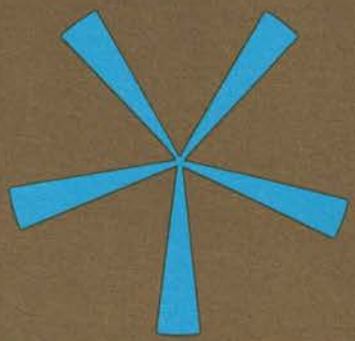

The DELAWARE RIVER BASIN COMMISSION

Annual Report • 1966

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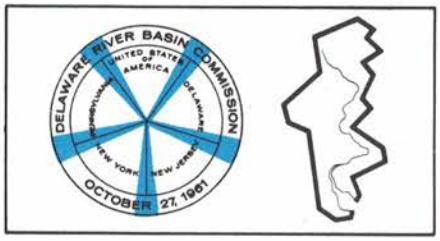


Introduction

This is the fourth annual report of the Delaware River Basin Commission, the interstate-federal agency established in 1961 under the Delaware River Basin Compact to guide the regional planning, development and management of the valley's water resources. The four-state, 13,000-square-mile basin, while small in area for a river valley, accommodates demands for water supply, waste disposal, recreation and other water benefits far out of proportion to its size. Within its boundaries live nearly 7 million persons, while more than twice that number live in neighboring areas, principally New York City and metropolitan North Jersey, that are dependent in part on the Delaware.

The Compact rode to enactment largely on impetus from flood threats growing out of the 1955 Delaware River disaster, yet not since that time has there been a serious flood. However, two great water problems of quite another nature came to the fore this year in the Delaware — the drought's threat to supplies of New York City and Philadelphia and the great public outcry for cleanup of polluted streams.

Since the Commission's Compact jurisdiction encompasses virtually all phases of water management, the agency was thrown immediately into the midst of these critical situations. Under arrangements forged by the Commission, the drought perils that confronted Delaware-reliant areas have been warded off thus far. The major tests of the Commission's pollution abatement effectiveness still lie ahead, although the start has been made.

This report covers the year ending June 30, 1966. The standout feature of this period is the Commission's confrontation finally by major problems posed by the river itself — drought and pollution, particularly in the estuary south of Trenton. This report describes the success that has been achieved in the former and the great magnitude and direction of actions to be taken in the latter. Previous years were marked largely by organizing the agency, blueprinting the programs to be undertaken, assembling the necessary technical data, and molding the Commission's relations with executive and legislative officials of the five signatory governments.

To the people of the basin, the Legislatures of the States of New York, Delaware and New Jersey and the Commonwealth of Pennsylvania, and the Congress of the United States this report is respectfully presented.

Gov. Terry, Gov. Scranton, Sec. Udall, Gov. Hughes, Gov. Rockefeller

The Commission • 1966

Chairman
CHARLES L. TERRY Jr.*
Governor, Delaware

Vice-Chairman
WILLIAM W. SCRANTON*
Governor, Pennsylvania

STEWART L. UDALL†
U.S. Secretary of Interior

NELSON A. ROCKEFELLER*
Governor, New York

RICHARD J. HUGHES*
Governor, New Jersey

Alternate Commissioners

Mr. Kilborne, Dr. Goddard, Gen. Lack, Mr. Northrop and Mr. Adams

NORMAN M. LACK *Delaware*

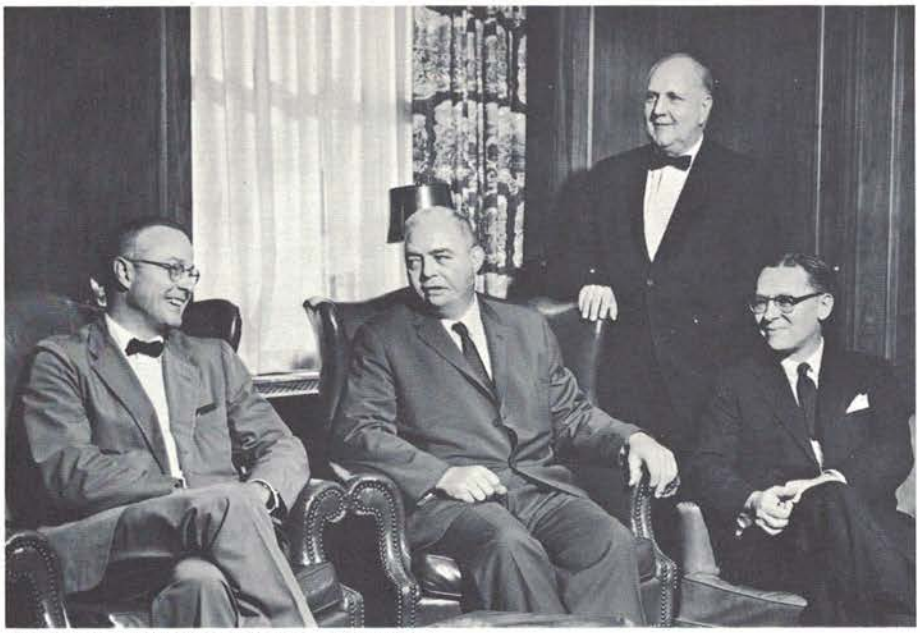
MAURICE K. GODDARD *Pennsylvania*
SAMUEL S. BAXTER, *Advisor*

VERNON D. NORTHROP *United States*
COL. ELMER P. YATES, *Advisor***

R. STEWART KILBORNE *New York*
JAMES L. MARCUS, *Advisor*

H. MAT ADAMS *New Jersey*

* Ex-Officio
† By appointment of the President
**Succeeded by Col. William W. Watkin Jr. on August 1, 1966



Mr. Whitall, Mr. Wright, Mr. Peeck and Mr. Miller

The Staff

JAMES F. WRIGHT
Executive Director

WILLIAM MILLER
General Counsel

W. BRINTON WHITALL
Secretary

ARTHUR E. PEECK
Chief Administrative Officer

Planning Division

HERBERT A. HOWLETT
Chief Engineer

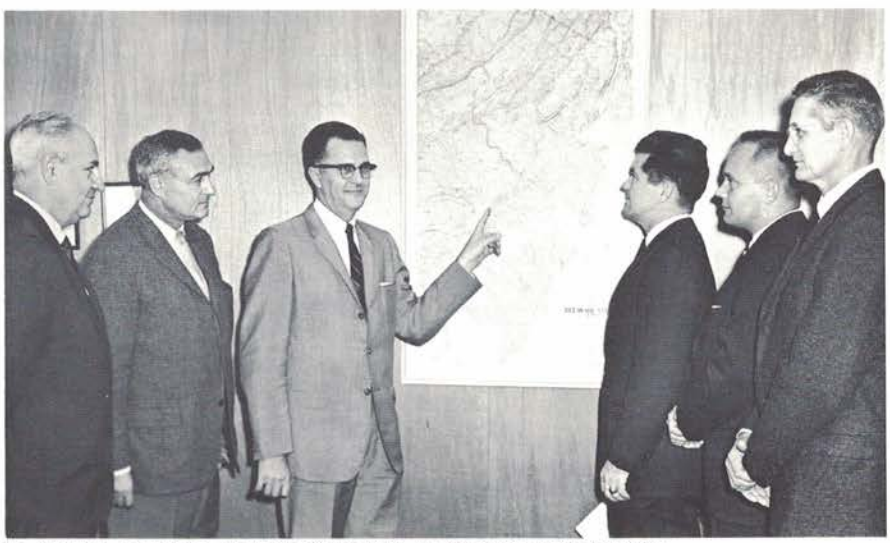
C. H. J. HULL, *Head*
Program Planning Branch

THEODORE BRIGANTI, *Head*
Project Review Branch

RALPH PORGES, *Head*
Water Quality Branch

ROBERT L. GOODELL, *Head*
Operations Branch

J. W. THURSBY
Staff Economist



Mr. Briganti, Mr. Porges, Mr. Howlett, Dr. Hull, Mr. Goodell and Mr. Thursby

1965-66 In Review

Challenging year brings pollution to fore as water peace is restored

Agreement that a river system crossing state lines must be managed on those same terms gave birth to the Delaware River Basin Compact and Commission. Their ability to deliver finally came to a test in 1965-66.

The Commission was just closing the books on the previous year as it was confronted by a challenge to resolve a bitter water supply allocation dispute between upper and lower basin interests following the worsening of the already prolonged drought to a critical state. This crisis developed against a backdrop of interstate courtroom feuding which, if reopened for litigation, threatened a serious blow to the prestige and effectiveness of the Commission.

A whirlwind period of proposals and counter proposals, negotiations and finally compromise was jammed into the first week of the new year. With that initial hurdle surmounted, the ensuing months brought on trying, if less difficult, periodic renegotiation of the allocation compromise.

The year ended with all parties successfully surviving the feared consequences of a dry New York City water system or a salt-contaminated Philadelphia system. It had been proved that the basin could get safely through its driest period on record with its reservoirs operated as a system under the Commission's regional powers. Although its critical extent subsided as 1966 progressed, the drought emergency persisted throughout the year. (A separate section on the drought appears on page 18.)

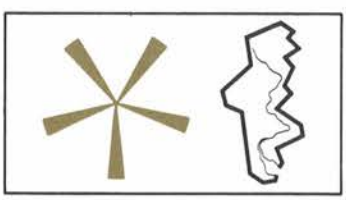
The President's Water Resources Council reported early in 1966, "Water management by the Delaware River Basin Commission successfully combatted the advance of salt water toward the Philadelphia intake while providing maximum availability of water for New York City." Citing increased reservoir storage over the year, the Council added, "Except for wise management of resources and far-reaching measures to conserve water in 1965, conditions on February 1, 1966 would have been much worse than they were a year earlier." If the Commission deserved such compliments, there were some offsetting factors. Daily research, surveillance, liaison, and other drought activities demanded attention of the limited staff to the extent that many prescribed functions often went unattended. This personnel drain resulted in a less productive year in many planning fields, including refinement of water supply policy, reduced flood losses, water quality, recreation-fish and wildlife, and general comprehensive planning.

Nonetheless, work on the drought provided the Commission's staff and policy makers useful experience for dealing with non-drought problems. The data collected, alone, will be invaluable to a commission whose multi-purpose operations enable it to shift emphasis as unforeseen problems arise. Water matters are so interrelated that the handling of each problem better prepares the staff for the next. Above all, mutual trust developed over years of association by representatives of the five signatories brought to the negotiations a cooperative atmosphere that was made to order.

