



# The Delaware River Basin Commission 1984 Annual Report





*On the cover is reproduced a fascinating map of "Novi Belgii" (New Belgium) dating to before 1682, more than three centuries ago. Taking in the New World's Atlantic seaboard from Virginia to New England, it includes the region's principal rivers — the Susquehanna, Delaware, Hudson and Connecticut. Courtesy New Jersey State Library.*

*Pictured on these pages are scenes in Washington Crossing State Park, Pa. (left), and Narrowsburg, N.Y., as viewed from the Pennsylvania side of the Upper Delaware. Photos by James M. Staples.*

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



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*Canoeists enjoying the Scenic and Recreational Upper Delaware at Hawk's Nest.  
Photo by James M. Staples.*

## Introduction

When the four Delaware River Basin states of Delaware, New York, Pennsylvania and New Jersey and the United States government became partners in the 1961 interstate-federal compact to bring the region's water resources under unified management, they charged their new agency with a multitude of responsibilities. These were – and still are – cutting pollution down to levels compatible with water-use goals; reducing flood damages; assuring enough surface- and ground-water supplies to accommodate legitimate water needs; averting harm to the resource from proposed projects; and, above all, achieving these and our other management goals through a shared interstate sovereignty.

Indeed, in its more than 23 years of service, the Delaware River Basin Commission has engaged in the full range of water-management activities – some, at times, more heavily than others. But since 1980, uncontrollable changes in weather patterns have imposed a seeming preoccupation with drought, and more drought.

Half-century-old water-crop assumptions had proven to be obsolete. This helped trigger historic negotiations and eventual agreement on long-term drought management for the region

among the four states and New York City. They are the parties to the long-standing U.S. Supreme Court decree on interstate sharing of the Delaware.

The governors of the four states and mayor of New York agreed on their recommended drought-control program in 1983, and since then a preponderance of DRBC's work has gone into implementing their 14 suggestions. New standards for salinity and sodium control in the estuary, new criteria for declaring droughts, and a new formula for sharing shortages are on the books. Enlargement of the region's water-storage capacity and design of a conservation program are in the works. In fact, virtually all of the governors' recommendations have been adopted or initiated.

Much of this report, DRBC's twenty-third, relates to 1984 activities on drought preparedness and associated issues of conservation, salinity intrusion and ground-water management. The executive director's own report this year discusses fishery matters, while other sections deal with pollution-control progress and matters of special interest to the mountainous and rural upper basin.

The report is presented respectfully to the basin's 7 million residents and their elected state and federal representatives.



# DRBC gets new members from Delaware and U.S.

The Delaware River Basin Commission gets new members in 1985 from two of its five signatory parties – Delaware and the United States.

Michael N. Castle was elected Governor of Delaware in November 1984 to succeed two-term chief executive Pierre S. duPont, with whom he served as lieutenant governor, and automatically becomes the First State's principal representative on the Commission.

The federal membership changes hands with the selection of Donald P. Hodel to replace William P. Clark as Secretary of Interior. Mr. Clark submitted his resignation to take effect February 7, 1985. The holder of that cabinet position has been the presidential appointee as federal member of DRBC in each national administration since the Commission was established in 1961.

The new alternate to Governor Thomas H. Kean of New Jersey will be Dr. Richard T. Dewling, a deputy environmental protection commissioner, succeeding Environmental Commissioner Robert E. Hughey. Dirk C. Hofman continues to serve as alternate in the absence of Dr. Dewling, as he did for Mr. Hughey. Dr. Dewling formerly was deputy administrator for the New York

region, including New Jersey, of the U.S. Environmental Protection Agency from 1979 to 1984 and earlier had been a division director there. He holds an environmental science doctorate from Rutgers University and has operated wastewater treatment plants for New York City, edited and written for technical publications, and taught his specialty at numerous colleges.

The rotating chairmanship of DRBC was passed from Secretary Clark to Governor Mario M. Cuomo of New York for 1984-85, and he was succeeded as vice chairman by Governor Kean.

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James F. Wright, who was appointed DRBC's first executive director in 1962 following a nationwide talent search and who retired in 1977, died in January 1985 in Santa Rosa, Cal. A native of Auburn, N.Y., Mr. Wright came to the Commission from California's department of water resources and returned to the Golden State upon retirement. As chief executive of DRBC's previously untried approach to water-resources administration for a multi-state river basin, Mr. Wright organized and built DRBC into an instrumentality that continues to

attract international recognition as a model of river-basin management.

Retirement has ended the long and valued service of two popular members of DRBC's staff.

Miss Marie A. Combs closed out 20 years with the Commission in 1984 as secretary to the two executive directors it has had – Mr. Wright and Gerald M. Hansler, who has held the position since 1977. Her assignment with the Commission built upon her earlier years of public service with the governor's office in Trenton and as assistant secretary of the New Jersey Highway Authority.

Entering retirement early in 1985 is veteran water resources engineer Seymour D. (Sy) Selzer. For the final 15 of his more than 22 years with DRBC, Mr. Selzer was head of its planning branch. At various times, he worked on DRBC's project review, water quality and general planning programs. An important recent responsibility was his supervision of the final-report preparation of the "Level B" Comprehensive Study that is the guidepost of much of the agency's current activity on conservation and drought readiness.



Governor Castle



Mr. Hodel



Dr. Dewling



Mr. Wright



Miss Combs



Mr. Selzer



# Executive Director's Report "Fish Stories"

By Gerald M. Hansler

There are many water resource management functions considered by the DRBC, such as pollution control, flood control, water supply, hydroelectric, etc. And, not all of the "public interest" segments of our basin cover every function. However, the DRBC does consider another important element characterized by an ancient Chinese proverb:

*If you wish to be happy for one hour,  
get intoxicated.*

*If you wish to be happy for three days,  
get married.*

*If you wish to be happy for eight days,  
kill your pig and eat it.*

*If you wish to be happy forever,  
learn to fish.*

Many of our policies, programs and project reviews do relate to the protection and enhancement of fish.

To begin with, a massive effort to reduce pollution in the Delaware Estuary was initiated by the Commission. In the early 1950s, the Delaware Estuary in the Trenton/Philadelphia/Camden/Wilmington area often exhibited zero levels of dissolved oxygen — oxygen that is an absolute must for higher and healthier forms of aquatic and marine life. The program of industrial and municipal point-source pollution is "paying off."

Minimum average daily oxygen levels have risen dramatically. And, when the Camden, Philadelphia Northeast and Philadelphia Southeast sewage treatment plants are completed (they're now under construction), the picture will be even brighter.

Shad migration up and down river somewhat parallels the estuarine water-quality improvement. The Delaware Basin Fish and Wildlife Management Cooperative\* stated in its *Management Plan for the American Shad in the Delaware River Basin* that "... it

appears that the improvement of dissolved-oxygen levels from 1951 hence were coincident with the commencement of sewage treatment by the City of Philadelphia." Therefore, completion of Philadelphia's remaining two plants, plus the Camden main plant, is of vital importance.

