not exceed one and one-half gallons of water per flush.

Regulations in effect that contain performance standards that do not comply with the DRBC standards must be revised to meet compliance by Jan. 1, 1990.

A provision of the regulation requires periodic reviews of the standards to determine if more stringent ones should be imposed based on technological breakthroughs in the plumbing industry. As a result of that review, the committee recommended in November of 1988 that the Commission require 1.6 gallon-per-flush water closets in the basin as of Jan. 1, 1991 — again only in new construction and renovations. Hearings on the recommendation were expected to be held during 1989.

The recommendation was based in large part on feedback from a seminar the Commission had co-sponsored a month earlier on the 1.6 gallon, or low consumption models. Industry experts at this session addressed such issues as performance, availability and price. It was determined that all the low consumption models currently on the U.S. market meet or exceed the current test criteria established by the American National Standards Institute (ANSI) to measure the ability of a water closet to thoroughly flush and transport solids, slurry and liquids to a drainage system.

Some 20 years ago, nearly all water closets were designed to flush on five to seven gallons. The 3.5-gallon toilets, known in the industry as "water savers," appeared in this country during the 1970s; the 1.6-gallon models a decade later.

Other areas of the country, also facing growing demands on water supplies, are looking at low consumption toilets as a way to conserve.

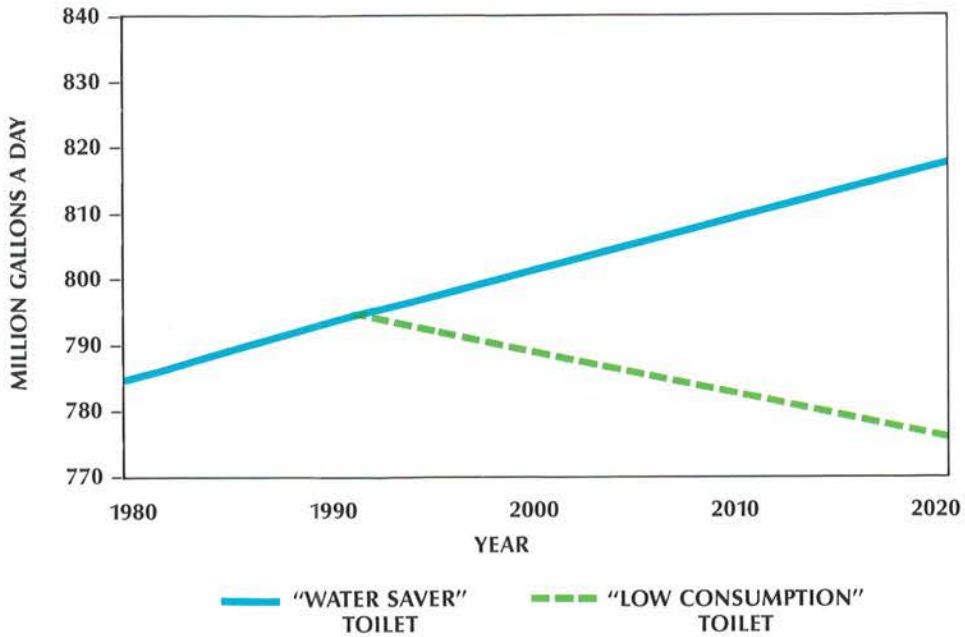
The Commonwealth of Massachusetts now requires the 1.6 gallon-per-flush models, as does Glendale, Ariz., Calvert County, Md., and the City of Frederick, Md. The City of Los Angeles will require them as of July 1, 1989.

There are many benefits that accrue from water-saving plumbing fixtures. For one, the amount of wastewater is reduced, increasing the capacity of sewage treatment plants and, in some cases, delaying the need to build costly new plants. Saving water by reducing per capita use also can save energy, which in turn can save money on both water and heating bills. In addition, the use of low consumption plumbing fixtures can improve the performance of septic tanks and soil absorption systems by decreasing hydraulic loads.

About two-thirds of residential interior water use is for toilet flushing and bathing and, in most cases, the use of low consumption water closets, shower heads and faucet aerators can cut this water use in half. In a recent demonstration project conducted in an office building by the Delaware Department of Natural Resources and Environmental Control, it was found that installation of low consumption toilets alone resulted in a 45 percent reduction in water use.

About a dozen manufacturers currently produce low consumption (1.6 gallon) water closets, turning out about 150,000 units a year. It is expected that production will jump to over one million units in 1989, largely in response to the requirements of the Massachusetts and Los Angeles markets.

**PROJECTED SUMMER RESIDENTIAL WATER USE**
**DELAWARE RIVER BASIN**
**1980-2020**



Regarding cost, the low consumption models currently are about 50 to 100 percent more expensive than the 3.5 gallon "water saver" models — in the $150 to $200 range compared to $50-$100. It was the consensus among experts at the fall seminar that the price of the low consumption products will decrease as production increases, but probably will not completely erase the price gap due to their more exacting design specifications. However, the increased costs for the low consumption products can easily be offset in a year or two due to savings from lower water and sewer bills.

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The Water Conservation Advisory Committee sponsored two technology transfer sessions during 1988 in an effort to trade off information on how certain industrial sectors were saving water through retrofit and other water-saving programs.

The first session was held February 18 at the Commission headquarters in West Trenton, N.J., with representatives of the pulp and paper industry.

Officials of the Curtis Paper Co., a division of the James River Corp., outlined how the firm over a five-year period had reduced its water use from 800,000 gallons per day (gpd) to 200,000 gpd at its plant at Newark, Del.

The company looked to water conservation to reduce its wastewater treatment and sewer costs and to eliminate its discharge to White Clay Creek. Excess water use at the plant was extremely expensive and posed a threat to the environment.

The program was initiated in 1984 and completed a year later.

Company officials explained at the seminar, attended by representatives from other basin pulp and paper companies, how water-use per ton of product had dropped from 40,000 gallons to 7,000-8,500 gallons. They said the program, which was implemented entirely by in-plant personnel, had yielded significant economic benefits as well on an annual basis: effluent reduction ($900,000), savings in pulp ($325,000), and elimination of settling ponds ($35,000). The program, they said, paid for itself in three months.

Company officials indicated that the changes made at the Newark facility could well be applicable to other pulp and paper plants in the basin.

The second technology transfer session was held Nov. 17 in Cherry Hill, N.J. with representatives of the chemical and pharmaceutical industries. Officials from DuPont Co., Merck, Sharp and Dohme and the Pennsylvania Department of Environmental Resources outlined methods of reducing water consumption while improving productivity. Programs included retrofitting and water audits.

An official from Merck, Sharp and Dohme, for example, explained how its Pennsylvania plant at West Point was using the same amount of water as it was using ten years ago even though the operating facilities at the site had increased by one-third. This was accomplished, he said, through various process and non-process changes, leading to an annual savings of about 161,000,000 gallons of water.