Pollution

As the drought became less critical, another water concern picked up momentum so fast that it too seemed to approach crisis proportions before the year's end. This matter, water pollution, in the long run, probably is the most serious and complex water issue in the basin.

The national spotlight on water pollution is engendering annual passage of important new laws in the states and especially in the Congress aimed at speeding and stepping up action for cleaner streams. The principal legislative action of the year was enactment of the Water Quality Act of 1965 requiring local authorities in each interstate river basin to submit before July 1, 1967 standards for maintaining the quality of water at levels acceptable to federal authorities. Completion of a five-year federal study into the sources and extent of pollution in the Delaware estuary, one of the nation's most heavily burdened waste disposers, and the existence of an



interstate-federal agency with broad pollution abatement powers have combined with the 1967 deadline to focus heavy local and national attention on the Delaware.

At the Commission's annual meeting on May 6, 1966, at which he became chairman, Governor Charles L. Terry Jr. of Delaware cited the Commission's formal commitment to meet the federal deadline and declared:

"We have proved this Commission is workable in a water shortage crisis — and we are going to prove it can respond with equal effectiveness in the fight against contamination of our rivers and streams . . . The people of the four-state Delaware valley want a cleaner river and tributaries and it is our intention to attain this in their behalf."

As the year drew to a close, the federal estuary study group disclosed its findings and the Commission prepared to conduct a basinwide water quality conference with emphasis on implementation of the estuary study. Also in preparation were public hearings on proposed quality objectives for interstate waters of the basin, to be followed up by actual adoption of standards.

Col. Yates

Col. Watkin

Pollution, particularly in the estuary, promised to be a dominant subject for years to come. (A water quality report starts on page 7.)

"Summit" Meeting

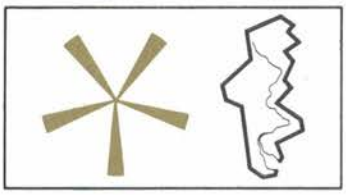
New Jersey's new Cultural Center in Trenton was the setting for the Commission's annual meeting, at which Governor Terry succeeded Governor Richard J. Hughes of New Jersey as chairman. Participation by Governor Nelson A. Rockefeller of New York, Governor William W. Scranton of Pennsylvania and U. S. Secretary of Interior Stewart L. Udall provided perfect attendance. While there was no turnover from the previous year in the membership of the Commissioners, 1965-66 marked the first termination of services by one of the five original Alternate Commissioners when Dr. Harold G. Wilm left his post as New York State Conservation Commissioner to return to Syracuse University as Director of the Water Resources Institute there. Dr. Wilm, whose Delaware Basin affiliation dated back a decade to the Compact negotiation days, was succeeded as both Conservation Commissioner and Governor Rockefeller's DRBC Alternate by R. Stewart Kilborne of Westchester County. The retirement of Arthur C. Ford as President of New York City Board of Water Supply resulted in his replacement as Advisor to the Commission's New York State member by James L. Marcus, whom Mayor John V. Lindsay later named Water Commissioner. Colonel Elmer P. Yates of the Corps of Engineers was to be replaced shortly after the end of the year as Advisor to the Federal Commissioner by Colonel William W. Watkin Jr., the new Philadelphia District Engineer.

Tocks Island, Other Projects

The long-awaited approval of the companion feature to the 37-mile long Tocks Island reservoir, where another year of preconstruction design was completed, became a reality when the President signed legislation establishing the Delaware Water Gap National Recreation Area on September 1, 1965. The expected completion date for this great reservoir-recreation project remains at 1975. (A progress report on the Recreation Area and Tocks Island reservoir appears on page 22.)

President Johnson requested funds for beginning preconstruction design of two more federal multi-purpose reservoirs, both features of the Commission's Comprehensive Plan. One of these, Trexler, will be built on a Lehigh valley tributary due west of Allentown, and the other, Prompton, in the Lackawaxen watershed of northeast Pennsylvania, is now a flood control-only project to be enlarged for recreation and water supply. The second year of designing and engineering was completed on Blue Marsh reservoir, west of Reading in the Schuylkill valley, and construction was to start on Beltzville reservoir in the upper Lehigh valley. This brings the tally of federal reservoir action in the Delaware Basin to three flood control reservoirs completed with one of them in design for enlargement, one multi-purpose project going into construction, and three others in various stages of design.

Dr. Wilm (right)
Mr. Marcus (lower left)
Mr. Ford (lower right)



Review

The U. S. Soil Conservation Service, cooperating with local sources, continued to build and plan dozens of small tributary water control facilities to augment the 18 already constructed throughout the basin. Meanwhile, Pennsylvania and Delaware progressed on their Delaware reservoir projects and New Jersey started buying land for its Hackettstown reservoir on the Musconetcong River.

The year covered in this report marks the passing of a decade since the great Delaware flood of 1955. Structural and other work performed during that period has added much flood damage protection to the minimal amount in existence 10 years ago. However, it is the large group of projects to be constructed mostly in the coming decade that will dramatically reduce the threat of great flood damage and loss of life in the future of the Delaware Basin. (A section on Delaware flood protection begins on page 12.)

Projects, Planning, Programs

For the first time, outdoor enthusiasts now have a detailed guide to recreation on the Delaware River. The Commission prepared and published in time for the 1966 recreation season a series of 10 maps of the nontidal main stream of the river, extending 200 miles from Trenton to Hancock, N. Y. in the foothills of the Catskills. The maps contain a variety of information including boat launching sites, parks, recreation areas, good fishing and swimming spots, streamflow characteristics, channel location and depth, rapids and riffles, and hazardous sites. More than 3500 sets have been distributed, and sets are available from the Commission at $1 each.

Engineering and design work was completed preparatory to reconstruction of the Lambertville-New Hope wing dams, which create a popular recreation pool in that resort area but which have deteriorated over the decades to a threatened point of washout. The Commission was awaiting final bistate appropriation action before hiring contractors to proceed with the restoration in behalf of Pennsylvania and New Jersey.

To augment its in-house activities in the fields of water quality and water supply, the latter concerned with locating potential wholesale water customers and drawing a pricing policy, the Commission actively pressed for state and local action to solve one of the basin's most critical problems. This is the widespread practice of communities independently constructing their own sewerage and water supply facilities without entering joint operations with neighboring towns. Besides urging regionalization in this field, the Commission offered and rendered technical assistance to authorities aware of the inherent dangers here.

Scores of public and private projects that inevitably have both a cumulative or independent bearing on the valley's water resources are constantly in progress. Checking their compatibility with basinwide planning, the Commission approved 173 applications that had been cleared by the Project Review Branch, including 22 surface water supplies, 27 sewerage projects, 24 industrial waste works, 77 wells, nine waterfront projects for navigation and six watershed development programs. Of this total, 82 were incorporated in the Comprehensive Plan as public projects.

As in the previous year, Commission staff personnel, mostly resource professionals, totaled 39, and was not slated for substantial increase for at least another year. The technical arm of the Commission is the Planning Division, with 25 employees, under which the Program Planning, Project Review, Water Quality and Operations Branches are manned by technicians in water supply, water and land use, recreation-fisheries, power, water pollution, reservoir operations, flood control and other specialties. The Executive Director heads a staff of six in the Directorate, and six persons make up the Administrative Division. The Commission operated on a budget of $600,490, compared to $552,976 the previous year. Ralph Porges, a veteran of 26 years of pollution control work with the U. S. Public Health Service, was engaged as head of the Water Quality Branch to succeed Dr. Nicholas J. Lardieri, who resigned.

The Commission publishes annually a voluminous Water Resources Program, which presents a statistical supply-demand picture of the basin and recommendations for keeping it in balance. The 1966 edition is available for $2.25.

Water Quality

In the national spotlight, the Delaware community steps up its cleaner water drive

Not since the pollution control advancements registered more than a quarter of a century ago by INCODEL had there been a period so significant as 1965-66 in water quality developments up and down the Delaware Basin.

As a wave of water pollution consciousness swept the nation, a coincidental group of factors combined to aim an extraordinary amount of attention in this field at the Delaware.

The Congress and the President added an important new chapter to the pollution control laws of the nation with the adoption of the Water Quality Act of 1965. The principal effect of the new national policy was to establish a broad new jurisdiction by the Federal Government over the quality of interstate waters across the land. The 1965 law created the Federal Water Pollution Control Administration and set a deadline of July 1, 1967 for state authorities to adopt standards for interstate waters. Failure of state authorities to comply would result in the Federal Government setting the standards.

In itself, this requirement is the same for the Delaware as for any interstate waters in the nation. The difference lies in what had transpired only in the Delaware Basin. For one thing, the basin community, together with the Federal Government, had set up in the Delaware Basin Commission an apparatus to tackle all regional water problems, pollution included. Moreover, federal water quality authorities at the time were bringing to a close their $1.2 million five-year effort known as the Delaware Estuary Comprehensive Study. This pioneering undertaking employed for the first time computerized techniques to determine the cause and effect of pollution in a complicated tidal river and offered alternative solutions (see table below.)

In short, the Delaware, like other areas, was faced by the requirements of the federal law, but unlike the others, it had both the administrative apparatus for the basin to undertake its own river cleanup and the results of the massive federal study of the conditions in the estuary.

From all directions, eyes were on the Delaware in search of evidence that a basin community could respond locally to the increasing public demands for cleaner streams.

As the Commission moved further into the year covered by this report, attention to water quality increased constantly. At its fifth annual meeting, held in May 1966 at Trenton, the emphasis was strong. Governor Charles L. Terry Jr. of Delaware, assuming the chairmanship, said he felt the Commission had proved its ability during the drought to surmount a regional water crisis and predicted that it would be equally effective in the forthcoming pollution abatement drive, particularly in the river's tidal estuary. Governor Terry warned that the cleanup costs to both the taxpayers and to water-using commercial institutions would be great but said he felt the basin could afford it.

The Alternatives

Federal report on estuary pollution offered five Objective Sets below.