Another factor aiding in the return of a healthy shad population is the increased minimum summer and early autumn flows in the Lehigh River and the Delaware River above Trenton. Historically, low average daily flows in the Delaware at Trenton were around 800-900 cubic feet per second (cfs). That was before the construction of upstream storage reservoirs which provided augmented flows during low-flow



Mr. Hansler

periods. Now, a 7-day minimum flow of 2,500 cfs can be realized at Trenton with a recurrence of the drought of record. This 300 percent increase in minimum flow aids the juvenile shad in eluding river predators (piscivorous species) such as the large mouth bass, walleye and muskellunge — all of which were introduced into the Delaware system and are now considered indigenous.

With the Cooperative's efforts to rekindle a shad-migration cycle in the Lehigh, flow-augmentation releases from Beltzville and F. E. Walter reservoirs in assuring acceptable dissolved oxygen, as well as minimum flow levels in that stream. However, cold-water effects on spawning and juvenile shad need special attention concerning any augmented reservoir release program.

DRBC reviews of various projects focus on fish and wildlife impacts. State-of-the-art intake screens are required for new surface-water-withdrawal projects to mitigate against significant entrapment, impingement or entrainment of important aquatic species. The Commission has established a wetland protection policy that requires proper consideration of fish and wildlife aspects for any new project which may affect a wetland of 25 acres or more.

Upstream water-use practices which can impact on downstream and Delaware Bay fisheries also are recognized — not only concerning the anadromous species, but also varieties such as our famous benthic-bound oysters. Before final Commission approval was given to the Merrill Creek reservoir project, the mode of water-withdrawal operations from the river was revised to reflect the recommendations made by Delaware Bay oyster experts.

Higher up in the Delaware and its tributaries, increased attention has been given to protection of the cold-water fishery established by New York State's Department of Environmental Conservation. A permanent thermal-stress release bank (additional amounts of water in reservoir storage) has been placed in DRBC's comprehensive plan to aid in the maintenance of the permanent trout fishery now established. In late summer of 1984, emergency action by the DRBC granted additional amounts of water from storage to protect against fish kills from higher river temperatures.

In summary, though shad, trout, and even the much sought-after Atlantic striped bass are experiencing better reproduction in the Delaware Basin system, care and continued vigilance are necessary. The remaining major municipal treatment plants must be completed on time. Focus is needed on non-point pollution sources which exert a major burden on dissolved-oxygen levels. The impact of chlorine and its halogenated hydrocarbons created by year-round disinfection of waste effluents needs further and immediate assessment. And, finally, another warning — harvest management is of real import to assure an adequate retention of breeding stock. To decimate the anadromous fish runs through over-zealous commercial and sport fishing — such as occurred with the salmon in the Pacific Northwest — just doesn't make sense.

\*The Cooperative is an organization of the fish and wildlife agencies of Delaware, New Jersey and New York; the Pennsylvania Fish Commission, the National Marine Fisheries Service (Department of Commerce), and the U.S. Fish and Wildlife Service (Department of the Interior).



# The Commission • 1984



*Governor Cuomo*



*Mr. Williams*

## United States

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Chairman

Henry G. Williams\*  
Alternate

Joseph T. McGough Jr.  
Advisor

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Executive Director

David J. Goldberg  
General Counsel

Susan M. Weisman  
Secretary

Dawes Thompson  
Public Information Officer

Raymond J. DiFrancesco  
Chief Administrative Officer



*Governor Kean*



*Mr. Hofman*

## New Jersey

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Vice Chairman

Dirk C. Hofman  
Alternate

## Engineering Division

Robert L. Goodell  
Chief Engineer

C. H. J. Hull  
Staff Engineer

Jeffrey P. Featherstone  
Ground Water Project Director



*Governor duPont*



*Mr. Touhey*

## Delaware

Governor Pierre S. duPont  
Member

Robert J. Touhey  
Alternate

## Branch Heads

Seymour D. Selzer\*\*  
Planning

David B. Everett  
Project Review

Richard C. Tortoriello  
Operations



*Governor Thornburgh*



*Mr. Weston*

## Pennsylvania

Governor Dick Thornburgh  
Member

R. Timothy Weston  
Alternate

William J. Marrasso  
Advisor

\*Irwin H. King serves as Alternate  
in Mr. Williams' absence

\*\*Mr. Selzer retires in 1985



*Secretary Clark*



*Mr. Kanuck*

## New York

Secretary of the Interior  
William P. Clark  
Member

George J. Kanuck Jr.  
Alternate

Lt. Colonel Ralph V. Locurcio  
Advisor



# Coping with the dry years

Substantial progress was recorded on several fronts in 1984 to better equip the Delaware Basin to cope with future droughts as recommended by the four basin-state governors and mayor of New York City in their "good faith" report on Interstate Water Management of a year earlier.

Most of the 1984 progress centered on one of the three main categories of the governors' recommendations. They urged development of physical projects to increase the basin's basic water-supply storage capacity by 20 percent and a program to alleviate ground-water supply problems in Camden and two adjacent New Jersey counties.

Implementation of the suggested storage expansion program actually had begun late in 1983, when it was incorporated into DRBC's comprehensive plan. In 1984 three of the projects moved toward construction.

The specific storage proposals were that the Francis E. Walter and Prompton flood-control impoundments in the Pocono Mountains of Pennsylvania be enlarged for water supply by the U.S. Army Corps of Engineers; that the dam at New York's Cannonsville reservoir on the Delaware's West Branch be elevated by New York State; and that the Merrill Creek reservoir in Warren County, New Jersey, planned by a group of power companies, be built.

Merrill Creek, scheduled to be the first completed, received DRBC docket approval in October, following years of technical and environmental investigation. At year-end it was awaiting permit approvals from New Jersey and the Corps. Once fully cleared, construction is to take about 30 months.

With funds appropriated by Congress, the Corps worked on the design and

environmental-impact aspects of the Walter project. Walter is slated for water-supply operation by 1990. The Prompton enlargement, scheduled for completion five years later than Walter, has not been designed yet.

On Cannonsville, New York State's Department of Environmental Conservation initiated the necessary pre-construction feasibility and environmental studies. As with Walter, the target date for completing the Cannonsville enlargement is 1990.

On another reservoir-related suggestion by the governors, DRBC enacted in 1984 a plan for coordinated drought-period operation of the existing Walter (with temporary emergency water-supply storage) and six other impoundments to assure adequate minimum streamflows in the Delaware and its principal tributaries and to hold the so-called "salt front" safely below the Camden-Philadelphia area so it would not contaminate its drinking and industrial water supplies. (A description of the salinity problem appears on page 8.)

This plan is coordinated with the downstream flow-augmentation function of New York City's three Delaware River Basin reservoirs during water shortages. It sets criteria for systematically making additional downstream releases from the seven facilities. These are Walter and Prompton; two other existing federal reservoirs, Blue Marsh in the Schuylkill River valley and Beltzville in the Lehigh valley; Nockamixon, a state-owned impoundment in Bucks County; and Lake Wallenpaupack, a power-company facility in the Pocono Mountains, all in Pennsylvania; and a group of hydroelectric reservoirs operated by a power company in Sullivan County, New York. The power reservoirs are not part of the basin's normal



water supply pool during non-drought periods.