The Commission's interest in sponsoring such seminars stems from its efforts to promote water conservation in the four-state Delaware River Basin. In addition to its regulation setting water-saving plumbing fixture standards, the DRBC has recently adopted regulations pertaining to source and service metering and leak detection and repair programs.

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During 1988, the Water Conservation Advisory Committee reviewed information provided by the four basin states regarding the effectiveness of state and DRBC management plans in reducing depletive water use during droughts.

It is the Commission's policy that such conservation measures as non-essential water-use bans be designed to reduce depletive water use by 15 percent during such drought emergencies.

In order to determine whether this goal was being met, committee members developed a common methodology for calculating depletive use savings. Using this methodology, the committee compared in-basin water use during a normal year (1983) with water use in the latest drought year (1985).

The results strongly suggest that the water use restrictions and bans imposed by the DRBC and the states during 1985 were effective in reaching the 15 percent goal.

The Water Conservation Advisory Committee is chaired by Bruce Stewart, executive director of the Water Resources Association of the Delaware River Basin; vice-chairman is Joseph Miri, chief of the Office of Water Policy Analysis, New Jersey Department of Environmental Protection.

# Hydrologic Report

## Flirting with a Drought

Record-breaking summer heat and a significant precipitation shortfall placed heavy demands on the basin's water supplies during 1988, and by year's end storage levels in the major water supply reservoirs in the upper basin were nearing the drought warning stage.

A precipitation deficit of eight inches was recorded in the upper basin (above the tri-state line at Port Jervis, N.Y.) during calendar year 1988, aided by the driest June on record. The deficit above Trenton, N.J. was five inches for the year. Deficits in the three- to four-inch range were notched below Trenton.

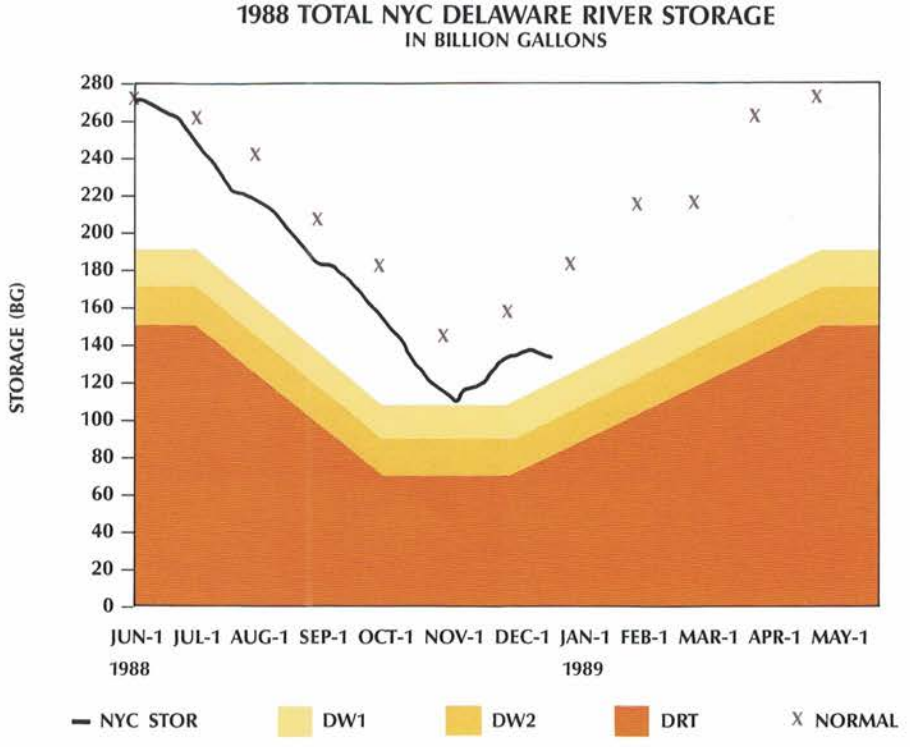
Flows in the Delaware River also averaged below normal during 1988. At Trenton, an average flow of 8,800 cubic feet per second (cfs) was recorded, 84 percent of the normal annual average of 10,490 cfs.

The maximum average daily flow (37,400 cfs) occurred on March 28; the minimum daily flow (3,050 cfs) on August 23. Flows at Montague, N.J. also were off for the year, averaging 3,730 cfs or 70 percent of normal.

Ground-water levels in reported observation wells in the basin fluctuated seasonally during 1988, generally remaining near normal levels.

Maximum intrusion of the salt line (the location in the Delaware River where the concentration of chlorides in water is 250 parts per million) occurred in late October at River Mile 82, off-shore of Chester, Pa.

The year began with a carryover of dry weather from the late fall of 1987. In the upper basin, a wet May offset precipitation shortfalls in January, March and April, and by June 1 New York City's three upper in-basin reser-



voirs (Neversink, Pepacton and Cannonsville) were filled to their combined 271 billion gallon capacity and spilling.

Six weeks of extremely hot, dry weather followed, plunging much of the basin into an agricultural drought and placing heavy demands on existing water supplies and distribution systems. Crops were stunted by the record heat and many farmers suffered heavy losses.

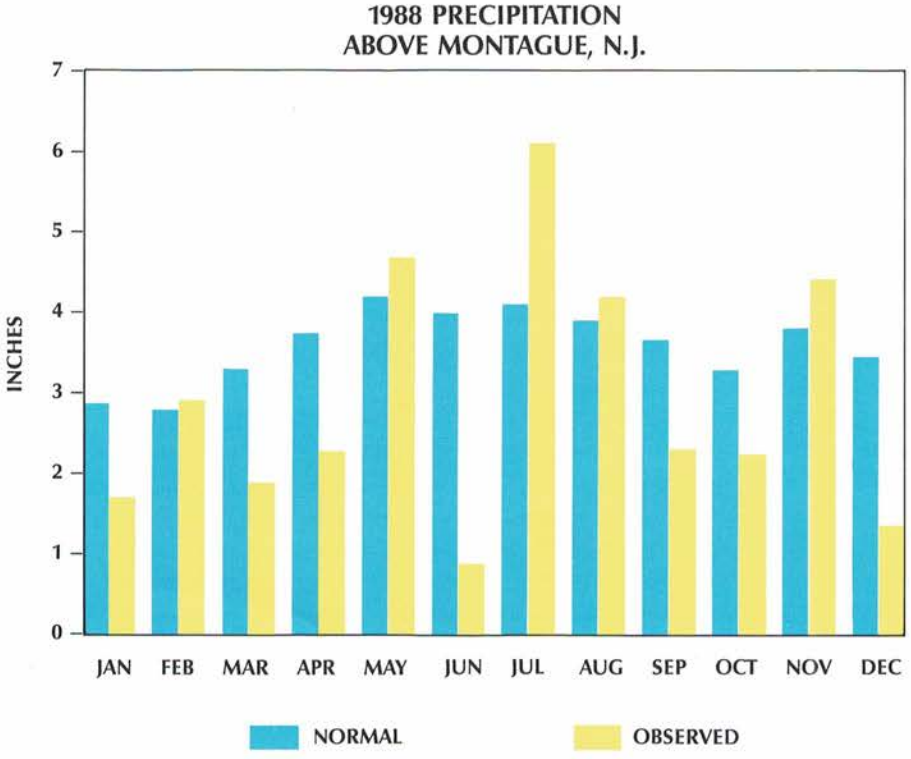
In Pennsylvania, a "drought watch" was declared in early July with the commonwealth calling for voluntary water conservation measures. Some communities and water companies in the basin implemented mandatory restrictions on such non-essential uses as watering lawns and washing cars.