	20-year costs, public and private (millions)	Annual costs per capita	Permissible estuary discharge* (lbs.)	Required overall treatment 1964	1975
Set I	$490	$8.80	100,000	95%	97%
Set II	$230-330	$3.80-5.50	200,000	90%	95%
Set III	$130-180	$2.30-3.00	500,000	75%	88%
Set IV	$100-150	$1.80-2.50	600,000	70%	85%
Set V	$30	$0.50	1,000,000	50%	75%

* oxygen-demanding carbonaceous wastes

At the same meeting, the Commission formally assured the Federal Government that it would meet the 1967 deadline for filing standards covering its interstate waters.

The Delaware estuary study group disclosed the preliminary findings of its study of pollution in the 86-mile Delaware estuary, one of the most highly urbanized and industrialized areas in the United States, if not the world, and clearly the most severe pollution area in the basin. (Copies of the Report Summary are available from the Commission at 25 Scotch Road, Trenton, N. J. 08603.)

The total carbonaceous oxygen-demanding waste load produced daily in the basin is 1.9 million pounds, the study found. With 900,000 pounds, nearly half, removed during treatment, 1 million pounds was being discharged into the estuary, about 65 per cent from municipalities and 35 per cent from industries. Additional oxygen demands on estuary waters result from industrial and municipal nitrogenous material and bottom deposits of sludge and mud, totaling 800,000 pounds, but the study's waste removal proposals deal only with the million-pound carbonaceous load.

Heavy concentrations of coliform bacteria, traced primarily to unchlorinated wastes, were detected. Large quantities of acid, about 1.3 million pounds daily, were being emitted to the estuary.

The study found extreme deterioration of estuary waters below Philadelphia, reflecting almost complete depletion of oxygen in some locations during summer months. The study said: "The net result is a polluted waterway which depresses aesthetic values, reduces recreational, sport and commercial fishing, and inhibits municipal and industrial water uses."

The report contained the additional alarming note that the area's population stands to increase 30 per cent by 1975 and 135 per cent by 2010, and estimated that the current waste production total will be doubled by 1975 and increased five and one-half fold by 2010.

Based on the assumption that existing conditions would no longer be tolerated and that there would be a general enhancement of the quality of the river in future years, the estuary study group produced five alternative groups of quality goals for the river — called objective sets, each accompanied by related costs and an evaluation of tangible benefits.

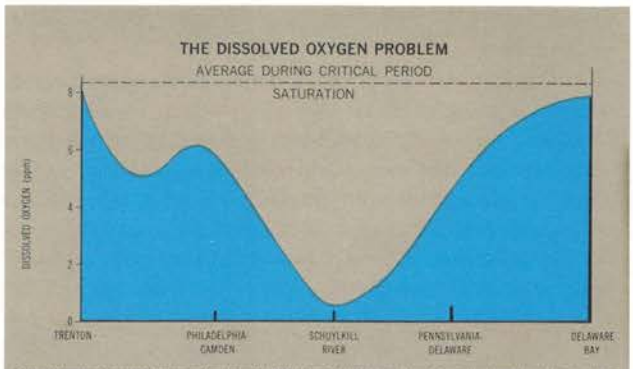
The five objective sets developed by the estuary study group (see table, page 7) range from (Set V) merely maintaining the conditions found at the time of the study to (Set I) attaining high river quality for such an estuary through removal of 95 per cent of oxygen-consuming wastes. In between were three intermediate objective sets, one (Set IV) encompassing slight improvement over existing conditions, another (Set III) providing substantial improvement, and still another (Set II) calling for a higher degree of cleanup that would insure almost complete survival annually of spawning fish runs, a stronger assurance than under Set III.

The estuary group's findings were not developed in a vacuum. They were subject to constant review by three advisory committees that helped prepare the report — a policy committee of representatives of state, interstate and federal agencies having legal pollution abatement powers, a technical committee from agencies participating in the study and familiar with the scientific aspects of pollution control, and, finally, a water use committee comprising four subcommittees from the general public, industry, local government and planning agencies, and recreation, conservation and fish and wildlife interests. In all, more than 100 organizations and 200 individuals cooperated with the study group's staff. The FWPCA study group itself made no recommendation from the five objective sets, but reported "a consensus of Objective Set III as the final recommendation of the Water Use Advisory Committee." Editorial reaction strongly favored a high degree of estuary pollution cleanup by the Commission and its cooperating signatory agencies.

As shown in the table, the objective sets carry sharply contrasting cost estimates. For example, merely maintaining the present quality level under Set V without further deterioration would cost $30 million over a 20-year implementation span. The goals under Set I, achievement of which the report suggests is questionable under present technology, would carry a pricetag of about $490 million. The objectives enumerated in Set II are physically attainable and would cost about $330 million, as are those of Set III at about $150 million and Set IV at $120 million.

A breakdown by estuary population shows that Set I would cost $8.80 a year for each person, compared to $3.80-$5.50 for Set II, $2.30-$3 for Set III, $1.80-$2.50 for Set IV and $.50 for Set V. These figures do not take into account any division between public and private costs, nor do they reflect any funds that might come into the basin from federal or state grant programs for construction, planning or administration.

As the year closed it was the Commission's expectation that basinwide standards for the interstate waters of the Delaware valley would be established well in advance of the July 1, 1967 date to which it was already committed and that preparations would be made to expand the Commission's water quality staff, currently numbering only five technical personnel, by the beginning of the 1967-68 fiscal year. The pollution abatement staffs of the four basin states were also expected to undergo some enlargement.



Dissolved oxygen is a principal measure of water purity. Most fish avoid levels below 4 (parts per million) and kills often result at 2 and below. FWPCA chart shows average warm weather concentrations dip to nearly zero in Delaware estuary near Schuylkill's mouth.

Water Quality

Pollution abatement in massive quantities of water is a gradual process. It requires planning, design, financing and construction of new publicly-owned sewage treatment plants and modernization and improvement of others. It entails similar costly building or upgrading of many industrial waste treatment facilities. It involves formulation and public acceptance of policies, standards, regulations and enforcement of pollution control measures that will mean added burdens to the general public in such forms as taxes, waste-water and consumer fees and consumer costs of manufactured products. It will mean a good deal of work simply to keep the estuary study group's findings current.

The Commission welcomed the action of the E. I. duPont deNemours Co., which announced a two-year waste treatment upgrading program that will have the effect of cutting 50 per cent of its acid discharges into the estuary. Industries, along with our cities and communities, rely on the estuary's waste assimilative capacity, and a cooperative public-private program will be essential to the cleanup effort.

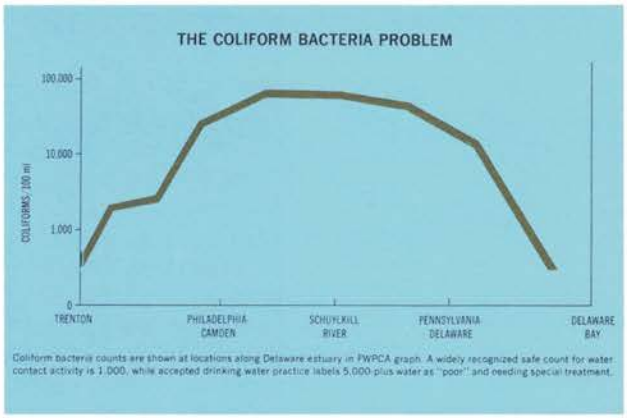
Basinwide Water Quality

The greatest pollution emphasis in the Delaware rightfully is upon the estuary. Most of the water, most of the people, most of the cities and most of the industries of the Delaware Basin are in the estuary, and so are most of the serious pollution problems. Outside the estuary, the quality of more than 90 per cent of the streams — main stem and tributaries alike — can be described as excellent. Nonetheless, the non-estuary portion of the 13,000-square-mile basin is spotted with both major and minor water pollution situations. Action has been taken in some and is under way in others, some are undergoing planning activity that should effectively combat local water quality problems, while still others are being watched for potential signs of water deterioration from anticipated community, industrial or recreational growth.

New York State

North of the Tri-State Rock where Pennsylvania, New Jersey and New York converge is a large portion of the Delaware Basin where the waters are of generally first-rate quality and where it is the Commission's goal to keep them that way. This area presents only occasional pollution and no serious control problems.

One problem spot in this upper basin area occurs on the West Branch of the Delaware, into which one small town discharges untreated sewage and several businesses pipe either inadequately or untreated wastes just five miles above New York City's new Cannonsville reservoir. The result is pollution in the West Branch and jeopardy to the quality of the water of the reservoir. Stream quality standards adopted by the New York Water Resources Commission are not being met,



Coliform bacteria counts are shown at locations along Delaware estuary in FWPCA graph. A widely recognized safe count for water contact activity is 1,000, while accepted drinking water practice labels 5,000-plus water as "poor" and needing special treatment.

and the New York Department of Health has ordered the offenders to provide adequate treatment.

Lehigh-Schuylkill

The Delaware's largest tributaries are the Lehigh and the Schuylkill Rivers, both in Pennsylvania and both presenting similar quality problems in their headwater areas. About 50 tons daily of acid from coal mines drain into these two large watersheds, harmfully affecting the natural fish and aquatic life of some 200 stream miles and requiring extensive treatment if the water is to be made usable to communities and industries. The Pennsylvania Health Department has a 10-year mine drainage pollution abatement program calling for expenditures of $2 million in the Delaware Basin through the next seven or eight years. This program is 40 per cent complete and ahead of schedule in the Delaware Basin part of the state.

In the Allentown-Bethlehem area, the Lehigh River receives treated wastes discharged from many industries and municipalities resulting in occasional high bacteria counts and low dissolved oxygen and impaired fish and aquatic life. Like many others, this area is still undergoing heavy development. Water quality conditions will be improved by the current expansion of the Allentown sewage treatment plant and by flow augmentation to be provided in the Lehigh by releases from storage in the multi-purpose reservoirs to be built in the headwaters. Construction of Beltzville reservoir is now under way and it will be in operation by 1970. Also, local planning agencies are developing waste treatment plans for this area with assistance from the State Health Department.

The quality of water in the Schuylkill River, aside from the mine region, has improved greatly in recent decades, especially since the removal of coal silt. There is, however, growing need for regional planning and new treatment facilities on one Schuylkill tributary, the Wissahickon Creek. During low flow periods, more than half of the flow in this creek is made up of waste discharges, which, although they receive secondary treatment, seriously overtax the creek's assimilative capacity.