The governor's one additional reservoir recommendation, that the long-authorized Tocks Island lake plan for the river's main stem near the Delaware Water Gap be held in reserve for development after year 2000 if needed for water supply, had been adopted as formal DRBC policy in 1983.

**New storage = 61 billion gallons**

*The forthcoming reservoir-expansion program will add 61 billion gallons (bg) to the basin's current water-storage capacity. This will increase the combined pool from 362 bg to 423 bg, boosting flow-augmentation capability for salinity control by 630 cubic feet per second (cfs). The minimum flow goal at Trenton, sometimes unmet due to deficient storage, is 3,000 cfs.*

*Storage capacity was only 235 bg during the basin's record 1960s drought – before Cannonsville, Nockamixon, Beltzville and Blue Marsh were built.*

Still another effort recommended by the governors was initiated in 1984 when New Jersey began its investigation into potential alternative solutions to water-supply problems in Camden, Gloucester and lower Burlington counties. The already overpumped Potomac-Raritan-Magothy aquifer, that area's principal drinking-water source, is vulnerable to salinity intrusion in event the salt front reaches as far upstream as Camden, as is possible during droughts. The "good faith" report suggested that New Jersey consider water-supply alternatives for the tri-county area, including pumping from the large Cohansy Sands aquifer or conjunctive use of surface and ground waters by developing a new

Delaware River source or hooking up with Philadelphia's water-supply system.

To go along with their program for increasing the four-state basin's water-supply storage capacity, the governors presented still another important category of recommendations for reducing the impact of droughts – conservation. Work on the report's conservation elements commenced immediately also.

First, all four basin states responded to one of the conservation recommendations when they submitted to DRBC by January 1, 1984 their respective phased contingency plans for saving water during shortages, including non-essential uses to be restricted.

After adopting a suggested basinwide policy objective that depletive, or evaporative, fresh-water losses should be reduced by 15 percent during droughts, DRBC's staff went to work on a major conservation-related effort recommended by the governors. This called for formulation of a regulatory program to control future depletive losses to balance storage availability. DRBC is to establish a depletive water-use budget under which it would approve applications from new users for depletive losses only to the extent of the basin's capability to augment streamflows from the region's reservoir system for meeting the salinity-control goal for the estuary. (A separate section on conservation appears on page 10.)

The other category of the governors' drought-readiness program called for new criteria for declaring shortages and a formula under which regions using Delaware water will share the deficits. The several measures necessary to implement this phase of the "good faith" program had been enacted by DRBC in 1983 within a few months after it received the report.



# Salinity: The problem, the solution

Seaward of Trenton the Delaware River is at sea level, forming an estuary subject to the ocean tides. Flood tides bring sea water into the estuary where turbulent mixing of salt and fresh water produces brackish water in a varying reach of the tidal river. The length of this reach depends on mean sea level and the phase of the tide, as well as the quantity of fresh water flowing into the estuary from the Delaware River at Trenton and seaward tributaries. The up-estuary end of the brackish reach is approximated by the so-called salt front, which was assumed to be the location where the chloride concentration is 250 milligrams per liter (or approximately 250 parts per million) – even though some salts of ocean origin may be present in lesser concentrations above this location.

Excessive salinity is harmful to many water users that take their supply from the estuary, either by direct withdrawal from the tidal river itself or indirectly from wells tapping aquifers that are recharged in part by the estuary. High salt content in a water supply damages pipes, plumbing, and machinery, as well as products contacting the brackish water in certain processes. In the case of a drinking-water supply, the sodium ions found in brackish water are a threat to public health, contributing to hypertension and other diseases among persons ingesting the water.

The problem of protecting the waters of the estuary from the invasion of sea salts is not new. It was a major concern in litigation more than a half-century ago in the U.S. Supreme Court following New York City's announcement of a plan to divert water from the upper Delaware River Basin. It was argued by downstream interests in the lower basin that the proposed diversion of 600 millions of gallons per day (mgd) would significantly increase salinity in the Delaware estuary.

In this first Delaware River diversion case, the Supreme Court issued a 1931 decree that cut back the proposed diversion to 440 mgd from two new reservoirs – Neversink and Pepacton – and required New York City to compensate the in-basin interests by augmenting the low flows of the Delaware River.

The diversion of Delaware River water to New York City did not begin until December 1953. By that time, growing demands for water led the City to petition the Supreme Court for an increase in the diversion right to 800 mgd, which resulted in the second Delaware diversion case before the high court. In a settlement negotiated by the parties to the litigation (*New Jersey v. New York City and State*, with Pennsylvania and Delaware as intervenors) and adopted by the Supreme Court, the court decreed in 1954 that the diversion could be increased to 800 mgd with a third impoundment – Cannonsville – on line, and that the downstream interests must be compensated by further augmenting the low flows in the Delaware River. Under this ruling, the City was required to release water from its reservoirs in the upper basin as necessary to maintain a minimum flow of 1,750 cubic feet per second (cfs) at Montague, N.J., just downstream of the New York-New Jersey border.

The lowest flow ever recorded in the Delaware near Montague was 175 cfs. This means that New York City compensates for its out-of-basin diversions by guaranteeing a minimum flow in the mainstem 10 times greater than before its storage reservoirs were built.

Storage of water by New York City in wet seasons does reduce the natural flow in the river, tending to increase estuary salinity, but this occurs in non-critical times when the salinity is not

high enough to endanger public or industrial water supplies. Conversely, when hot, dry weather results in critically reducing the flows down the Delaware, the City's reservoirs augment the deficient natural flow in the river and thus beneficially retard the salt-water intrusion.

New York City is not the only water user affecting the salinity of the Delaware estuary. The 1954 decree also permitted the State of New Jersey to divert up to 100 mgd from the Delaware Basin for use in the central and northeastern parts of the state – without a requirement for compensating releases. In addition, consumptive use within the basin has increased significantly since the decree, and a series of droughts has further decreased the dependability of fresh-water inputs into the estuary. At the same time, sea level has risen, adding to the tidal forces that drive sea water up the estuary.

All of these factors have forced recognition of the need for additional flow-regulation reservoirs to maintain flows of fresh water sufficiently to control salinity at reasonable levels in critical parts of the estuary. Years of study have been culminated by the adoption of a salinity-control objective and a plan to meet that objective.

In 1983, on the recommendation of two major studies, DRBC decided that the 30-day average chloride concentration of the tidal river at river-mile 98 should not exceed 180 mg/l and sodium be not more than 100 mg/l. Mile 98 is midway between the Ben Franklin and Walt Whitman bridges that link Philadelphia and Camden. This was adopted as an interim objective achievable currently and in the near future based upon storage capacity in existing reservoirs available now for flow regulation.

Besides the three New York City impoundments, the existing reservoirs



routinely available for flow augmentation are two multi-purpose Corps facilities in Pennsylvania. During droughts, however, the Commission has arranged also for backup salinity-control supplies to be stored in a Commonwealth of Pennsylvania lake for recreation and future water supply; in a group of utility-owned impoundments normally used only for generating hydro-power; and in a Corps facility normally restricted to flood-control use.