The six-week dry spell gave way in mid-July to two weeks of soaking rains, with the heaviest amounts falling in the lower basin. Streamflows in the Delaware and its tributaries rose well above normal levels and the salt line retreated nine miles downstream to the Delaware Memorial Bridge.

But more dry weather was to follow. Below normal rainfall fell throughout the basin in both September and October and by November 5 storage in New York City's three upper basin reservoirs had dropped to 111.2 billion gallons, a mere 1.2 billion gallons above the DRBC's drought warning rule curve. Normal storage for that date is 142 billion gallons.

Above average precipitation in the latter part of November helped storage levels rebound somewhat, but the recovery was short-lived. Precipitation fell off markedly in December, and by month's end storage in the New York reservoirs was only eight billion gallons above the drought warning zone and once again falling.

Although streamflows were below normal in the Delaware for most of the year, the normal minimum flow target of 3,000 cfs at Trenton was never missed due, in part, to the release capabilities of two lower basin reservoirs.




As the heat wave of early summer extended into July, the DRBC called for the release of 830 million gallons of water from Blue Marsh and Beltzville Reservoirs to augment downstream flows and improve water quality. A second release of 129 million gallons was made in mid-October from Beltzville, again for flow augmentation.

The DRBC owns water supply pools in both reservoirs, which are operated by the U.S. Army Corps of Engineers. The Blue Marsh impoundment is located on Tulpehocken Creek, a tributary to the Schuylkill River, and Beltzville is on Pohopoco Creek, a tributary to the Lehigh. Both the Lehigh and Schuylkill flow into the Delaware.

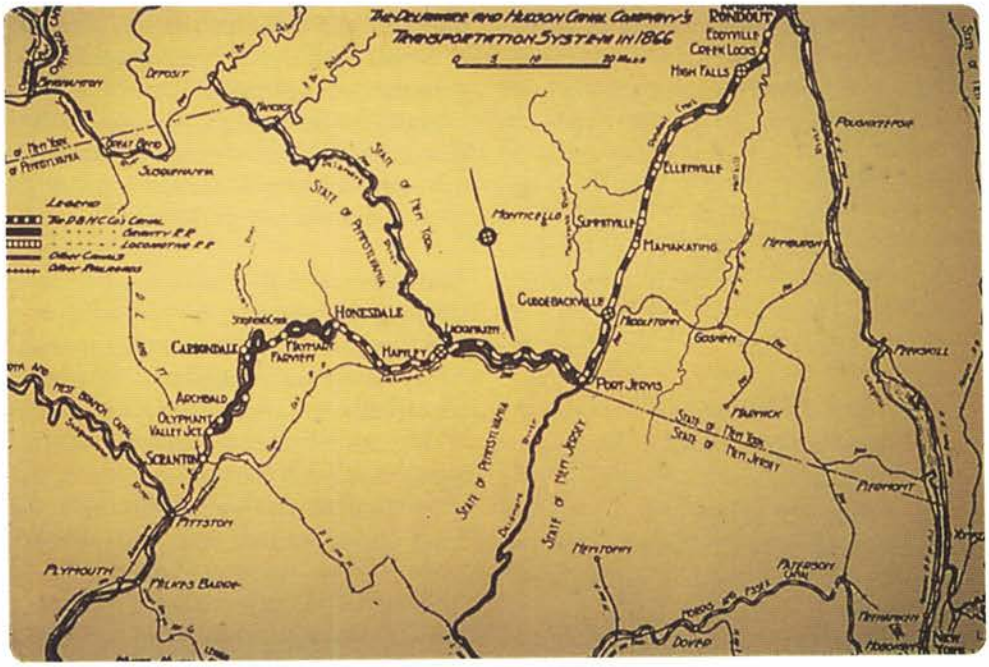
*On October 29, 1988, Cannonsville Reservoir (above) was only 26 percent full. By November 5, combined storage in this impoundment and in New York City's two other upper basin reservoirs had dropped to 111.2 billion gallons, a mere 1.2 billion gallons above the DRBC's drought warning rule curve. Normal combined storage for that date is 142 billion gallons. (Photo by David Everett)*

During dry periods, special releases from these reservoirs play an important role in protecting water quality and enhancing streamflows in all three rivers.

A special release program also was utilized during the year to protect the cold water fishery in the upper basin. From early June through mid-July, two billion gallons of water were released from the three New York City reservoirs to cool the trout-rich waters of the East and West branches of the Delaware River below Pepacton and Cannonsville Reservoirs, the Neversink River below the Neversink Reservoir, and the upper reaches of the Delaware main stem.

# The Delaware Aqueduct

## A Bridge Across Time




MINISINK FORD, Pa. — If Maurice and William Wurts hadn't needed to get their coal to market, and if the Delaware River wasn't so moody, then maybe the Delaware Aqueduct bridge wouldn't have been built and a bit of history would have flitted by these unspoiled hills.

But the Wurts brothers, dry goods merchants from Philadelphia, had considerable anthracite holdings near Carbondale in northeastern Pennsylvania, and because of fierce competition in downriver markets fed by the Lehigh and Schuylkill Rivers, they decided to sell their coal in New York City. They had a lot of coal and an even bigger idea: build a canal to get it there.

Things were simpler back then, and it wasn't long before surveyors were mapping out the route. In October of 1829, the entire Delaware and Hudson Canal, fed by a 17-mile-long gravity railroad, was opened for business. Coal from Carbondale was loaded onto railroad cars to be hauled over the Moosic Mountains. At Honesdale, it was placed on canal boats and transported to the Hudson River, then transferred to schooners and barges for the trip to New York City and points north.