Neshaminy Creek

Continuing growth of Bucks and Montgomery Counties in Pennsylvania has compounded water problems of the Neshaminy Creek, but these problems fortunately have

not gone unattended by the local officials. Here again, the problem is treated waste discharges exceeding the watershed's ability to assimilate them. Among other activities, the Pennsylvania Department of Health has just completed a study of this watershed and the report to be issued soon will provide a good basis for action.

New Jersey Tributaries

Some of the most serious tributary pollution problems are in the Camden metropolitan area. The Pennsauken Creek watershed, lying in nine Burlington and Camden County municipalities, is overloaded with wastes that the creek cannot assimilate even though they are treated. A comprehensive waste management plan is in the early days of preparation, however. Throughout Camden and Gloucester Counties are dozens of sewage treatment works operating independently and which are typical of the many areas in need of regional planning of facilities for water supply and sewage disposal. Both counties are undertaking sewerage master plans.

On another New Jersey tributary, Rancocas Creek, rapid growth will cause serious pollution problems unless regional action is undertaken soon. Planning in this direction is getting under way.

In Mercer County, the New Jersey Health Department has ordered improvement of some treatment facilities along the Assunpink Creek, where a recent pollution study should serve as framework for badly needed action.

In Northwest Jersey, rapid development is endangering the quality of water in Lake Hopatcong, Lake Musconetcong, the projected Hackettstown reservoir and the Musconetcong River. The acute need for a regional attack on pollution problems here has stimulated some local action, thanks partly to the work of the newly formed Musconetcong River Watershed Association.

Delaware Bay Area

It has been proposed that the Delaware estuary study group of the FWPCA extend its study into the bay which, unlike many similar areas, has water of generally acceptable quality. In this region, the Delaware has one of the last remaining natural seed oyster beds in the country that nonetheless dips into occasional periods of low productivity due to various factors. Detailed studies are needed to determine the effects waste discharges to tributary streams have on the quality of water in the bay. Also, oyster problems encompassing such factors as salt intrusion, temperature and movement of tidal currents need examination. Several beaches and marshland areas along the bay are in danger of pollution from wastes originating in streams that empty into the bay.

One bay tributary with quality problems is St. Jones River in Kent County, Del., where numerous treated municipal and industrial wastes, including those from Dover Air Force Base, are discharged to small streams that merge in a tidal marsh enroute to the bay. Waste discharges during low flow periods often comprise most of the flow in these streams, resulting in low oxygen and high bacteria counts. Toxic materials in these wastes threaten the bay's nearby oyster seedbeds. The State of Delaware is moving on a program to collect the waste discharges in an interceptor after secondary treatment and disinfection and run them to an outfall in the bay between the mouths of the St. Jones and Mispillion Rivers.

Tocks Island

In May 1966 the Commission launched a study into water supply and waste disposal problems in the area around the Tocks Island reservoir, where contamination is threatened due to the prospective influx of millions of visitors annually to the Delaware Water Gap National Recreation Area, as well as the development anticipated in the region generally. The Tocks Island dam goes into construction within two years and the National Recreation Area is to be developed concurrently with the reservoir. Concerned that the wastes from this large tri-state area could leach into and seriously pollute and curtail the usefulness of the 37-mile-long lake and park, the Commission launched a $430,000 program involving the projection of population and land use for more than a half century, forecasts of the area's water supply needs and planning for disposal of its wastes. This activity, under the general guidance of the Commission, also involves county, regional, state and federal agencies. The Federal Government will pay $250,000 towards the program.

Other Reservoirs

Prevention of pollution in and around the multi-purpose reservoirs in the Commission's Comprehensive Plan is a necessity. Development of recreation facilities at these reservoirs will produce a rapid buildup in nearby areas similar to, but of lesser magnitude than, those anticipated in the Tocks Island region.

The Approach

The Commission staff has classified the basin's water quality problem areas into three broad categories.

First are those requiring immediate attention, since the problem causes are identified, solutions are available and an agency has emerged to tackle them. These include the estuary, the acid mine areas in the Lehigh and Schuylkill watersheds, the Allentown-Bethlehem reach of the Lehigh, Assunpink Creek, Neshaminy Creek, the St. Jones River portion of the Delaware Bay area, and Delaware West Branch.

Second are those where the problem areas are identified but solutions are not yet available. These include Tocks Island and other reservoir areas, Musconetcong River, Pennsauken Creek, Rancocas Creek, Camden and Gloucester Counties in New Jersey, Wissahickon Creek on the lower Schuylkill, and the Delaware Bay area.

The third category is the entire remainder of the basin, where it is the Commission's job to be alert to potential pollution problems through careful monitoring of quality conditions and analyzing prospective land and water use changes. Such monitoring and projecting are continuing functions of the Commission staff. By long-range planning and proper timing of construction, it is possible to assure the pollution problems will not occur in these areas.

Annual Meeting

Commission's fourth reorganization meeting May 6, 1966 brought the four river-state governors together with Interior Secretary Udall, their fellow Delaware Basin Commissioner. Events were held at New Jersey's handsome new Cultural Center near the Statehouse.

Flood Control

A decade after Connie and Diane, how is the basin coping with flood threats?

During the second week of August 1955 the Delaware River Basin was in the midst of one of its ever-increasing number of droughts when the season's third hurricane worked its way inland across the valley. The inches of rainfall left in the storm's path normally would have been enough to cause severe flooding. But the dry spell had left the land parched and both stream and well levels low, and the basin fortunately was able to absorb Hurricane Connie's torrents.

Six days in the wake of Connie, however, followed Hurricane Diane. Unlike the earlier tropical storm, Diane found the basin saturated. The result was flood devastation previously unseen in this valley, at least in terms of lives lost — 100 — and property damage — $104.7 million. Also, it was probably the most dramatic termination of any Delaware drought.

Records show that this flood was of the magnitude that occurs about each 50 to 100 years in the Delaware. However, these records apply only to water levels, not losses. Never before had a flood of this severity struck the Delaware since its great industrial, commercial, recreational and residential buildup occurring in the first half of this century.

August 1965, part of the year covered by this report, marked the 10th anniversary of the great Delaware flood.

Could it happen again? What flood protection progress has been made in the decade that has passed? What will be the extent of the basin's flood security when all of the dams on the drawing boards have been completed?

Yes, it could happen again, but the odds against a repetition are improved in view of the protection added since 1955. As for the future, the odds will grow dramatically better in the next couple of decades. If nature will hold off for that duration from dumping such torrential precipitation on the basin, it is unlikely that the Delaware will again see such a disastrous flood.

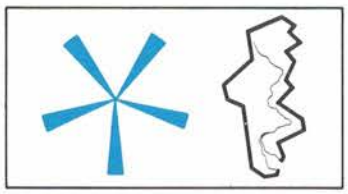
A Decade Ago

At the peak of the 1955 flood at Trenton, where the non-tidal stretch of the river ends, the Delaware crested at a peak stage of 20.83 feet, or 8.6 feet above flood stage. At that moment the river flow was 329,000 cubic feet a second. (At one point during the recent drought the flow at Trenton dropped to 1180 cubic feet a second.) If the same weather conditions that produced the 1955 flood were to be duplicated today, the flood crest at Trenton would be cut by recently-built protection works to 19.5 feet. Once the additional flood control reservoirs in the Commission's Comprehensive Plan are in service, the crest at Trenton will be cut to 13.5 feet through the temporary holdback of more than half of the 1955 flood crest volume. Bear in mind that a single foot at crest levels carries several times more water than the normal flow at Trenton.

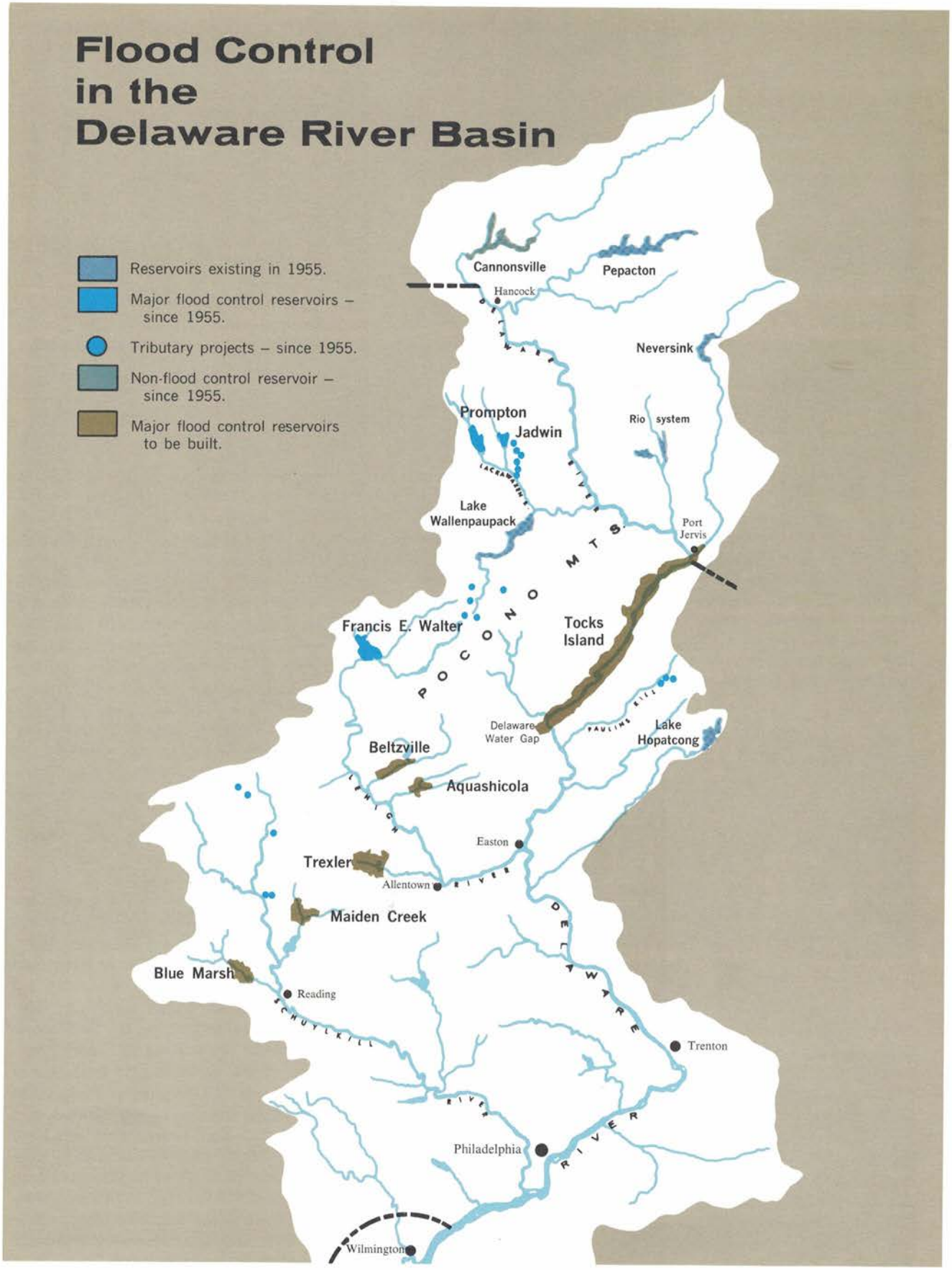
Nonetheless there can be no absolute guarantee, regardless of how many reservoirs are built or how large, that there will never be an even worse flood. Until the paths of nature's storms themselves can be controlled, there is no assurance that some future hurricane season will not deliver an even more severe series of blows than 1955 or that some unprecedented spring thaw and spring rains will not follow some unprecedented heavy blizzards. There is no such thing as elimination of flood risk. Society could not afford to build flood control projects numerous and large enough for absolute protection.