To reduce the flow-augmentation demands on the existing reservoirs during shortages, DRBC and state regulatory agencies have called for conservation measures to cut back consumptive use of water in the basin as part of official drought-warning or -emergency declarations. Further, with the concurrence of the parties to the 1954 Supreme Court decree, diversions to New York City and north-eastern New Jersey and also the minimum downstream flow target have been reduced to conserve water for salinity control and other purposes. These measures, supplementing strategically timed reservoir releases during critical low-flow periods, have contributed significantly to salinity control.

Looking to the future, the Commission has recognized that with expected increases in sea level and depletive water use, the existing capability for regulating streamflows will not be adequate to meet the current salinity-control objective, let alone the long-term upgraded standard of 150 mg/l for chlorides and 83 mg/l for sodium. Consequently, the Commission has called for construction of additional water storage capacity in the basin.

The new storage capacity would result from enlargement of two federal flood-control projects in Pennsylvania and one of the three big New York City reservoirs, plus a new impoundment

in northwestern New Jersey to be constructed by a group of electric utility companies to offset the salinity-increasing effects of new power plants in the basin.

The utilities were ordered by DRBC to plan their facility eight years ago when it became apparent to the Commission that government-sponsored projects would not be adequate to compensate for the growing consumptive use of water by the electric utilities. Releases from the reservoir during low-flow periods will offset the consumptive use at the companies' power plants and allow them to keep operating.

In cooperation with the basin states and New York City, the DRBC carries out a continuing program of research on the relationship between reservoir operations and salinity in the estuary, using sophisticated mathematical models. Based on these analyses, reservoir operating rules are devised — and revised as new information becomes available.

Recent worldwide research indicates that the past trend of rising sea level may be accelerating. This is an indirect result of increasing concentrations of atmospheric carbon dioxide and other gases, causing warming of global temperature (the so-called "greenhouse effect"), thermal expansion of the oceans, and melting of glaciers and polar ice. This has added a new dimension to the concern about salinity in the Delaware estuary. At the request of the U.S. Environmental Protection Agency, the DRBC staff is using its salinity-intrusion model to predict the salinity effects of several assumed increases in sea level, the highest a rise of 8.2 feet.

It appears that the salinity of the Delaware estuary will continue to be a matter of concern for the foreseeable future.

# Conservation: Partner with storage

Conservation is one of the most effective means of helping to assure there can be enough water to meet society's needs during the unpredictable yet inevitable droughts that nature inflicts periodically.

In the usually water-rich Delaware River Basin, mired in its fourth shortage in five years, conservation is very much an important ingredient in DRBC's long-range formula for softening drought impacts.

Supplies must be stretched during droughts primarily so that they will be adequate to keep fresh-water stream-flows voluminous enough to prevent the so-called "salt front" of brackish water from reaching as far upstream as the Camden-Philadelphia area, where it would threaten to contaminate industrial and drinking water supplies. (A separate section appears on page 8 describing the salinity problem and its control.)

Another major tool for making sure there is enough water to go around in dry spells is plenty of reservoir capacity for storing runoff in wet periods rather than allowing it to flow to the ocean. The big problem with the reservoir approach is that it has grown unpopular due to environmental opposition over recent years — not to mention expensive.

The Delaware Basin's drought-readiness program does include increasing the region's water-storage capacity. But the projects that are planned represent a drastic scaledown of those foreseen a quarter-century ago, and they involve enlargement of existing reservoirs rather than building giant new ones.

The combination of the reservoir-construction scaledown and the ever-increasing total of depletive, or consumptive, water losses thus makes conservation a major partner with reservoir storage in this region's future water planning. Under current policy, Delaware Basin water managers consider the importance of demand management as well as provision of adequate supply.

Important recent reports on the basin's water management needs have strongly encouraged conserving water as a non-structural companion of new reservoirs. And the recent policy decisions and activities by DRBC strongly reflect those recommendations.

Primarily, the conservation emphasis is on reducing depletive uses — uses that permanently remove water from the river basin from which it was drawn, such as by exportation, evaporation, evapotranspiration, or other routes.

A large depletive loss within the Delaware Basin results from evaporation of water used for cooling at electric generating stations, whether they are nuclear or fueled by coal, oil or gas. Most new and planned power plants have cooling towers, which protect the streams from thermal pollution but which evaporate considerably more water than in once-through cooling operations where the heated water is discharged directly to the streams, thus exacerbating the depletive water loss problem. When the Merrill Creek reservoir that the region's power companies plan to build soon in New Jersey is completed, it will release water to the Delaware to make up for

the companies' cooling losses during droughts. Consequently, the power plants will not compound the problem of controlling the salt front during shortages.

The export of up to 800 million gallons (mgd) of water daily from three upper Delaware Basin reservoirs to New York City also represents a large depletive loss to the basin, but the city's three impoundments compensate for that by releasing water to the river for downstream use when natural flows fall below a specified volume. Another large depletive loss is the export of up to 100 mgd to central New Jersey via the Delaware and Raritan Canal, which is temporarily closed during repairs and dredging to increase its carrying capacity.

The Commission and the signatory states also espouse water conservation

## Conservation represents v

*Thirteen members comprise the Water Conservation Advisory Committee that has completed its first year of counseling DRBC on numerous water-saving policies and activities.*

*There are six non-governmental representatives, each contributing expertise gained from work in a different segment of the water-concerned public. The interests represented by the public members are agriculture, electric utilities, other industry, water purveyors, environmental movement and civic groups.*



as a part of their review of projects. The Commission routinely requires sponsors of public water-supply projects to develop and implement a leak-detection plan and a conservation plan. In addition, the Commission requires all new public and private water-supply systems that are designed to serve more than 250 connections or distribute water supplies in excess of 10,000 gallons per day to install water meters incident to the provision of such service at the retail level. Because the competition for water among various users is becoming more and more complex, the efficient use of available supplies is essential.

This was the first full year of work for DRBC's new Water Conservation Advisory Committee, which was given three specific assignments in addition to counseling the Commission generally on conservation policies and programs.

### **advisory group varied interests**

*The seven governmental representatives speak for the four Delaware Basin states, the United States and the cities of New York and Philadelphia.*

*Chairman of the committee is Bruce E. Stewart, executive director of the Water Resources Association of the Delaware River Basin, a 25-year-old organization that itself is made up of numerous elements of the water-interested public. The committee meets bi-monthly and its sessions are open to the public.*

The first specific charge for the committee was to review the adequacy of the drought-contingency plans that each of the four basin states submitted to DRBC, as recommended in 1983 by the four governors and mayor of New York City in their "good faith" report on *Interstate Water Management*. The governors urged that the plans be designed to achieve a target 15-percent reduction in depletive use during droughts.

In response to the advisory committee's analysis and comments, the states did make changes in their plans by developing more uniform criteria for identifying and determining droughts, by more comparably defining non-essential water uses to be restricted during shortages, and by imposing more uniform requirements for local drought-contingency plans by major water users, primarily industries.

Few if any of the other 46 states in the nation have established drought-contingency plans comparable to those now in effect in the four-state Delaware Basin.

A major review by the advisory group was of the policy adopted by DRBC in 1983, also at the governors' urging, setting an objective of reducing overall depletion of fresh water by 15 percent during shortages.