But by 1841 the canal was experiencing old-fashioned gridlock, especially at the banks of the Delaware River, which the canal boats had to cross to continue their journey. Boatmen waited days for slack water

JOHN A. ROEBLING, 1806-1869

to rise, for high water to fall. And once in the river, they had to dodge giant log rafts, made of timber cut from valley hillsides, floating downstream to mills in Trenton and Philadelphia. Collisions were common, as were brawls between "canalers" and raftmen, but even worse for the companies were costly lawsuits.

It was in February of 1846 that the canal company authorized the construction of two aqueduct bridges — one to span the Lackawaxen River and the other the Delaware between Minisink Ford in Pennsylvania and Lackawaxen in New York. Two proposals were received: one for a conventional trussed timber structure on masonry piers in six spans; the other for a wire-cable suspension aqueduct. The second proposal was submitted by John A. Roebling, who would earn a niche in history for his later design of the fabled Brooklyn Bridge, spanning New York's East River.

Roebling was selected. His scheme was cheaper and required only three piers instead of six, reducing the exposure to ice and flood hazards and making more room for the dreaded timber rafts to pass underneath.

The cost for both aqueducts was $60,400. Work began in March of 1847 and the aqueducts opened on April 26, 1849. For the next half century, these watery highways would carry the mule-pulled canal boats over two rivers on their journeys to and from market.

But if the Wurts brothers had had a good idea, so had Robert Fulton. The Iron Horse, a product of the "Steam Age," was taking over the valley, towing strings of coal cars to market at a rate much faster than mules. By 1898, the railroads were King and the canal company was liquidated.

*The canal boat "Little Freddie" on the Pennsylvania side of the Delaware Aqueduct in the 1890s. Two boys on mules (note feed bags) rest on the towpath. (Courtesy of the Wayne County Historical Society)*

*The water trunk was removed in 1930 and replaced with a wood deck. A worker pauses during the conversion project. (Photo by Haupt)*

John Roebling actually had built four aqueduct bridges in the region, the other two spanning the Neversink River and Roundout Creek. All but the Delaware Aqueduct were eventually demolished.

The Delaware Aqueduct was purchased and used as a toll bridge. In 1930, the aqueduct trunk was removed and replaced with a simple wood deck. Rising maintenance costs overtook meager revenues, and by the 1970s dilapidation was settling in.

The National Park Service purchased the structure in 1980, repairing railings, deck timbers and the lighting system. When reopened in the fall of 1980, only pedestrian traffic was permitted.

But the Park Service also had an idea:

*A worker rewraps the rehabilitated cables after the application of a rust-inhibitor paint. (Photo by Sandy Speers, NPS)*

restore the Delaware Aqueduct to its original form, substituting a concrete deck for Roebling's original water trunk. Engineering, architectural and construction firms were hired to do the work: Lichtenstein & Associates, Coastal Structures, Inc., Beyer Blinder Belle, Ammann & Whitney, and Chesterfield Associates.

It was the removing of the water trunk in 1930 that now posed the biggest design challenges. The trunk, with its 770-ton dead weight of water, along with massive wood trusses, had provided longitudinal stiffening. In contrast, the wood deck danced in the wind, the movement being translated to the cables, which

*The structure is blasted with water and rounded glass beads to remove rust and dirt. (Photo by Sandy Speers, NPS)*

were bent and stretched as they strained against the pier saddles.

To counteract this stabilization problem, a three-layer concrete deck was installed substituting for the weight of the water, and steel stiffening trusses were skillfully hidden within the existing wood superstructure.

Oversized Douglas Fir timber was brought in from the Cascade Mountains of Washington after being cut, dried and milled. In all, 118 timber frames were assembled and lowered in place.

Then the underpinnings of the concrete roadway were positioned. Included were neoprene bearing pads to absorb shocks and vibrations. A web of epoxy-coated reinforcement bars was set in place for the poured-in-place concrete slab. Sidewalks were installed and traffic signals erected at each end of the bridge to coordinate single lane vehicular traffic.

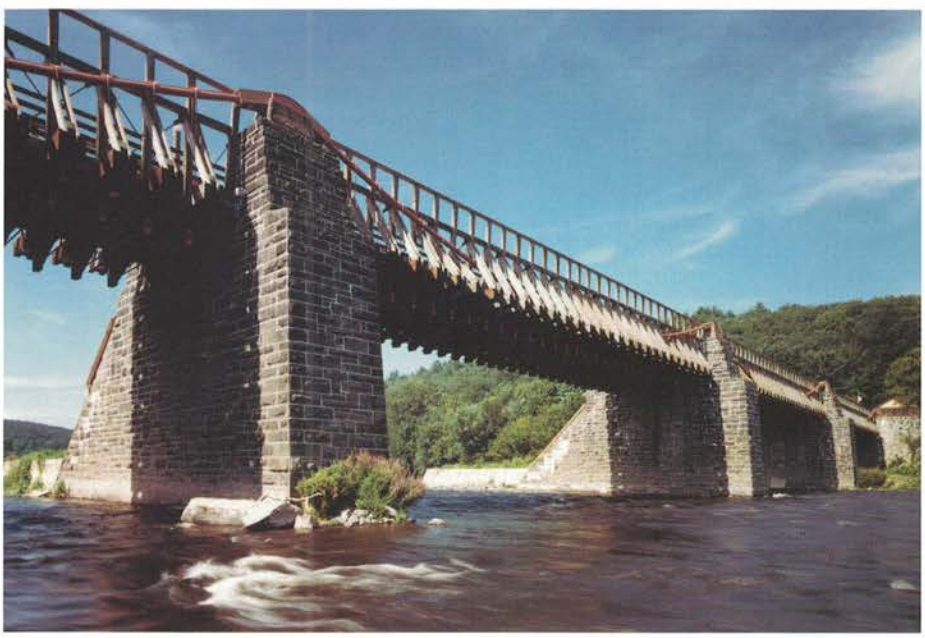
On June 13, 1987, Roebling's restored span was officially reopened as a parade of horn-tooting antique cars fittingly tried out the oldest existing wire suspension bridge in the United States.

On Nov. 10, 1988, the restoration project received a Presidential Award for Design Excellence, presented by the National Endowment of the Arts at a White House ceremony. It was one of only ten awards selected from over 500 projects.

There is still a little work left to do. The original towpaths, or mule walks as they are known around here, will be restored and the area landscaped.

Not far from the bridge stands the house where Zane Grey wrote his early novels before moving west in 1918 with his wife and children. He left a New York City dental practice behind and a lot of lore.

One can still stand on Zane Grey's porch and look out across the Delaware to the Roebling Bridge and the New York hills beyond and thank Maurice and William Wurts for having an idea. The river runs clear, dotted with canoes and fishermen who come for shad in the spring and for bass all summer.