Still, the odds are improving, and they will get much better.

In August 1955 there were no major reservoirs in the Delaware Basin intended either exclusively or partially for expressed flood control, and there were but three reservoirs of substantial size in the entire valley.



Flood Control in the Delaware River Basin



New York City had completed construction on two large water supply reservoirs in the Catskill Mountain portion of the upper Delaware. One is the Pepacton reservoir, located on the East Branch of the Delaware, which joins with the West Branch to form the main stem of the Delaware at Hancock, N. Y. The other, Neversink reservoir, is located on the river for which it is named and which empties into the Delaware at Port Jervis, N. Y. During that storm, these two large storage facilities joined with Lake Wallenpaupack, in northeastern Pennsylvania, a utility company hydropower reservoir and summer resort, to prevent some additional damage from occurring downstream along the main stem. The effect of these projects in 1955 reduced the peak stage at Trenton by two feet.

Fortunately, as was the case in 1955, hurricane season flood threats occur following the summer dry spells that normally leave our water supply reservoirs at least partially empty.

A group of hydropower reservoirs in New York State also were in existence, but their capacity is small by comparison, as is that of Lake Hopatcong in New Jersey.

A limited amount of non-reservoir flood protection work had been completed in the basin prior to 1955. Flood walls built along the Delaware at Morrisville, Pa. following heavy damage from earlier floods saved it from far worse destruction. One year before the big flood, the Corps of Engineers completed levee and flood wall construction to protect Chester, Pa. from overflows of the Chester Creek. Channel improvement work had been done in the Lackawaxen River for the safety of Honesdale, Pa. and in Rancocas Creek for the Mount Holly, N. J. area.

Forecasting and Warning

The U. S. Weather Bureau issues official flood forecasts and warnings in the Delaware Basin. The principal forecasting service in the Delaware is operated on a cooperative basis by the U. S. Weather Bureau, the Pennsylvania Water and Power Resources Board, and the U. S. Geological Survey and has been in operation since 1937. Flood forecasts issued in 1955 significantly contributed to reducing flood losses by providing time, through advance warnings, for evacuation of people and protection of property.

Since 1955

Three flood control reservoirs, the basin's first, have been constructed in the past decade, all on northeastern Pennsylvania tributaries. They stand ready to capture 59 billion gallons of flood waters. The largest of these is the Francis E. Walter reservoir on the Lehigh River, protecting communities of the upper Lehigh River and, like all other tributary reservoirs, contributing toward the reduction of flood levels in the main stem. Prompton and Jadwin, the other recently built flood control reservoirs, like Lake Wallenpaupack, are located in the valley of the Lackawaxen River, which joins the Delaware above Port Jervis.

Completed only last year is the Cannonsville reservoir on the West Branch, an addition to New York City's water supply system in the upper basin. While intended only for water supply and low flow augmentation, this is second in size only to Pepacton among all the lakes in the Delaware valley and therefore adds some insurance against flood damage. The total reservoir storage capacity in the Delaware Basin has been increased by more than 50 per cent with the construction of the three flood control reservoirs and Cannonsville.

Cumulatively, large reservoirs are by far the most effective means of holding down the level of flood crests along the main stem. However, if built along the headwaters, they can be equally successful in protecting communities located on tributary streams. Prompton, Jadwin, and Walter reservoirs all help protect local areas too.

Large reservoirs are vital, but by no means do they tell the whole story of flood protection.

Small Dams and Levees

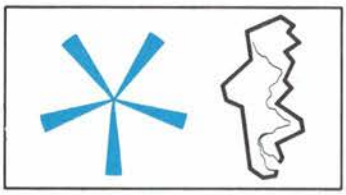
Many of the most severe blows dealt by floodwaters occur along small tributary streams. While of limited effect on the level of main stem flood crests, a small retarding floodwater structure can prevent local disaster.

Partnerships between the U. S. Soil Conservation Service and local sources have produced, all within the past decade, 26 small water control structures among whose primary purposes is flood control.

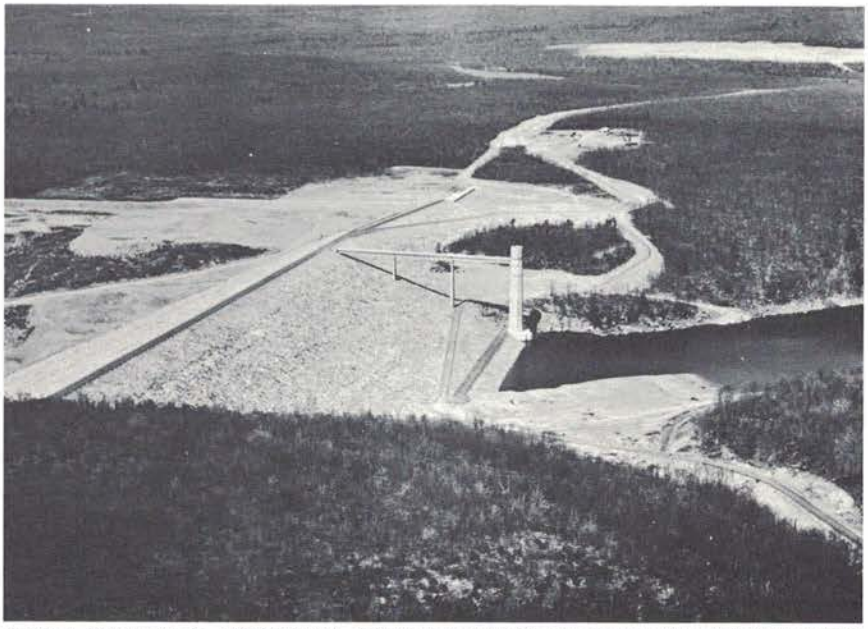
Sixteen of these are located in Pennsylvania. In the Green-Dreher section of the Poconos, which suffered loss of 11 lives and a million dollars in property damage in 1955, four flood control dams and a multi-purpose reservoir, including flood control, have been completed, with 11 more to go. Heavy property losses were inflicted a decade ago on agricultural and built-up areas in the Lackawaxen River watershed, where six of seven planned flood control structures have since been completed. Five dams have been built along headwaters of the Schuylkill River in Berks and Schuylkill Counties, an area where property damages approached $2 million in 1955. The Stroudsburg-East Stroudsburg area, hard hit a decade ago, now enjoys protection from flood walls built by the Commonwealth of Pennsylvania.

Channel improvement and construction of levees and flood walls have increased the protection of Hawley and other communities in the Lackawaxen valley, and similar work has added to the security of the Bethlehem-Allentown area and smaller towns along the Lehigh River.

Losses on New Jersey tributaries in 1955 were far less than those in Pennsylvania. But flooding of Paulins Kill in 1955 did bring heavy damage to the Newton and Blairstown areas, and three flood control structures have since been built on the upper end of this tributary. Projects to curb local flooding conditions that threaten both farms and communities in Cumberland and Salem Counties in South Jersey have been completed. Since tributaries in this area drain into the tidal bay and estuary area, they have no effect on main stem flooding.



Flood Control



Francis E. Walter reservoir, built since 1955, is the first of four large dam projects in the Lehigh valley that will protect both that river's communities and the Delaware main stem from Easton south. Corps of Engineers

Flood Plain Encroachment

Reducing the disastrous effects of floods is not confined to erecting structures.

Storms and thaws sometimes send more water down to sea than the streams are capable of carrying off within their banks. The overflow areas, known as flood plains, have been carved out by nature over millions of years to handle the excess. Build a cottage on a flood plain and sooner or later it will be flooded — it's that simple. Even the worst floods would take a comparatively light toll if society were to stop encroaching on flood plains.

One of the Commission's jobs is to reconcile society's and nature's competing use of flood plains. There are compatible uses, such as for parks, farming, and even floodproof buildings. Part of this program involves research into the history of flood-prone areas and recording it on maps to show the precise overflow lines of past floods. Under the laws and practices of the Delaware Basin states, zoning is a matter of home rule. It is, therefore, the responsibility of the communities to decide just how far they will permit development of flood plains — those that are not already too far gone.

The Army Corps of Engineers, the U. S. Geological Survey, a local community and the Delaware River Basin Commission have completed flood mapping of 97 miles of the Delaware River and tributaries as a basis for local flood plain control action.

Completed flood plain mapping studies include the upper Neshaminy Creek and the Wissahickon Creek by the Corps of Engineers, the lower Neshaminy Creek and Little Neshaminy Creek by the Neshaminy Valley Watershed Association in cooperation with the Bucks County Planning Commission, the Delaware River near Easton, Pa.-Phillipsburg, N. J., and the Schuylkill River from Conshohocken to Philadelphia, Pa., both by the U. S. Geological Survey under contract with the Delaware Basin Commission.

Two local flood warning systems have been developed in the basin since 1955 in cooperation with the U. S. Weather Bureau, one for the Neshaminy Creek watershed, and the other in the Rancocas Creek watershed in New Jersey.