In studying how the policy should be implemented, the committee advised that it be achieved by the implementation throughout any drought period of conservation measures that are designed to produce a 15-percent reduction during the 122-day peak depletive-use period (June through September).

The committee advised also that the 15-percent reduction should be based on the total depletive use and not applied to any individual sector or user category, but rather to all sectors and use categories collectively.

The committee recommended also that the DRBC, when considering the suggested depletive water use cut-backs, recognize and make allowances during drought periods for water users who since 1965 have instituted long-term measures that have reduced depletive water use.

Some industries already have instituted improved conservation practices, which generally mean big savings in energy costs as well as in water. DRBC staff estimates that this may be the case with up to half of the basin's pharmaceutical, chemical, oil refining and paper industries, but will know better after a canvass of major water users is completed.

Meeting the long-term 15-percent depletive-use saving is closely tied to another important recommendation by the governors — that a regulatory program be established by DRBC to limit future depletive losses to balance existing, new, or expanded water uses with the capacity of the basin's reservoir system and its ability to augment flows for salinity control in the estuary.

The advisory committee's third specific responsibility is to develop and recommend a regulatory and information-education program of conservation in five major user areas. They are agriculture, electricity generation, other industry, golf courses and other recreation, and public water supply. This will be a big part of the committee's 1985 activities.

# Managing the ground waters

Ground water, the precious and invisible resource that supplies a third of the Delaware Basin's 7 million residents, continues to rank high on DRBC's agenda for dealing with the region's water problems.

This was a year of considerable activity on ground-water matters, primarily in formulating an extensive management program that grows out of the recommendations of a special three-year investigation on the subject that was completed late in 1982.

A busy advisory committee and the Commission's staff turned out a package of eight detailed proposals recommended in the earlier investigation for Commission consideration. They generally are the principal suggestions made in the 1982 report, on which the advisory committee also had worked.

Hearings on the individual proposals, required as with all amendments to DRBC's comprehensive plan, are to commence soon, and adoption of major elements of the eight-point package could be voted in 1985.

The initial matter up for consideration, so timed because much of the overall program will depend on its findings, calls for registration of every well in the 13,000 square-mile basin that yields at least 10,000 gallons daily. Registration would be conducted by environmental agencies of the respective four basin states, which would automate their records.

The registration program's goal is development of the first comprehensive – and uniform – ground-water data base for the whole four-state valley. Probably the first multi-state and river-valley-wide program of its kind in the nation, its data will

be computerized and kept current by the U.S. Geological Survey for all water-management agencies in the Delaware valley. All four states now have some form of registration, but they differ in authority and types of information collected. The new plan provides legal authority and sets up minimum information requirements for well registration.

Into the data base would go two general types of information – one on ground-water sites, such as geological formations, locations of aquifers and types and depths and locations of wells; the other on the use of the water withdrawn.

The information would be important to water-quality activities, such as monitoring for suspected toxic waste-disposal locations, as well as to water quantity. Well pumping can modify paths of movement of contaminants. This is especially true where ground-water development has created large cones of depression. These cones of depression can cause or accelerate the movement of contaminants from buried wastes toward pumping centers, improperly constructed waste-disposal facilities, and other sources. Well pumping also can induce flow of surface water into aquifers. Where surface water is of poor quality, it can seriously pollute the aquifer.

Another, and perhaps most significant, water-quality aspect of the basinwide well-registration program, is to manage the resource to prevent substantial impact on low flows of perennial streams. If the ground-water table is excessively lowered, once-perennial streams can become intermittent and the seven-day, 10-year low flows – upon which treated waste-effluent requirements are based – become meaningless. Also, fish, wildlife, recre-



ation, downstream water supplies, and waste-assimilation uses can become impaired.

Following are the other seven measures that complete the package presented to the Commission by the advisory committee in 1984:

- *Metering large withdrawals.* Wells pumping 100,000 or more gallons a day would have to be metered, except for farm and quarry operations, with data turned over to the states.
- *Administrative criteria.* A set of minimum standards and criteria for issuance, review and modification of water-withdrawal permits for wells, focusing largely on administrative issues including intergovernmental coordination and administrative agreements between DRBC and the states. Since it provides for state issuance and review of permits on behalf of the Commission where there is such permitting authority, New Jersey and Delaware would handle their own permits, and DRBC would implement in the New York and Pennsylvania parts of the basin.
- *Regional v. non-regional sewerage facilities.* Measure urges reconsideration of 1967 DRBC policies favoring large regional sewage collection and treatment facilities. Suggests case-by-case determinations instead to avoid instances where big regional operations contribute to drying of perennial streams due to transfer of water between local watersheds.
- *Nondegradation.* A suggestion that DRBC moderate a 1980 withdrawal-limits policy that is con-

sidered difficult to administer and could unnecessarily limit groundwater development.

- *Withdrawal-limits criteria.* Rules setting forth minimum standards and criteria for addressing issues of well interference, water-quality degradation, ground-water recharge, streamflow maintenance, water-budget analyses and problem areas. These rules are intended to further refine the concepts contained in the Commission's withdrawal-limits policy adopted in 1980. Implementation would be carried out by DRBC and states both.
- *Conjunctive-use policy.* A measure to encourage ground-water-withdrawal sponsors to consider joint use of both ground- and surface-water sources in their planning for water supply, long-term cost effectiveness and environmental protection.
- *Advance notice of exploratory drilling.* A requirement that states conduct an advance-notice procedure for evaluating potential well applications and adopt standards for well construction and abandonment. Applies to New York and Pennsylvania only, since other states have such programs.

The ground water advisory committee consists of 11 members – one each from DRBC's five signatory parties and six public members representing various fields of interest. The chairman is David C. Yaeck, executive director of the Chester County (Pa.) Water Resource Authority. For most of 1984, the committee met bi-monthly.

# Water quality progress

## Camden

The long awaited upgrading of community wastewaters finally is progressing in heavily developed Camden County, New Jersey, where the problem has been one of inadequately treated discharges from dozens of municipalities. Preliminary construction work on the larger of two scheduled treatment plants commenced under the auspices of the county's Municipal Utilities Authority (MUA), although legal disputes on rates and charges to be assessed against contributing communities are under litigation and are being reconciled. Completion of the initial phase of the secondary plant is slated for December 1986.

In addition, the regional sewage conveyance system for the Cooper River drainage basin is currently being bid. This will allow the elimination of 16 sewage treatment plants currently discharging to the Cooper River and its tributaries. The construction of these interceptors is to be completed by December 1986 also.

The MUA has proposed various modifications to the approved facilities plan. These modifications include cancellation of the smaller treatment plant, the conveyance of those flows to the plant now under construction, and also conveyance of the wastewater flows from Berlin Borough and Berlin Township (presently not sewered) to the plant being built. The treatment of these flows along with those from the Big Timber Creek watershed would be accomplished by expanding the plant under construction to a capacity of 96 million gallons a day. The modifications must win the approval of the New Jersey Department of Environmental Protection and DRBC. The Department will require an acceptable financial arrangement from the Authority.

## Philadelphia

The largest, costliest and most significant water-quality improvement program, that of the City of Philadelphia, continues to move toward completion. The first of the city's three sewerage-plant upgradings was completed in 1980. Then the quality of the river there improved. That completion was of the Southwest plant near Philadelphia International Airport. The modernized Northeast plant is to begin full-compliance operation in 1985, and the Southeast facility a year later.