*The Delaware Aqueduct shortly after major restoration work was completed. (Photo by Alan Schindler)*

# Other Basin Highlights

### Data Management

The Delaware River Basin Commission is implementing a comprehensive water resources database as part of a program to create a regional, uniform pool of automated water-use information for the watershed. Known as the "compendium" database, it is being developed on a new Digital minicomputer system (VAX 3500) the Commission purchased during 1988.

The need for a common pool of computerized data was underscored back in 1982 with the publication of the "Special Ground Water Study Basinwide Report and Executive Summary." The study recommended that the Commission develop a comprehensive ground water database for the purpose of improving ground-water management.

A year later, the Commission recommended that a depletive water-use budget be prepared to balance further depletive uses with existing and proposed basin storage facilities.

To improve the quality of data to be computerized, and to ensure consistency in data collection programs among the four basin states, the Commission adopted two key regulations: well registration (Resolution No. 85-19) and source metering (Resolution No. 86-12). The information obtained from the two programs represents primary data sources for the compendium.

Under Resolution No. 85-19, which was adopted on May 29, 1985, all new and existing wells or projects that withdraw 10,000 gallons per day or more during any 30-day period must be registered with the respective basin states in which they operate. Since the inception of the program, thousands of wells have been registered in the basin under programs administered by the Delaware Department of Natural Resources and Environmental Control, the New Jersey Department of Environmental Protection, New York Department of Environmental Conservation, and the Pennsylvania Department of Environmental Resources.

The well registration data currently are being stored in state databases and in the Ground Water Site Inventory or GWSI database operated by the U.S. Geological Survey. This effort is being assisted through funding from the U.S. Environmental Protection Agency. During 1988, selected data elements from these databases were transferred to the Commission's system. By late 1989, the Commission expects to have a database that contains records for about 10,000 wells.

Under Resolution No. 86-12, which was adopted on June 25, 1986, all surface and ground-water withdrawals exceeding 100,000 gallons per day (10,000 gpd in Pennsylvania's Ground Water Protected Area) must be metered or measured at the source. The regulation requires affected water users to report their withdrawals to regulatory agencies in their respective basin states. The program took effect on January 1, 1987.

The metering data are being stored in state databases and in the USGS's State Water Use Data System or SWUDS databases. During 1988, water-use information for 1987 was transferred to the Commission's computer system.

The new minicomputer system was purchased to handle the large bulk of information being generated from the well registration and metering programs. Previously, such information was stored in various microcomputers, but limitations in processing speed and auxiliary disk storage precluded their usefulness for processing large volumes of data. In 1989, reporting programs will be developed to link the specific location of water withdrawals and discharges to sub-basin hydrology in order to track water use in a budget.

Computer model simulations of the Delaware River also are being run on the new system at a much greater speed than in the past. What previously took a week's time to simulate the hydrologic effects of the record drought of the 1960s, using both the Daily Flow Reservoir Operation Model and the Salinity Model, now can be completed in two days.

### Striped Bass Study

For eight weeks during the spring of 1988, a 70-mile stretch of the Delaware River, four Delaware tributaries, and the Chesapeake and Delaware (C&D) Canal were sampled to assess striped bass spawning activity as part of an ongoing study by the Delaware Basin Fish and Wildlife Management Cooperative.

Seventy-six percent of the striped bass eggs located were found in the C&D Canal, which links the Delaware and Chesapeake Bays. Striped bass eggs also were found throughout the sampled portion of the Delaware River (from Bristol, Pa. to Artificial Island, N.J., just below the C&D Canal) and in the Christina River and Racoon Creek. However, none were found in the two other Delaware River tributaries — the Schuylkill River and Oldmans Creek.

Striped bass larvae also were detected in the Delaware River, as well as in

Racoon and Oldmans Creek, but not in the Christina or Schuylkill Rivers. And although most of the eggs were taken in the C&D Canal, no larvae were found there.

Comparing the current study's results with earlier sampling results, it was determined that eggs and larvae were concentrated in the same regions of the Delaware River in 1988 as in the 1960s and 1970s. However, unlike the results of previous studies, eggs and larvae also were found off Philadelphia, an area historically subject to a dissolved oxygen sag or "pollution block."

Other differences were found:

— Mean egg density in the Delaware River during 1988 was substantially less than in the 1970s; however, larval densities were similar.

— Densities of eggs and larvae in the Delaware River in 1988 were considerably lower than densities reported for the Hudson River and Chesapeake Bay in any recent year.

The current study will continue through 1989 in an effort to sort out some of the apparent inconsistencies generated by the 1988 efforts. Among the questions to be answered:

— Why were the majority of striped bass eggs collected from the C&D Canal yet no larvae found there?

— Why were eggs in the Delaware River concentrated near Wilmington, Del., yet larvae were concentrated upriver near Philadelphia and were more evenly distributed throughout the river?

The 1989 effort also will include stock identification studies in an effort to determine whether striped bass found in the Delaware system are indigenous species or migrants from, say, the Chesapeake Bay via the C&D Canal.

The study, which provides a rare insight into fish spawning activities in the Delaware estuary, is funded by the states of Pennsylvania, New Jersey and Delaware. The Delaware River Basin Commission provides the administrative and contractual functions for implementation of the program.

**Christina Drought Plan**

On Oct. 26, 1988, the DRBC voted to amend its Comprehensive Plan to include a drought management strategy for the Christina River Basin which straddles parts of northern Delaware and southeastern Pennsylvania.

In taking the action, the Commission noted that the Christina Basin is heavily dependent on ground-water supplies in southern Chester County, Pennsylvania, and that, therefore, the DRBC's basinwide drought management plan, which is triggered by falling storage levels in upper basin reservoirs, is not always an effective tool in dealing with hydrologic conditions in the Christina watershed. Past droughts, for instance, have shown that surface water conditions may improve to a point where restrictions on non-essential water uses are lifted, while some local ground-water levels have not sufficiently recovered to justify such action.

The Christina Basin Drought Management Plan is incorporated in the drought management plans of both Pennsylvania and Delaware. It is administered by a committee made up of representatives from the Pennsylvania Department of Environmental Resources, the Pennsylvania Emergency Management Agency, the Delaware Department of Natural Resources and Environmental Control, the Delaware Geological Survey, the Water Resources Agency for New Castle County, Delaware; the Chester County Water Resources Authority, and public and private water purveyors in the area.

The plan contains "drought warning" (voluntary water conservation) and "drought emergency" (mandatory water-use restrictions) stages. It is activated by declarations by the governors of Delaware and Pennsylvania based on recommendations from the committee which analyzes such hydrologic conditions as precipitation levels, ground-water levels at selected monitoring sites, and streamflow in the Brandywine Creek at Chadds Ford, Pa. The plan can be implemented in conjunction with state or DRBC drought actions, or can be activated independently if warranted by conditions in the Christina Basin.