Coming Projects, Programs

Six reservoirs in the Commission's Comprehensive Plan will be multi-purpose projects with flood control a major feature. Recommended by the Army Corps of Engineers in their Delaware Basin Study following the 1955 flood, all six have been authorized by Congress and four are in various stages of progress.

In the Lehigh valley, construction now begins on the Beltzville reservoir near Lehighton and final design and engineering work is started on Trexler reservoir just west of Allentown. These, along with a future project to be known as Aquashicola, will join the existing Walter reservoir in protecting Allentown, Bethlehem, Easton and six other towns along the Lehigh as well as rural areas. Two full feet would be cut from the 1955 flood crest at Bethlehem.

Two large projects in the headwaters of the Schuylkill will cut four and one-half feet from the 1955 peak at Reading and also benefit Pottstown, the Philadelphia area and several other communities. These reservoirs will be Blue Marsh, now well into the final design stage, and Maiden Creek.

Damage was heavy in 1955 on the main stem of the Delaware from Easton to Burlington. For example, five bridges alone were washed out. The flood control reservoirs built in the last decade along with those soon to be built on the Lehigh all will benefit this main stem reach,

Flood Control

but its greatest protection will come from Tocks Island, where construction will begin just above the Delaware Water Gap within two years. Behind the dam at Tocks Island will be more flood control storage than in all the other Delaware Basin reservoirs combined. Tocks Island will provide flood protection by 1972.

In tributary areas not previously cited, Soil Conservation Service programs will provide flood benefits not already enjoyed along Brodhead Creek in the Poconos, Kaercher Creek in Berks County, Brandywine Creek in Lancaster, Chester and Delaware Counties, Mauch Chunk Creek in Carbon County, Wissahickon Creek in Montgomery County and Neshaminy Creek in Montgomery and Bucks Counties, all in Pennsylvania, and in the City of Salem, Repaupo Watershed in Gloucester County, and Assunpink Creek in Mercer County, all in New Jersey.

Also, flood plain mapping work is under way or scheduled for Perkiomen Creek in Montgomery County, Pa., Chester, Darby, Crum and Ridley Creeks, all in Delaware County, Pa.; Brandywine Creek and its tributaries and Red Clay Creek and White Clay Creek, all Pennsylvania-Delaware projects; Christina River in Delaware; entire Cumberland and Cape May County borders of Delaware Bay in South Jersey and Cohansey and Maurice Rivers in those counties; Rancocas Creek in Burlington County, N. J.; the Delaware River bordering Bucks, Hunterdon and Mercer Counties, and the Delaware River in the vicinity of Belvidere, N. J.

Efforts are also progressing to expand the local flash flood warning networks throughout the basin.

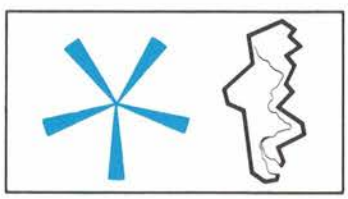
Flood Damages

Although dramatic floods that bring injury and death and impose great damage on private property and public facilities do not occur every year along the Delaware, local flash storms and floods do strike constantly across the basin.

The Commission estimates that the annual damages throughout the basin average $9.5 million and, based on recent flood plain development trends, would increase to $9.8 million in 1970 and $10.1 million in 1975 without further structural measures. In 1958, average annual damages were running $7.9 million, but would have been cut to $4.1 million if the flood control structures in the Comprehensive Plan had been built. About a fifth of total damages occur on upstream reaches of small headwater streams.

The need for localities to control the use of their flood plains has been demonstrated. If these damage figures are to be cut, incompatible flood plain development must be curbed.

Corps of Engineers



Among the protection structures built since 1955 flood are levees along Lehigh River at Bethlehem (above), and Jadwin, a "dry" reservoir in Pennsylvania's Lackawaxen River valley (left).

The Year's Hydrology

Better rains, flows and storage helped, but not enough to end 5-year drought

The four-year-old story got a year older as hydrologic conditions in 1965-66 remained at drought levels. Yet a decided improvement, mostly in storage, was registered over the previous year, which is unrivaled as the worst on record in many respects.

What improvement there was in surface water conditions was not reflected in ground water levels, which, if anything, declined.

Precipitation for the year was 75 per cent of the long-term average of about 44 inches, a 10 per cent improvement over the previous 12 months.

In the surface water picture, the first and tenth months of the year — July and April — generally were the worst. Streamflows continued to hit occasional new lows. The worst flow situation of the year came in July, when the flow by Trenton was the least of any single month in the 54 years of record keeping there. New low records for August and April also were tabulated.

At Montague in Sussex County, N. J., the principal upstream measuring point, it was the worst April flow ever. July measurements were also unusually poor, as were early winter flows. The Schuylkill and Lehigh Rivers and other tributaries generally reflected the main stem's problems.

A little improvement in precipitation, though still deficient, combined with a lot of reservoir management to substantially bolster stored water volumes in the basin. As the year began, storage in New York City's Pepacton and Neversink reservoirs was the least they had ever contained at that time of year, yet by year-end their storage was above average. The City's new Delaware Basin reservoir, Cannonsville, was virtually empty in August-September yet contained 40 billion gallons nine months later. It was used for the first time to help regulate the river.

Spring low flows permitted the deepest salt front penetration ever recorded in the beginning of a July, as the unpalatable salt line reached to within five miles of the mouth of the Schuylkill River. The salt concentration advanced slowly through the summer, and had to be warded off by increased reservoir releases to protect Philadelphia's water supply intake. As July 1966 arrived, the salt front was eight miles below its position of 12 months earlier.

The usual seasonal variation occurred in the dissolved oxygen of the tidal estuary's waters as levels dropped to nearly zero at times during the summer and spring.

Ground water levels continued to decline at a relatively steady rate through the summer and fall of 1965, with many checkpoint wells hitting new lows by late fall. Winter and spring recharge was generally late and below average. By late spring, water tables resumed their decline until most hit new bottoms.

Levels in eight of the nine observation wells in New Jersey hit depths previously unreached.

Trenton Times

Aerial view of river freezeup during Winter 1965-66. Trenton is to the right, Morrisville to left.

Drought

Nature cuts available water and a sectional crisis arises

The 1965-66 year dawned by threatening the water security of the four-state valley and by challenging its young Delaware River Basin Commission to restore the peaceful interstate relations that had led to its establishment.

The year concluded with optimistic hopes that an end to the five-year drought — one that brought the valley an equivalent of only four years' precipitation — might be in sight. At least the critical conditions of 1965 had been surmounted and the proof was in that regional reservoir management could get the basin through the worst water supply emergency in its history.

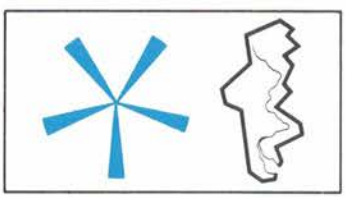
The events of this period demonstrated also that interstate water hostilities that twice had gone unresolved to the U. S. Supreme Court could be reconciled around the table of cooperation that the contestants themselves had set up for this purpose — and others.

In mid-June 1965, New York City, with three major reservoirs in the upper Delaware Basin, had cut off downstream releases mandated by the nation's highest court after the spring, normally wet, had left its reservoirs two-thirds empty instead of two-thirds full.

The downstream states of Pennsylvania, New Jersey and Delaware protested that New York's action was hastening the seasonal upstream march of salt water from the ocean and cutting down on the river's fresh water to which they were entitled by judicial decree. Especially, there was the threat that the unpalatable salt front (250 parts chlorides per million) might reach the intake of Philadelphia's water supply in the northern part of the city by fall.

On July 1, 1965, top representatives from the Delaware Basin Commission's five signatory parties were called to Trenton by Governor Richard J. Hughes, then chairman, in an effort to stem the crisis. Rival proposals were cooly received and the tense atmosphere seemed to foreshadow new court action. Yet it was agreed that another try would be made the following week at a hearing already called by the Commission in the hope that some emergency accord might keep the rivals out of court.

The Commission's hearing was held, and all the evidence — from industrial, governmental and civic spokesmen — affirmed reports on the extent of the critical water shortage. Six hours of spirited negotiations finally succeeded in producing these compromise provisions that were accepted formally that night by the Commission:



- *Declaration of a basinwide state of drought emergency activating special interim Commission water supply jurisdiction under the Delaware Basin Compact. This initial declaration was for 30 days.*
- *Supersedure of the Court's decree setting upstream-downstream allocations.*
- *Reduction of New York City's diversions of Delaware water and resumption of downstream releases from New York's reservoirs, but at volumes less than those normally required in dry spells, in place of the Court's formula.*
- *Authorization for negotiations with private power companies for downstream releases from their reservoirs.*

These cumulative downstream releases were calculated to swell fresh water flows into the estuary sufficiently to keep the salt water away from Philadelphia's intake until the salt front's normal autumn retreat.

Twelve months after the first declaration, the emergency had been renewed seven times and was to remain in force at least until late in calendar 1966. The specific diversion and release provisions were modified several times during the year in response to changing conditions in storage, weather and streamflow.

The year ended with New York having survived its water supply crisis. Also, the salt front had not gotten within 10 miles of Philadelphia's intake in 1965. With greatly improved reservoir storage and mildly better precipitation and streamflows in 1966, the Commission felt it could guarantee against

salt contamination of Philadelphia's withdrawals, and the salt line did remain safely downstream through summer.

While there was intermittent if slight precipitation improvement, it was principally the operation of the public and private reservoirs in the upper basin as a unified system which had secured the water supplies of two great United States cities — one from depletion and the other from quality deterioration.

Here, chronologically, are the highlights of how the system worked:

July — Under the first emergency action, New York's allowed limit for diverting Delaware water was cut from 490 million gallons daily to 335 million. It resumed making downstream releases, at 200 million gallons, only a fraction of what its obligation would have been with the Court decree in effect. But this amount was felt inadequate to block the salt movement. To compensate, Pennsylvania Power & Light Co. agreed to a Commission request for 200 million-gallon daily discharges from its Lake Wallenpaupack, and Orange & Rockland Utilities, Inc. consented to release 65 million from its Mongaup River reservoirs in Sullivan County, N. Y. At home, New York City imposed strict water conservation measures.