Completion of the Camden and Philadelphia programs will represent overcoming the final major obstacles to attaining acceptable quality of the 85-mile estuary from Trenton to below Wilmington. Only a handful of small municipal operations on both sides of the river remain to be upgraded to secondary treatment levels, and vast improvement of the quality of discharges from the many water-using industries along both shorelines has been attained already. The Delaware estuary reclamation effort, probably the nation's most ambitious, commenced a quarter-century ago with the principal result being the gradual but significant improvement of the most depressed section of the river, adjacent to and just downstream of Philadelphia. The oxygen content of the water in that river reach has improved considerably — over a longer stretch of the river and for greater duration, especially during the troublesome warm-weather months.

## Wasteload reallocations

A mathematical model of the tidal Delaware River was designed and put into service by the federal government in 1960 as the first step in what then was the most advanced river reclamation project in the nation. Its pollution cause-and-effect findings were turned over to DRBC five years



later and formed the basis for selecting the estuary-cleanup standards in effect ever since. The estuary was divided into four zones; each zone was assigned its share of the estuary's waste assimilative capacity; and, in turn, the permissible wasteload was allocated among each zone's dischargers, both industrial and municipal.

The once highly sophisticated river model used over the past quarter-century is now obsolete, and the design of a new and far more versatile model by DRBC is nearly complete.

Unlike the outdated model, whose printouts provide information only from a single-dimension channel profile of the estuary, the new computerized river replica will produce many additional kinds of data that will enable DRBC to reassess – and refine accordingly – the wasteload allocations assigned to the estuary's 80-odd dischargers in the 1960s. The model will predict quality conditions across the river in a two-dimensional image from above Philadelphia to Wilmington.

The newly available information will include half-hourly changes in river quality; impacts of individual storms in terms of combined-sewer overflow; storm runoff; urban point and non-point pollution sources; wasteloads, and much more. This information will be used to determine the maximum total daily loads from all sources to meet water-quality goals. The total daily loads will be apportioned between point loadings (individual wasteload allocations) and non-point loadings (tributaries, storm runoff, combined sewer overflows and sediment oxygen demand).

#### **“Use attainability” assessment**

The new mathematical model of the estuary also will be an effective tool in determining the river uses that are

attainable through pollution cleanup. Federal law requires that all streams must be upgraded to “fishable and swimmable” condition unless lesser standards can be justified by a “use attainability assessment.” With the help of the new model, the Commission will be in a better position to weigh the chemical, physical, biological, hydrologic and economic factors necessary to the assessment.

The Commission staff is working with DRBC's water quality advisory committee and the Delaware River Basin Fish and Wildlife Management Cooperative to develop a plan of study for the assessment. Funds to carry out various elements of the study are being sought from the National Oceanic and Atmospheric Administration and other federal and state agencies.

#### **Seasonal disinfection**

Still being debated within and outside the Commission was whether chlorine disinfection of treated sewage discharges should be cut back from the present year-round requirement to the five warm months of May through September. Under the proposal, on which the DRBC signatory members are not in agreement, the seasonal arrangement would replace the 12-month policy throughout the basin except in the Delaware's 79 miles from the ocean to the Delaware-Pennsylvania state boundary for shellfish protection. Harmful bacteria in wastewaters are killed by disinfection, but the chlorine and the chlorinated hydrocarbons formed are very toxic for aquatic and marine ecosystems in the receiving streams. A decision awaits more data from a sophisticated survey of the effects of the rival arrangements on water quality in shellfish areas. This two-year study is scheduled to begin next July. Efforts are under way to obtain funding.

# Spotlight on the Upper Basin

## **Protecting cold-water fish**

Releases of relatively cold water from storage in New York City's impoundments in the upper basin help to maintain a good cold-water fishery in the East and West branches of the Delaware River below Pepacton and Cannonsville reservoirs and in the Neversink River below Neversink reservoir.

But when those releases are withheld because they are not necessary to augment natural flows and thus help meet the mandated minimum streamflow of the main Delaware at Montague, N.J., the tributaries downstream of the three reservoirs tend to warm up, putting trout and other cold-water species under life-threatening thermal stress.

To minimize such stressful occurrences, the four basin states and New York City, along with the Commission, have agreed that a special "thermal stress bank" of nearly 4 billion gallons of water is to be stored in the impoundments for release during warm-water periods.

In the summer of 1984, extraordinary hydrologic conditions in the upper Delaware Basin resulted in unusually high demands on the stress-release bank, and the Commission, with the five parties' concurrence, temporarily doubled its volume. The extra releases made possible by this action were instrumental in protecting the upper basin's valuable cold-water fishery during the late summer and early fall.

## **Ice-jam project considered**

In preliminary findings, a special study by the Army Corps of Engineers suggested that damage from ice-jam flooding where Pennsylvania, New York and New Jersey converge could

be reduced by a diversion project. Ice-jam flooding following a severe storm in February 1981 caused major damage in the area of Matamoras, Pa., and Port Jervis, N.Y., where the Delaware makes a 90-degree southwesterly curve around the Tri-State Rock. Curiously, it is in New Jersey that a diversion channel could be built to bypass Delaware water through Montague Township and thus alleviate the problem just upstream in the neighboring states. The Corps needs a non-federal sponsor for the project, which would cost less than \$2 million, and is looking to DRBC to fulfill that interstate role in behalf of the benefiting areas. A decision on whether and how to proceed awaits completion of the Corps' final report. DRBC coordinated the initial 1982 efforts among local officials and federal and state agencies to explore a solution and subsequently asked Congress to fund the study, which commenced in 1983.

## **Upper Delaware National Scenic and Recreational River**

Completion of an acceptable management plan and institutional structure for the Upper Delaware Scenic and Recreational River, a mandate of the 1978 federal legislation that designated the river segment, has become at the same time a challenge and a frustration to the local, state and federal interests participating in the cooperative effort. Rejection by local interests of a management plan draft early in the year led to development of a fresh approach to respond more fully to the concerns and interests of the residents and businesses in the Upper Delaware region. With funding provided by the National Park Service to the area's 15 towns and townships in two states and five counties, private consulting firms were engaged



to develop a new draft plan to resolve the issues identified by local interests. Members of the earlier cooperative intergovernmental planning team, including the National Park Service, DRBC, New York State's Department of Environmental Conservation, Pennsylvania's Department of Environmental Resources and representatives of the counties along the 73-mile upper river in both states, now combined with local interests and their consultants, continued their involvement working toward a final product. The Commission has continued its participation in detailed planning activities by providing technical information and support in response to interstate concerns relating to water quality, environmental protection and especially flow management on the Upper Delaware. A new draft management plan was projected to be ready for public review soon.