David Yaeck, executive director of the Chester County Water Resources Authority, commended the close governmental and private cooperation which led to the formation of the plan, particularly noting the DRBC's role in providing a forum to share common goals.

**Shad Restoration**

Pennsylvania Gov. Robert P. Casey has signed into law a bill which appropriates $3.3 million for the construction of fish ladders, or passageways, at two dams on the Lehigh River.

Placement of the fish passage facilities at the Easton and Glendon dams in Northampton County would open the river to American shad and other anadromous species for the first time in 160 years. Fishery biologists estimate that the Lehigh could produce up to 450,000 American shad each year, creating a high quality sport fishery as well as new spawning areas for Delaware River stock.

Prior to construction of dams on the Lehigh in the 1820s, large schools of shad migrated upriver each spring to spawn.

A study by the Pennsylvania Fish Commission in the early 1980s determined that the water quality of the Lehigh River, particularly the lower and middle reaches, was suitable for anadromous fish restoration if fish passageways were constructed over existing dams. Other studies have shown that shad are likely to spawn in the Lehigh with the young remaining through the nursery period prior to their seaward migration in the fall.

The fish passageway project is supported by the Fish Commission, the Lehigh River Protection, Preservation and Improvement Foundation, the Delaware Basin Fish and Wildlife Management Cooperative, the Delaware River Shad Fishermen's Association, and other sportsmen's clubs.

Meanwhile, American shad spawning runs in the Delaware River continue to improve with the 1988 upriver migration considered excellent, based on fishermen interviews and other factors. Sampling results from the Delaware indicate that juvenile shad production appears equal to or better than the 1987 index. Improved water quality, especially higher dissolved oxygen levels, has been instrumental in the recovery of this sport fishery which generates a substantial investment of recreational dollars in the basin.

### Hydropower Charges

The DRBC broadened its water-use charging system during 1988, incorporating a fee schedule for hydroelectric projects which benefit from water storage facilities owned by the Commission.

Since 1974, the DRBC has been charging in-basin, surface-water users who came on line after Oct. 27, 1961, the date the Commission was created. It also has imposed charges on users who have exceeded their legal pre-1961 entitlements. The fees (currently six cents per thousand gallons for consumptive use and six-tenths of a mill per thousand gallons for non-consumptive use) are used to repay the federal government for the water supply costs of federal reservoirs constructed in the basin.

These water supply charges, however, were not structured to reflect the operational characteristics of hydroelectric power projects, which are subject to regulatory review by the DRBC. Several applications for hydro projects were recently submitted to the Commission, prompting a draft resolution to clarify their status in the user fee program.

A public hearing was held on Aug. 3, 1988 and the hearing record was extended to Sept. 20. On Oct. 26, the resolution was adopted, amending the Commission's Comprehensive Plan and Basin Regulations/ Water Supply Charges to provide that:

- Owners of conventional run-of-river hydroelectric power plants that benefit from water storage facilities owned or partially owned by the Commission shall pay an annual base charge of one dollar per kilowatt of installed capacity.
- In addition to the base charge, annual charges tied to the power generated at each facility will be imposed based on increased hydraulic head and/or increased flows which result directly from investments by the Commission.
- All hydroelectric generating projects that do not benefit from storage owned by the Commission are exempt from these water charges.

### Flood Insurance Studies

During 1988, the DRBC completed computer modeling for a Limited Detail Flood Insurance Study for portions of Schuylkill and Carbon Counties in Pennsylvania. The work was completed under contract with the Philadelphia District of the U.S. Army Corps of Engineers and was under the direction of the Federal Emergency Management Agency as part of the National Flood Insurance Program.

The work includes computation of the 100-year water surface profile for approximately 72 miles of stream in 16 communities in the two counties. The profiles provide the basis for developing the 100-year flood boundary maps for the communities.

When requested, the DRBC will continue to assist in the preparation of technical evaluations used for flood insurance studies. However, as these types of studies are phased out by the federal government, the DRBC will emphasize the development of flood warning and preparedness programs in the basin. This will include the preparation of flood stage forecast maps for use by state and local flood emergency coordinators.

### River Management Plan

The DRBC on March 23, 1988, voted to add to its Comprehensive Plan the Management Plan for the Upper Delaware Scenic and Recreational River, including the entire river corridor and not just the river's main stem and tributary streams as originally proposed.

The river corridor comprises some 55,000 acres. Within that area, the plan calls for purchase by the National Park Service of no more than 124 acres from willing sellers, primarily for river access and visitor facilities.

The DRBC also has endorsed the creation of the Upper Delaware Council, which is helping to oversee the plan's implementation. The council consists of members from the Park Service, the states of New York

and Pennsylvania, and at year's end eight of 15 towns and townships in the Upper Delaware region. The DRBC serves on the council in a non-voting advisory capacity.

Under the National Wild and Scenic Rivers System legislation, the designated stretch of the river (extending 73 miles from Hancock, N.Y. to Matamoras, Pa.) must be protected in its free-flowing state and must be managed for the benefit and enjoyment of present and future generations.

**Ice Jam Project**

A proposed project to reduce ice jam flooding in the Delaware River in the Port Jervis, N.Y. area was stalled at year's end due to legal challenges over environmental issues and a significant increase in the estimated cost of acquiring real estate easements.

The signing of local cooperation agreements between the DRBC and New York State and Pennsylvania was pending a decision by the U.S. Army Corps of Engineers whether to approve the new cost estimate for the easement acquisition.

The legal challenges were brought by the American Littoral Society and the Delaware River Keeper regarding a stream encroachment permit issued by the New Jersey Department of Environmental Protection (NJDEP) and a determination by NJDEP that the project is exempt from newly-implemented freshwater wetlands regulations.

The project is estimated by the Corps to cost $1 million. It is to be paid for on a cost-sharing basis: 75 percent by the Corps and 25 percent by the Commonwealth of Pennsylvania, New York State, the City of Port Jervis, the Borough of Matamoras, Pa. and Westfall Township, Pa.

In 1982, the DRBC, through Congress, requested that the Corps conduct a study of the ice jam flooding problem which a year earlier had caused an estimated $14 million in property damage in the Port Jervis area.

On April 29, 1986, the DRBC agreed to act as the project's non-federal sponsor after the Corps indicated that it would be economically feasible to construct a diversion channel, 200 feet wide and 13,000 feet long, along Mashipacong Island, just south of Port Jervis. The channel would be designed to provide a passageway for ice-clogged river water.

That fall the Corps received authorization from Congress to prepare project plans and specifications. The DRBC voted to add the proposed project to its Comprehensive Plan on May 28, 1988.