September — The crisis had heightened for both Philadelphia, with the salt front still on the move, and New York, faced with the prospect of empty reservoirs within weeks at their depletion rate. New York discontinued its releases and agreed to store equal volumes in lieu thereof in a "water bank" under the Commission's jurisdiction for disposition later, as needed. This 200 million-gallon loss to streamflows was more than offset, however, by increasing the utility companies' combined releases from 265 million to 650 million after summer recreation needs dropped off. Still further releases came from the Army Engineers' Francis Walter reservoir, a floodwater impoundment in the Lehigh valley where the gates had been shut temporarily at the Commission's request. The 1965 salt front peaked 10 miles from Philadelphia's intake on October 7-8.

January — Seasonal increases in precipitation and four months without making downstream releases reflected improved storage in New York's reservoirs. The City's daily diversion limit was boosted from 335 million gallons to 450 million and its downstream releases again were resumed, this time at the normal full level as required by the Court — enough to maintain a flow of 1525 cubic feet a second in the Delaware at Montague, N. J. Releases from the power companies' reservoirs, after being cut to 390 million gallons in October, were discontinued.

April — New York's normal diversion allowance of 490 million gallons was reinstated as storage in the city's reservoirs approached normal levels due to reservoir management, conservation practices and some improved precipitation. The emergency remained in force, but there were no more changes in the reservoir operation policies through the end of the year (June 30). At that time, the "water bank" contained 45 billion gallons and had not been drawn upon.

Actually, the drought picture began improving early in 1966, but spring brought another severe reversal. Precipitation falloff depressed flows at Trenton to a third of normal and the worst April in history went into the record books as the salt front advanced five miles beyond its April 1965 position. But in May, the upswing returned with good precipitation boosting stream volumes, slowing down the salt movement and further raising the storage levels.

Fearful that it was too risky to drop controls under these see-saw conditions and with the summer dry season coming on, the Commission again extended the emergency, this time into 1966-67.

President Johnson's 1965 Drought Disaster Declaration for the Delaware also was still in effect as the year ended. Under the Presidential declaration, issued in August 1965 at the request of the Delaware Basin State governors acting as members of the Commission, the Corps of Engineers installed a temporary pump-pipeline system for tapping Lake Hopatcong to help water short areas; Philadelphia received funds to accelerate completion of a new water intake; the Corps readied a standby barge-and-dredge system that would have delivered fresh Delaware water to Philadelphia's intake if the salt front had reached that point, and the U. S. Geological Survey embarked on a program of test-well drilling for standby supplies.

The year's water allocation success could not have been achieved without the downstream releases through the dams of the utility companies and Corps of Engineers in place of normal releases from New York's reservoirs. Nonetheless, New York took significant steps that helped its own cause. Through an intensive conservation program at home, the city slashed its water use by 20 per cent (saving a day's consumption of a billion gallons every five days) and it rebuilt its Chelsea pumping station on the Hudson for a daily yield of 100 million gallons. In addition, at year's end, New York was preparing to make universal use of water meters, a move that had been urged for decades.

Although the Delaware Basin was in water supply trouble throughout the year, it did manage to lend a hand to another needy neighboring area aside from New York. In Fall 1965, metropolitan Northeast Jersey's supplies had dipped so low that the state turned to the Commission for consent to pump water into the Passaic River Basin from Lake Hopatcong, located in the Delaware valley. The DRBC, which must approve out-of-basin diversions, granted a 4.3 billion-gallon drawdown performed under the Presidential order.

A special Drought Advisory Committee headed by Philadelphia Water Commissioner Samuel S. Baxter helped the Commission through the critical months of 1965 and also recommended publication of a "save water" pamphlet. More than 100,000 copies went into hard-hit drought areas.

Shad

An old-time Delaware visitor is finding the going a lot tougher

The most nostalgic and pleasant link to the Delaware River of many people is its shad. It fires the imagination of the fisherman and gourmet alike. Sometimes called the poor man's tarpon for its scrappiness, the American shad is awaited up and down the Delaware as a first sign of spring. Named in its honor is the "shadbush," whose beautiful white blossoms herald the arrival of warm weather even before leaves appear on the trees in the valley.

The shad is the best known and most popular of the seven varieties of anadromous fishes that come into the Delaware from the ocean to spawn. It is the largest of three members of the herring family that make annual migrations up the river, the others being blueback herring and alewives. The Delaware serves also as spawning grounds for the anadromous striped bass, white perch, Atlantic sturgeon and sea lamprey. American eels are also found in the Delaware, but, by contrast to anadromous fish, spend most of their lives in fresh water and return to the ocean to spawn and die.

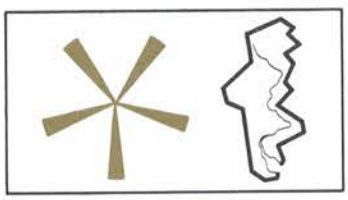
Anadromous fish utilize a wide variety of spawning habitat. For example, the Atlantic sturgeon barely gets into the fresh water stretch of the estuary, while the lamprey spawns in extreme upstream reaches, including remote tributaries.

Shad penetrate the Delaware as far upbasin as the East and West Branches, which combine to form the Delaware River at Hancock, N. Y. Hancock is a small Catskill Mountain town adjacent to the northeastern corner of Pennsylvania, 330 miles inland from the Atlantic Ocean. In springtime shad sport fishermen line the banks of the Delaware for the entire 200-mile stretch from Trenton to Hancock. The best shad angling in the Delaware is between Port Jervis, N. Y. and Hancock, the species' principal spawning area in the basin. Most commercial shadding is in the bay.

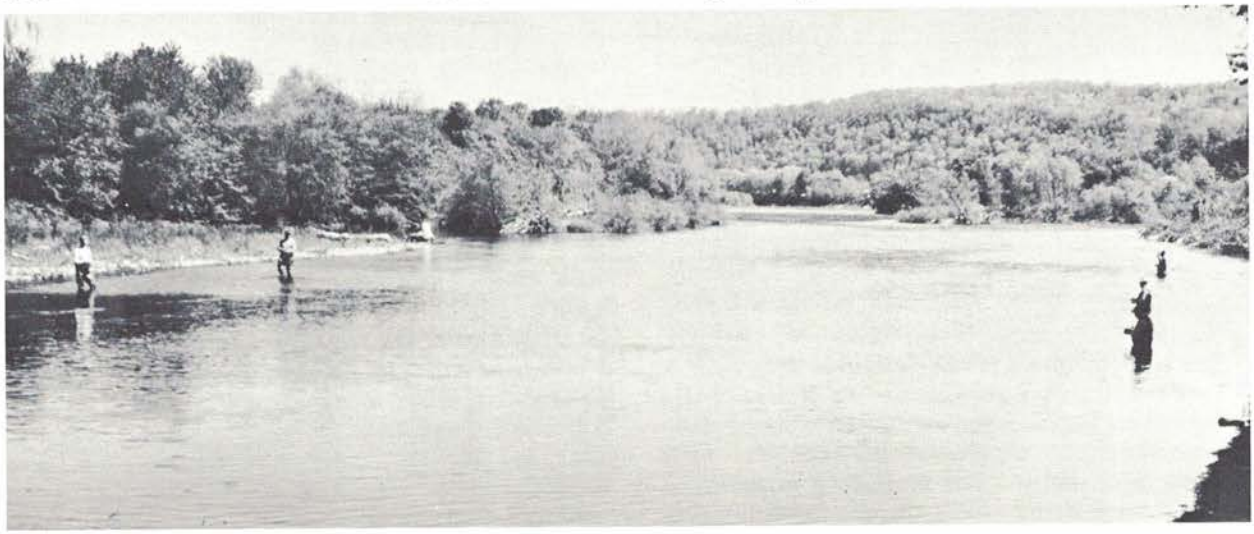
Shad Runs Declined After 1900

The unpredictable nature of shad makes compilation of accurate statistics on the size of each annual run difficult. While precise details are flimsy, records of the shad fishery date back to pre-Colonial times. Indicating the importance of this fish to the red man, shad scales have been found in excavations of Indian caves in the Delaware and Susquehanna Basins.

A federal research report tells us that the first statistics on the commercial fishery were compiled in 1837. One observer calculated from the average sized shad and the number of nets in operation that the catch that year totaled 10½ million pounds. Apparently it was not until the 1880's that estimates of the number of shad caught were made with any regularity. Information available indicates that from 1880 until the turn of the century yearly catches ranged from about 11 million pounds to 19.2 million pounds, the latter being the 1896 total and the largest one-year catch ever recorded.



Shad anglers try their luck as the fish head upstream to spawn. Scene is near Belvidere, N. J.



The poundage of the annual catches stayed consistently over 10 million until the harvest curiously began to drop sharply in the earliest years of the Twentieth Century. In 1901 the total catch was 13.4 million pounds, but this dwindled to 5.3 million in 1904, to 1.3 in 1916, and on down to 180,000 pounds in 1921. From that time until the mid-1940's, the annual harvest fluctuated between 150,000 and 500,000. Since 1947, this harvest has not once reached 150,000 pounds. Three times, in 1948, 1949, and 1954, it dropped to 75,000. In the late 1950's it began taking another nosedive, with some recovery in the 1960's.

Research into the causes of the great decline of Delaware shad has been limited. The decline has been coincident generally with the immense development of the river basin for residential and commercial purposes in the Twentieth Century and the resulting heavy pollution increase. Fishery experts claim a direct cause and effect relationship.

The Oxygen Problem

Like other living things, shad cannot exist without oxygen. And it is an unfortunate coincidence that the oxygen levels in the lower Delaware annually drop — sometimes to zero — at approximately the same time that the shad begin their annual spawning expeditions upstream.

The drop in dissolved oxygen, most critical in the Philadelphia-Chester area, is caused when seasonal rises in water temperatures step up biological activity of micro-organism oxidizing pollutants in the water.

If shad migrate early in the season, before the oxygen drops to lethal levels, the success of the run is almost assured. If they come later in the season, when the dissolved oxygen is depleted, the run likely will be lost.

No repeat spawners are found in the Delaware, fishery biologists report, because adult shad heading back toward the ocean in the late summer and fall are unable to get through the oxygen sag still persisting at that time of year. In contrast, about a third of the shad taken from the Susquehanna River below Conowingo dam have spawned previously. Juvenile shad normally head downstream later than adults. In years when their run occurs after cool weather breaks the oxygen block, they make it to the ocean. Since shad are known to return to the same river to spawn, the fate of future shad runs hinges on the success of the downstream journey of the juveniles.