### **Scenic River Quality**

Recreational use of the non-tidal Delaware River, particularly the two sections totaling more than 100 miles that are segments of the National Wild and Scenic Rivers System, has intensified many times over in recent years. Good water quality is an essential ingredient to the continued enjoyment of the river by its thousands of recreationalists. DRBC, which has been conducting summer limnological investigations in the upper basin for years, and the National Park Service, which monitors the water quality at its beaches, joined forces in 1984 to expand their respective monitoring programs to supplement the more limited activities of the three states. In 1984 the program, initiated on a trial basis in the Delaware Water Gap National Recreation Area, developed a series

of screening techniques to locate pollution problem areas and establish control priorities.

The information collected from 27 tributaries and at nine locations on the river in the recreation area pinpointed several problem spots but, more importantly, verified that water quality is excellent throughout much of the area. The scheduled 1985 followup included a monitoring conference of a dozen local, state and federal agencies and expansion of the monitoring into the 73-mile Upper Delaware Scenic River from Matamoras, Pa., to Hancock, N.Y.

The little-known monitoring program, which began in 1969, initially probed into potential impacts on fish and other biological life from the Tocks Island reservoir. After that lake plan was shelved in 1975, the monitoring emphasis was shifted to general water-quality surveillance and special biological studies. It also was expanded to include the upper scenic river, which attracts some 300,000 recreationists yearly, and the Delaware's East and West branches in New York State.

### **Reducing flood damages in New York**

DRBC coordinated the hydrologic phase of flood-insurance studies conducted by the U.S. Geological Survey in Albany for the Federal Emergency Management Agency on the upper Delaware and tributaries. It also suggested flood-protection measures to the U.S. Department of Housing and Urban Development on a low-income housing-improvement project on a flood plain in Long Eddy, N.Y., and defined DRBC's role for a Department of Environmental Conservation self-help manual in the New York portion of the basin.

# Additional highlights

## **Near-flood; near-drought**

Waterwise, it was strictly a feast-to-famine year for the Delaware River Basin.

Even though the basin had been in yet another drought warning for six weeks up until December 20 at the end of the previous year, the first seven months of 1984 were so wet that there were three flood threats on the Delaware main stem.

The last and most serious of the three threats, occurring on May 30, brought the highest crest seen at Trenton since the basin's worst flood ever in August 1955. This also was the first time since then that the flow actually exceeded the Trenton flood stage – by a half-foot.

Low-lying parts of Mercer and Bucks counties in the Trenton area experienced some minor flooding, and damages totaling about \$1.5 million were reported along the headwaters of the Schuylkill, Lehigh and Christiana rivers. The crests were kept to a minimum because more than 12 billion gallons of the runoff was captured in five flood-control reservoirs.

The water-supply reservoirs of New York City that are the region's guidepost for drought conditions actually were overflowing in mid-April, long before the May storm and weeks earlier than they do normally.

But then came five straight dry months from August through December that saw the storage in New York City's three up-river reservoirs plunge to within two days of triggering a drought warning at Thanksgiving time. And the supplies remained marginally close to the warning line for the rest of the year before dropping again into still another formal water shortage early in 1985 – the basin's fourth in five years.

Notwithstanding the flirtation with drought warning in November 1984, this was the first year since 1979 in which no shortage declaration had to be made by the Commission. The region's hydrologic pendulum had swung to the dry side in 1980 after 15 years of normal wet weather that followed the region's worst drought for several years in the 1960s.

The five-month dry spell that closed out the year was marked by a rainfall deficit of nearly six inches, yet 1984's total precipitation exceeded the annual norm of 43 inches by more than 10 percent, with record highs in May and July. And notwithstanding subnormal streamflows for several months, the cumulative flow for the full year was 30 percent higher than the long-term average.

## **Main stem flood protection**

One of the purposes of the now-inactive Tocks Island reservoir plan for the Delaware near the Water Gap was sharp reduction of flood-crest elevations from Stroudsburg, Pa., to Burlington City, N.J., which suffered considerable damage in the 1955 flood of record. After the Tocks Island plan was shelved by DRBC and the Congress in 1975, the Commission suggested that the Army Corps of Engineers take a look at alternative means of providing protection in that 100-mile river reach.

The study was finished this year, and in it the Corps concluded that non-structural measures for reducing damage potential would be economically feasible for 226 individual homes and commercial buildings in 12 New Jersey and Pennsylvania municipalities. In New Jersey they are Harmony, Holland, Hamilton, Delanco and Riverside townships, and in Pennsylvania they are Lower Mt. Bethel, Bridgeton, Plum-



stead, Tincum and Bristol townships and New Hope and Bristol boroughs.

The "feasible" measures are flood-proofing such as sealing off walls; construction of floodwalls around the buildings; elevating the buildings on new foundations; and purchase and removal of threatened buildings. The Corps said it could participate in these measures under cost-sharing arrangements with non-federal sponsors (not individual owners), but little immediate interest was shown by towns and counties that were canvassed. Discarded early in the study as far too costly was construction of reservoirs, levees and floodwalls.

#### **"Fishways" for the shad**

The tidal Delaware now has more oxygen and for longer periods, thanks to the pollution cleanup of the past 20 years, resulting in greatly improved annual migrations of the American shad. To expand the waters available to the growing numbers of the popular fish, the region's fisheries officials and organizations are promoting installation of fish ladders at low dams on Delaware tributaries that historically have been important to shad spawning. The Delaware Basin Fish and Wildlife Management Cooperative, comprising agencies of the four basin states and federal government, has listed the Lehigh and Schuylkill rivers and Brandywine Creek as the top-priority streams in need of fishways. Two of the three dams on the lower Lehigh are without fishways, as are eight of 10 dams on the Schuylkill as far upstream as Reading, and eight of 11 on the Brandywine. Working closely with the Cooperative on the program for the Lehigh, where the activity is more advanced, is the Lehigh River Protection, Preservation and Improvement Foundation, a local sportsmen's group dedicated to shad restoration.

#### **Striped bass restoration**

As part of the effort along the Atlantic seaboard to reverse the continuing decline of striped bass, the regional Fish and Wildlife Cooperative has embarked on a program aimed at enhancing the species in the Delaware. The Cooperative has planned a 1985 survey to ascertain this river's population of juvenile bass. If it is found to be improving, the Cooperative hopes for a natural rebuilding process that might entail a temporary moratorium on bass harvesting in the basin. If the population is more limited, stocking of the river may be considered to supplement the natural growth process.

In another endeavor, the Cooperative is reviewing fishery-related uses of the Delaware River, especially in the higher-pollution reaches along the heavily developed Philadelphia metropolitan area, to determine if present water-quality standards for the river are compatible with the uses divulged by the review.

#### **DRBC wins hydropower license**

The Federal Energy Regulatory Commission has issued DRBC a license to construct and operate a low-head hydroelectric power generating plant at the dam of Blue Marsh reservoir on Tulpehocken Creek, a short distance west of Reading, Pa. DRBC's engineering consultants on the project neared completion of the design, and the Commission entered negotiations with Pennsylvania Power & Light Co. on the rate the power company will pay DRBC for the electricity. The proposed power project, the first at any public reservoir in the basin, was found feasible in a study conducted jointly by the Commission and the Commonwealth of Pennsylvania. Its ultimate construction depends upon the anticipated future revenue stream that is based upon energy-only avoided fuel costs and construction bids.