A month earlier, Port Jervis Mayor Arthur Gray had appeared at a Commission meeting, requesting that the diversion channel be completed as quickly as possible. He testified that one person had died in the 1981 flood and that 2,000 area residents had been forced to flee their homes. The Delaware River, he said, rose 14.5 feet in one hour as a result of jammed ice which dammed up-river water, forcing it over the Delaware's banks.

**Project Review**

In fiscal year 1988, the DRBC processed 137 applications under its Project Review Branch, 23 more than in the previous year.

There were 108 projects approved under Section 3.8 or 10.3 of the Delaware River Basin Compact. Of those, 61 were concurrently added to the DRBC's Comprehensive Plan (CP) and 17 were renewal projects.

A breakdown of the remaining applications:

— Projects exempt . . . . . 25
— Projects approved for revision of the CP only . . . . . 3
— Applications withdrawn . . . . 0
— Applications denied . . . . . 1

During 1989, 21 permits will expire with their renewal subject to Commission review.

**Island Study**

The National Park Service (NPS) has released its draft report on a study of more than 52 Delaware River islands or island groups located between Easton, Pa. and the river's mouth.

The report contains information pertaining to current land use and ownership of the islands, development status, zoning, geologic and archaeological significance, recreational potential, fisheries and wildlife habitat and other related matters.

The study was requested by U.S. Rep. Peter Kostmayer of Bucks County, Pa. It was conducted by the Park Service under the National Wild and Scenic Rivers Act, which authorizes the NPS to assist various interest groups in developing river conservation plans.

Members of the study team included representatives from both the private and public sectors, including the DRBC.

**Blue Marsh Hydro**

A Federal Energy Regulatory Commission license held by the Commission for a hydroelectric power project at Blue Marsh Reservoir expired April 19, 1988 because construction had not begun.

Both financing and power rates continued to raise doubts as to the economic soundness of the project, which was envisioned at a time when high oil prices made hydro power an attractive alternative.

Consequently, a request was submitted to the Department of Energy to cancel the DRBC's outstanding loan obligation in connection with the project. The loan funds had been used to conduct feasibility studies for hydro projects at both Blue Marsh, located on Tulpehocken Creek in Berks County, Pa., and at Prompton Reservoir, located in the Pocono Mountains.

# Financial Summary

## Statement of Revenues and Expenditures — General Fund

**Year Ended June 30, 1988**

| REVENUES | Budget | Actual |
|---|---|---|
| Signatory parties: | | |
| State of Delaware | $ 203,600 | $ 203,600 |
| State of New Jersey | 550,000 | 550,000 |
| State of New York | 269,600 | 269,600 |
| Commonwealth of Pennsylvania | 631,900 | 631,900 |
| United States | 263,000 | 247,250 |
| Water Quality Pollution Control Grant | 240,000 | 240,000 |
| Reimbursement of overhead — Agency Fund | 28,000 | 28,000 |
| Sale of publications and sundry | 5,000 | 7,482 |
| Project review fees and other income | 41,100 | 72,517 |
| Interest income | 0 | 90,349 |
| Fines and assessments | 0 | 2,700 |
| Fund balance | 28,800 | 0 |
| TOTAL REVENUES | $2,261,000 | $2,343,398 |
| **EXPENDITURES** | | |
| Personal services | $1,331,500 | $1,329,656 |
| Special and contractual services | 173,000 | 163,262 |
| Other services | 56,400 | 54,965 |
| Supplies and materials | 53,200 | 51,480 |
| Space (including $24,319 of principal payments on mortgage note) | 142,300 | 124,868 |
| Communications | 54,600 | 52,592 |
| Travel | 35,000 | 21,544 |
| Maintenance, replacements, and acquisitions | 96,500 | 95,510 |
| Equipment rental | 28,500 | 25,338 |
| Fringe benefits and other | 290,000 | 273,861 |
| TOTAL EXPENDITURES | $2,261,000 | $2,193,076 |
| Excess of revenues over expenditures | 0 | 150,322 |
| Other financing sources: | | |
| Operating transfers in | 0 | 318,029 |
| Operating transfers out | 0 | (380,000) |
| Total net other financing uses | 0 | (61,971) |
| EXCESS OF REVENUE OVER EXPENDITURES (BUDGETARY BASIS) | 0 | 88,351 |
| Reconciliation to GAAP basis of reporting — encumbrances | 0 | 20,142 |
| EXCESS OF REVENUES OVER EXPENDITURES (GAAP BASIS) | $ 0 | $ 108,493 |

# Statement of Revenues and Expenditures — Capital Projects

**Year Ended June 30, 1988**

| REVENUES | Budget | Actual |
|---|---|---|
| Signatory parties: | | |
| State of New Jersey | $ 2,000 | $ 2,000 |
| Commonwealth of Pennsylvania | 25,000 | 25,000 |
| Water Charges | 961,100 | 882,522 |
| Interest Income | 164,800 | 149,186 |
| Western Berks-Facilities Use | 20,500 | 20,515 |
| TOTAL REVENUES | $1,173,400 | $1,079,223 |
| **EXPENDITURES** | | |
| Debt Service on Projects | $ 559,000 | $ 552,004 |
| Operation and Maintenance Cost on Projects | 109,500 | 112,757 |
| Administrative Cost | 68,600 | 49,176 |
| TOTAL EXPENDITURES | $ 737,100 | $ 713,937 |
| Excess of revenues over expenditures (Budgetary Basis) | $ 436,300 | $ 365,286 |

NOTE: Debt service and operating and maintenance cost are for the Beltzville Reservoir Project and the Blue Marsh Reservoir Project and payments are made to the United States Army Corps of Engineers.