The 1966 Blockade

Events of 1966 typify the dilemma of shad in the Delaware. In April 1966 commercial fishermen in the lower Delaware were already making good hauls of shad migrating through the bay, and some runners were well on their way upstream. Meanwhile, however, the prolonged Delaware drought took another downward turn. Precipitation was so poor during the early spring of 1966 that the flows for April set a new low for that month at Trenton. Early arrival of summerlike weather, aggravated by the sharp decline in the fresh water

A Commission staff assistant points to dead shad on New Jersey shore of Delaware opposite Philadelphia International Airport. Fish kill occurred after spring decline in estuary dissolved oxygen levels.

entering the estuary at Trenton, resulted in a dip to nearly zero levels of dissolved oxygen in the Philadelphia-Chester area.

On April 27 the Commission passed on to the public the staff report on the critical state of conditions in the estuary and forecast that, with most of the run still in the bay, a large shad kill might be expected within a few days. The Commission called an emergency session of its Fishery and Wildlife Technical Assistance Committee, comprising fishery experts of the basin states and the Federal Government, for a professional judgment on what if any interim or stopgap measures could be taken to prevent or reduce the size of the predicted shad kill.

Many emergency steps were considered, but all were discarded as too little, too late, too expensive, technically infeasible, or shooting in the dark. These included mechanical reaeration of the river, chlorination of organic wastes, augmenting river flows from reservoirs where storage levels already were low, and even barging and trucking shad across the stretch of oxygen sag in the river.

Almost while the deliberations were in progress, a change in the weather accomplished what could not be done artificially. Heavy rains arrived throughout much of the basin, and temperatures again dropped to pre-summer levels. Also, sharp northeasterly winds agitated the water, having a reoxygenating effect.

Before many more days had passed, Fred Lewis of Lambertville, the only commercial shad fisherman above the estuary, reported catches on several consecutive days beginning May 10. Reports of more catches, though small, came from farther upstream.

Some of the shad had succeeded in making their 1966 run up the Delaware after all. Fortunately, reproduction of even a small number of spawners is sufficient to assure perpetuation of the four-to-six-year spawning cycle in the life of this popular Delaware valley fish, providing they survive the pollution barrier and other natural hazards.

As an outgrowth of the Technical Assistance Committee's deliberations, technicians representing the group have been called together by the U. S. Bureau of Sport Fisheries and Wildlife to start work on a comprehensive fisheries program for the basin.

Tocks Island

Recreation area is added to Delaware's biggest project as the region braces for change

"Here they will come and they will fish and they will camp out, and their lives will be infinitely richer because they came this way."

These were among the closing words by President Johnson at the White House ceremony at which he signed into law the Delaware Water Gap National Recreation Area legislation on September 1, 1965. This was the culmination of an effort of more than three years to assure the development of this 70,000-acre national parkland concurrently with the 37-mile-long Tocks Island reservoir that will be the lake within the park. The reservoir itself has already gone into design as one of eight Delaware Basin multi-purpose reservoir projects authorized in 1962. All eight, as well as the National Recreation Area, have been part of the Delaware Basin Commission's Comprehensive Plan since it was adopted in March 1962.

The 1965 authorization of the National Recreation Area meant that the original target date of not later than 1975 for completion of the total reservoir and parkland project would be attainable so long as Congress continued to make the necessary planning and development appropriations.

As it now stands, the reservoir project is to go into the construction phase by early 1968. The National Park Service plans to open some facilities in the Recreation Area for public use in 1967 and 1968. The Tocks Island dam should be completed by 1972, thus delivering flood protection by then, and the pool should be filled and the reservoir in full operation by 1975.

The ramifications of this project that will cost an estimated $200 million in public funds — $140 million for the reservoir and $60 million for the park — are so diverse and abundant that they involve a great number of activities by many organizations and agencies aside from those directly responsible for the project's development. Encompassing flood control, water supply for a great metropolitan region, recreation for about 10 million visitors a year, and some hydroelectric power generation at the dam, the Tocks Island reservoir will be one of the great water resource landmarks in the East, and the nation.

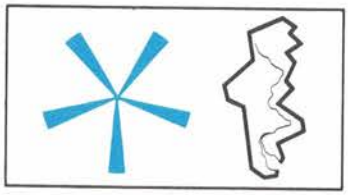
As of June 30, 1966, activities and developments connected with the project were progressing on many fronts.

The Corps of Engineers was completing work on its general design memorandum for the dam and reservoir project. This document will establish the framework within which final details will be worked out on such aspects as a fish passing device for migrating species, final pool elevations for flood control and water supply, and generating run-of-the-river hydropower. It will determine the extent to which levees will have to be constructed for the protection of Matamoras and Port Jervis, near the northern end of the lake. It also will include the reservoir's schedule of operations.

Also in final preparation was the master plan of the National Park Service for the recreation area, setting forth in detail all the leisure-time facilities and operations in the park.

Before the Congress were requests for appropriations to the Corps of Engineers for continued design and engineering work on the dam and reservoir and for beginning of land acquisition in the park.

Congress was also considering proposals under which the bonding powers of the Delaware Basin Commission would be employed to help accelerate the delivery of land purchase funds to the Corps to help stem the development of summer cottage communities and other land use changes within the recreation area.



A study estimating potential impact of the National Recreation Area on the surrounding communities was completed for the state planning agencies of Pennsylvania and New Jersey. As a follow-up to the impact study, the Pennsylvania Planning Board and New Jersey Planning Division were preparing a sketch plan presenting the framework for action that can be taken in controlling land use and meeting transportation and other needs in the impact area. Involved in this and all the other efforts to help the region adjust to the changes ahead is the newly created Tocks Island Regional Advisory Council. This group was created in October 1965 by the six counties in New Jersey, New York and Pennsylvania that are in or around the Tocks Island project.

Still another group, the Tocks Island Interagency Committee, continued its work of anticipating the planning and development problems presented by the project and helping coordinate the activities to meet them. This committee consists of representatives of state, interstate and federal agencies whose operations in some way touch on the reservoir and recreation development.

The Commission's Role

Just getting under way at year's end was the Commission's Tocks Island Region Environmental Study, launched out of concern over the threat of pollution to the new reservoir and nearby areas due to the influx of visitors and development of communities nearby. The three-year study will cost $430,000, of which the Federal Water Pollution Control Administration will pay $250,000. The rest will be borne by state, Commission and county contributions of $180,000. As its first step in the study, the Commission was working on the formation of task groups to project population and land use for 50 years in the six-county area, to determine the resulting water supply needs, and to plan for disposal of both solid and liquid wastes.

Still pending before the Commission was the proposal by three New Jersey electric utility companies — Public Service Electric & Gas Co., Jersey Central Power & Light Co. and New Jersey Power & Light Co. — for consent to build and operate a privately-owned pumped storage generating project on the west side of Kittatinny Ridge to become part of the permanent Tocks Island dam and reservoir works. Early in the year the companies amended their application to reflect enlargement of their proposal. The earlier plan for a 990,000-kilowatt operation that would have cost $80 million was expanded to 1,300,000 kilowatts for a higher cost of $93 million. The pumped storage would be financed entirely from private funds and is not included in the public expenditures for the reservoir and recreation projects. The amended application also proposes an annual payment to the Commission for the use of the public facility. The companies already have built a nearby pumped storage operation on the east side of the ridge linked to a small stream, Yards Creek. The Yards Creek and Tocks Island pumped storage facilities would be integrated into a single large generating operation. The companies have suggested the possibility of a secondary use of the pumped storage operation as a starting point for pumping water from the Tocks Island reservoir to be diverted out of the Delaware Basin into northeastern New Jersey to meet future water supply needs there. Governor Hughes of New Jersey has said that his state will need an additional 300 million gallons a day from the Delaware. Conservation interests who seek to preserve Sunfish Pond, atop Kittatinny Ridge, in its natural state have objected to the utilities' Tocks Island pumped storage plan. The pond would be part of the upper reservoir system.

In September 1965 the Commission assumed the obligation to pay the Corps of Engineers for building the water supply feature into the Tocks Island reservoir. Similar assurances had been provided for the Beltzville reservoir in Pennsylvania's Lehigh valley. This action insures a water supply yield capacity of 600 million gallons a day from the Tocks Island reservoir. Under a policy adopted more than a year ago, the Commission will have control over the storage, allocation and wholesaling of water supplies at Tocks Island and other federally constructed reservoirs in the basin. No diversions of Delaware River water from the basin, such as the prospective transfer to Northeast Jersey, can be made without the consent of the Commission.

There are times in the life of a river when it has too much water and other times not enough. Frequently the impact of droughts and floods can be greatly diminished by operation of reservoirs as a system during an emergency. The control of releases and withdrawals from many large upper basin reservoirs during last year's drought crisis was a good example of how impoundments can be successfully integrated into a single operation. The completion of the Tocks Island reservoir will greatly increase the Commission's flexibility for short-term hold-back, storage, release, transfer, or other control of surface water as the need might arise.

Budget Distribution

Fiscal Years 1966 and 1967

REVENUES

	1966 (Actual)	1967 (Anticipated)
Delaware	19,500	22,800
New Jersey	126,800*	143,000*
New York	125,800	142,000
Pennsylvania	126,800*	143,000*
U. S.	96,000	115,000
Public Health Service Grant	45,448	40,000
Miscellaneous	7,260	200
Working Reserve	52,882	0
TOTAL	600,490	606,000

*Includes $1000 appropriation for Capital Budget

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

EXPENDITURES

	1966 (Actual)	1967 (Anticipated)
By Organization		
Directorate	121,246	118,387
Administrative Division	79,813	74,027
Planning Division	386,247	411,586
TOTAL	587,306	604,000
By Program		
WATER SUPPLY	33,092	30,000
WATER DEMAND	88,707	45,000
RECREATION	43,560	31,000
POWER	37,321	28,000
PROJECT REVIEW	83,984	142,000
WATER QUALITY	116,035	123,000
COMPREHENSIVE PLAN	133,831	144,000
FLOOD LOSS	7,461	11,000
BASIN OPERATION	43,315	50,000
TOTAL	587,306	604,000
Unexpended Balance	11,184	0
Capital Program	2,000	2,000
GRAND TOTAL	600,490	606,000