# Financial Summary\*

## Budgetary

Revenues			Expenditures		
	Budgeted	Expended		Budgeted	Expended
Delaware	\$ 158,800	\$ 158,800	Personal services	\$1,096,000	\$1,036,285
New Jersey	398,000	398,000	Special and contractual services	214,000	213,571
New York	180,000	180,000	Other services	31,800	31,224
Pennsylvania	487,200	487,200	Supplies and materials	39,900	39,845
United States	269,000	269,000	Space (including \$46,532 of principal payments on Plant Fund mortgage)	174,200	174,183
Water Quality Pollution Control Grant	230,000	240,000	Communications	46,800	46,649
Reimbursement of Overhead — Water Supply Storage Fund	20,000	20,000	Travel	19,400	19,256
Reimbursement of Water Monitoring Costs — Water Supply Storage Fund	7,875	7,875	Maintenance, replacements, and acquisitions	52,900	50,273
Sale of publications and sundry	5,000	6,356	Equipment rental or lease	25,600	24,862
Project review fees and other income	13,125	24,871	Fringe benefits and other	215,100	197,263
Interest income	0	133,387		\$1,915,700	\$1,833,411
Fines and assessments	0	121,000	Excess of Revenues Over Expenditures	\$ 0	\$ 213,078
Contingent funding	108,900	0			
Fund balance	37,800	0			
	\$1,915,700	\$2,046,489			

## Non-Budgetary\*\*

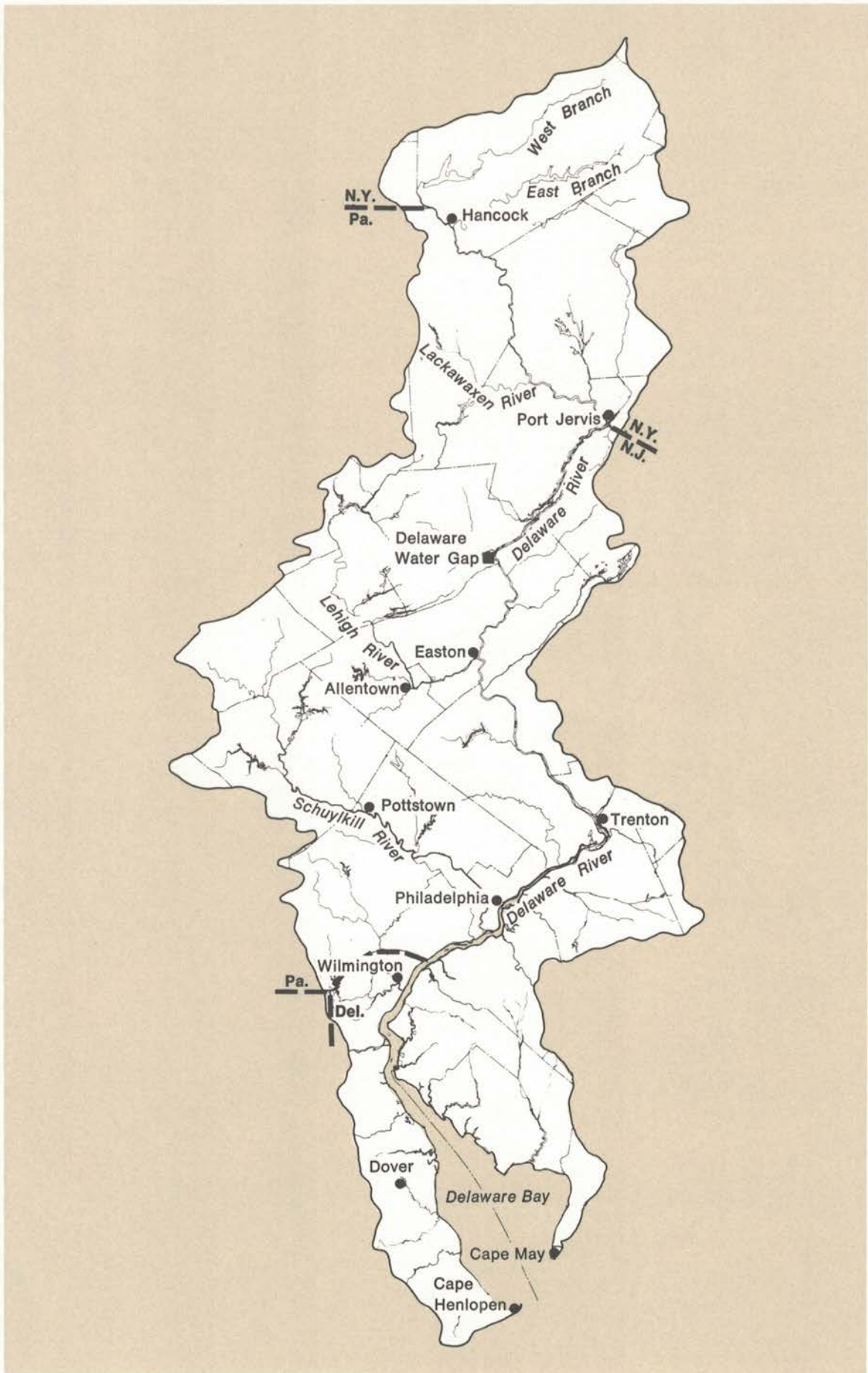
Special Programs and Projects	Fund Balances July 1, 1983	Revenues	Transfers	Expenditures	Fund Balances June 30, 1984
2 D model	\$ 0	\$ 10,000	\$ 0	\$ 10,000	\$ 0
USGS gaging	4,600	19,450	0	19,187	4,863
Monitoring Ship John Light-Reedy Island	0	18,750	0	18,750	0
Other monitors	263	12,000	0	31,150	(18,887)
Flood Plain Contract Fund — Pennsylvania #3	0	8,743	0	8,743	0
Blue Marsh — Prompton Dam	(28,000)	0	0	0	(28,000)
Study of Exotic Wastes — Phase II	44,393	2,040	0	354	46,079
Ground water	154,523	0	0	40,800	113,723
Merrill Creek	12,590	1,352	0	1,352	12,590
Flood Plain Contract Fund — Pocono	0	36,455	0	36,455	0
Recreational — Scenic Rivers	(5,000)	10,000	0	5,000	0
Feasibility Study — Blue Marsh	0	0	15,000	15,000	0
Ground water — Pennsylvania protected area	127,296	126,000	0	64,194	189,102
Merrill Creek Environmental	37,877	56,485	0	93,938	424
Ground water — withdrawal fees	1,035	10	0	0	1,045
Computer	37,731	0	0	0	37,731
Tybouts Corner — Delaware	0	12,433	0	12,433	0
	\$387,308	\$313,718	\$ 15,000	\$357,356	\$358,670

\*For Fiscal Year ended June 30, 1984.

\*\*Revenues from sources outside current expense budget.

The records of the Commission are independently audited each year as required by the Compact.





**The Delaware River Basin**



Delaware River Basin Commission  
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## ERRATA

Page 4, paragraph 1, line 6, word *cover* should be *covet*.

Page 4, last paragraph of middle column, line 5, it should read...  
*reservoirs aid in assuring...*

Page 5. Two of the delegation headings are reversed. It should read *New York* at top of page and *United States* at bottom.