# Statement of Changes in Special Projects Fund Balances

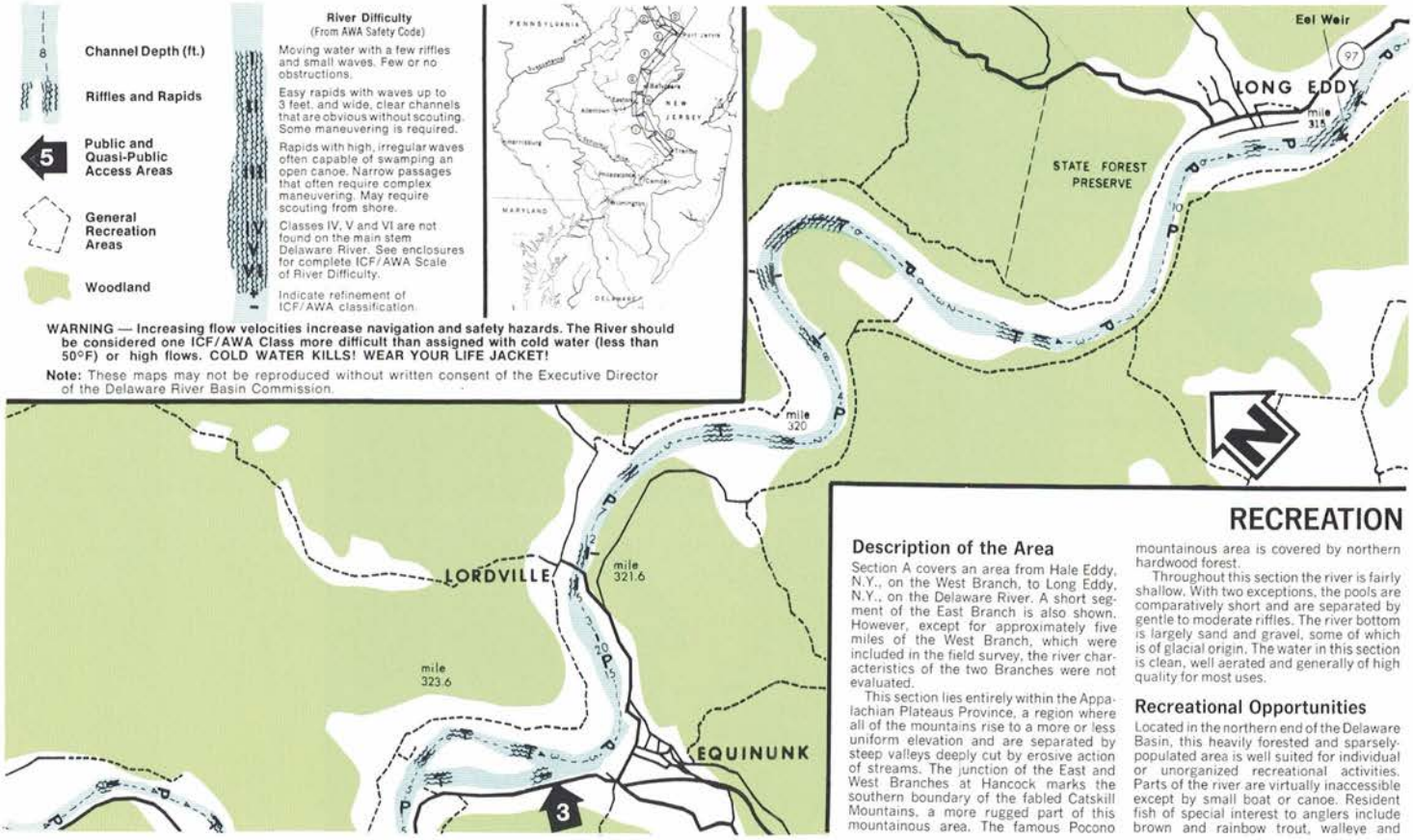
| Project | Fund Balances July 1, 1987 | Revenues | Transfers | Expenditures | Fund Balances June 30, 1988 |
|---|---|---|---|---|---|
| Recreational rivers | $ 0 | $ 13,000 | $ 0 | $ 12,986 | $ 14 |
| Well registration — EPA and PA | 2,059 | 15,704 | 0 | 17,763 | 0 |
| 2 D model | 10 | 10,000 | (10) | 10,000 | 0 |
| USGS monitors | 42,785 | 184,650 | 0 | 181,342 | 46,093 |
| Delaware estuary | 0 | 22,500 | 0 | 22,500 | 0 |
| Blue Marsh — Prompton Dam | (28,000) | 0 | 14,000 | (14,000) | 0 |
| Study of exotic wastes — Phase II | 46,047 | 0 | (46,047) | 0 | 0 |
| Ground water | 1,441 | 0 | (1,441) | 0 | 0 |
| Merrill Creek | 12,590 | 0 | (12,590) | 0 | 0 |
| Blue Marsh | 50 | 21,000 | 0 | 21,009 | 41 |
| Ground water—Pennsylvania Protected Area | 298,328 | 150,000 | (227,381) | 134,419 | 86,528 |
| Flood study—U.S. Army Corps of Engineers | 0 | 31,066 | 0 | 31,066 | 0 |
| Ground water — withdrawal fees | 1,135 | 0 | 0 | 0 | 1,135 |
| Computer | 44,563 | 0 | (44,560) | 0 | 3 |
| Flood plain contract — Commonwealth of Pennsylvania | 1 | 0 | 0 | 0 | 1 |
| Disinfection study | 18,750 | 280,500 | 0 | 144,197 | 155,053 |
| Delaware fish study | 0 | 63,000 | 0 | 38,000 | 25,000 |
| Coastal zone study | 0 | 46,870 | 0 | 46,870 | 0 |
| | $439,759 | $838,290 (A) | $(318,029) | $646,152 (B) | $313,868 |

(A) Revenues derived from:

| | |
|---|---|
| United States Government | $200,936 |
| Pennsylvania Department of Environmental Resources | 230,604 |
| Other states | 45,500 |
| Corporate and other grants and fees | 361,250 |
| | $838,290 |

(B) Expenditures were primarily for payroll costs and contractual services.

The records of the Commission are audited annually as required by the Compact.




# RECREATION

## Description of the Area

Section A covers an area from Hale Eddy, N.Y., on the West Branch, to Long Eddy, N.Y., on the Delaware River. A short segment of the East Branch is also shown. However, except for approximately five miles of the West Branch, which were included in the field survey, the river characteristics of the two Branches were not evaluated.

This section lies entirely within the Appalachian Plateaus Province, a region where all of the mountains rise to a more or less uniform elevation and are separated by steep valleys deeply cut by erosive action of streams. The junction of the East and West Branches at Hancock marks the southern boundary of the fabled Catskill Mountains, a more rugged part of this mountainous area. The famous Pocono mountainous area is covered by northern hardwood forest.

Throughout this section the river is fairly shallow. With two exceptions, the pools are comparatively short and are separated by gentle to moderate riffles. The river bottom is largely sand and gravel, some of which is of glacial origin. The water in this section is clean, well aerated and generally of high quality for most uses.

## Recreational Opportunities

Located in the northern end of the Delaware Basin, this heavily forested and sparsely-populated area is well suited for individual or unorganized recreational activities. Parts of the river are virtually inaccessible except by small boat or canoe. Resident fish of special interest to anglers include brown and rainbow trout, walleye and

*The Delaware River Basin Commission has available recreational maps of the Delaware and Schuylkill Rivers. The maps provide information on streamflow characteristics, access and general recreational areas, stream mileage and reference points, and river difficulty ratings.*

*The Delaware map contains ten sections and covers the area from Hancock, N.Y. to Trenton, N.J. The Schuylkill map comes in eight sections, covering the area from Tamaqua Dam to the Fairmount Dam in Philadelphia. Both sets of maps are waterproof. The cost is $6.25 for either set of maps, $12.50 for both. Checks should be payable to the Delaware River Basin Commission.*

# DELAWARE RIVER BASIN

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