

INTRODUCTION

1. The Corps of Engineers' role in water resources planning for the Delaware River Basin dates back to 1823 when the Corps formulated plans for a breakwater at the mouth of the Delaware River for protection of shipping from storms and ice. In 1933 the Corps conducted a study of our nation's water resources which was known as the "308" report. A preliminary study of the Delaware River Basin was part of that study. The Delaware River Basin portion of the study dealt with navigation, hydroelectric power, flood control, irrigation, and water supply.
2. Seventeen years later (April 1950), as a result of extensive changes in the region's population and economy, Congress, acting at the request of local citizens, asked for a review of the "308" report. Limited review was in progress in August 1955 when two tropical storms (Hurricanes Connie and Diane) moved up the eastern coast of the continental United States about a week apart. The flood damage and other destruction resulting from those storms dramatically emphasized the need for a full appraisal of the water problems of the Delaware River Basin. Subsequently, as a result of additional Congressional action, the Comprehensive Survey of the Water Resources of the Delaware River Basin was undertaken.
3. That comprehensive study was completed by the Corps in 1962 and recommended a plan for adoption as a guide to the timed and balanced development of the water resources of the basin. Also, as a result of that study, the Delaware River Basin Commission (DRBC) was established and charged with the responsibility to oversee the planning, development, management and protection of the water resources of the four state river system, including all of its tributaries.
4. Another significant step in the development of comprehensive planning came in 1972, with Section 209 of the Federal Water Pollution Control Act Amendments Legislation (Public Law 92-500). Section 209 directed that so-called "Level B" plans be prepared for all regions or river basins in the United States. This represented an acceleration of the Federal government's comprehensive planning program. Within the Delaware River Basin, the DRBC was charged with the responsibility to develop the "Level B" plan.
5. The original Comprehensive Survey of the Delaware Basin, completed by the Corps (1962), recommended that 19 major water reservoir projects and 39 smaller reservoir projects be included in a plan for the long-range development of the basin's water resources. The largest project recommended for construction was the Tocks Island Lake project. The Tocks Island project would have reduced recurrent flooding along the main stem of the Delaware River. In response to public controversy surrounding the project, Congress directed the Corps, in cooperation with the DRBC, to conduct a comprehensive and impartial review of the project and its alternatives.
6. On 31 July 1975, based on the results of that review, DRBC, by majority vote, recommended that construction funds for the project not be appropriated by Congress. This prohibited its construction. Nevertheless, DRBC has retained the authorized project in its comprehensive plan for possible development after the year 2000.

7. Subsequent to the denial of construction funding for the Tocks Island project, thirty-seven miles of the Middle Delaware River within the Delaware Water Gap National Recreation Area were assigned "recreational" status in an amendment (Public Law 95-625) to the Wild and Scenic Rivers Act (Public Law 90-542). This designation includes this section of the main stem Delaware River in the National Wild and Scenic River System.

The Wild and Scenic Rivers Act Section 7(b) declares that

".... no department or agency of the United States shall assist by loan, grant, license, or otherwise in the construction of any water resources project that would have a direct and adverse effect on the values of which the river might be designated as determined by the Secretary for its study."

In this case the "recreational" designation is defined as

"Those rivers or sections of rivers that are readily accessible by road or railroad that may have some development along their shoreline and that may have undergone some impoundment or diversion in the past."

8. The implications for any future construction of the Tocks Island project are that this stretch of the Delaware River would require the removal of this designation which, although not totally improbable, would at the minimum constitute a major planning impediment.

9. Recognizing that without the Tocks Island project, existing properties within the main stem area are without the realistic prospect of receiving protection from flooding, DRBC expressed an interest in the development of a flood damage reduction program for that area. Acting on this interest, several Congressional representatives, in November 1975, made a request to the chairman of the House Committee on Public Works and Transportation for Congressional authorization of such a flood control study. The result is the subject Delaware River Basin Study (DRBS).

STUDY AUTHORITY

10. This study was authorized by a resolution adopted 23 September 1976, by the House Committee on Public Works and Transportation. The resolution is as follows:

"Resolved by the Committee on Public Works and Transportation of the House of Representatives, United States, that the Board of Engineers for Rivers and Harbors is hereby requested to review the reports of the Chief of Engineers on the Delaware River and Tributaries, New York, New Jersey, Pennsylvania, and Delaware, printed in House Document No. 522, 87th Congress, 2nd Session, and other pertinent reports, with a view to determining the need for modification of the recommendations contained therein with particular reference to the advisability of adopting improvements for flood control and allied purposes in the Delaware River Basin, including but not limited to a flood protection program consisting of non-structural measures, in coordination with the Delaware River Basin Commission."

SCOPE OF STUDY

11. Flooding problems in the Delaware River Basin were addressed in the Comprehensive Plan of the Corps of Engineers for development of water resources in the Delaware River Basin as contained in House Document No. 87-522 (HD 522). Flooding problems exist throughout the basin. Their causes are complex and their solutions difficult. Since the authorization of HD 522 in 1962, many local and area-wide detailed flood control studies have been conducted. The larger efforts addressed portions of tributaries in New York, the Schuylkill River Basin, the Lehigh River Basin, the Lackawaxen River Basin, the Christina River Basin, the Rancocas Creek Basin, the Chester Creek Watershed, the tri-county region of New Jersey including Burlington, Camden, and Gloucester counties, and the reach along the New Jersey side of the Delaware River south of Gloucester County. However, since the proposed Tocks Island project was to provide protection, flooding problems along a major portion of the main stem of the Delaware River were not addressed further.

12. Taking into consideration flood control measures constructed by others, the main stem is where residual damage potential (i.e. damages that might occur despite the presence of flood control measures) is currently the greatest. Other water resource problems and needs in the Delaware River Basin, such as those related to navigation, water supply, recreation, and hydroelectric power, are adequately addressed by other ongoing or completed study efforts by the Federal and state governments and regional agencies including those listed in Table 1. Therefore, in accord with the wishes of the study sponsor, the Delaware River Basin Commission, the major purposes of this study are to determine more precisely the potential for flood damage and potential for solutions along the Delaware River below the Tocks Island site.

STUDY AREA

13. As shown in Plate 1, the physical boundaries of the Tocks Island flood control influence area and therefore, the study area considered in this report, covers approximately a 100 river mile portion of the Delaware River main stem from Stroudsburg, Pennsylvania, downstream to and including Burlington, New Jersey. This area includes portions of 58 municipalities in seven counties consisting of Monroe, Northampton, and Bucks in Pennsylvania and Warren, Hunterdon, Mercer and Burlington in New Jersey.

NATIONAL OBJECTIVE

14. This study was carried out by systematic preparation and evaluation of alternative ways to address the problems, needs, concerns, and opportunities under the "Principals and Guidelines" (P&G) of the Cabinet Council on Natural Resources and Environment. The P&G requires that Federal and Federally-assisted water resource planning be directed to achieve the National Economic Development (NED) objective. NED is to be achieved by increasing the value of the nation's output of goods and services and improving national economic efficiency. Each structural and nonstructural alternative plan's effect on environmental quality, regional development and other social effects were considered. This approach resulted in information that allowed effective choices to be made regarding resource management under existing projected conditions.

STUDY OBJECTIVES

15. There are two primary purposes for this study. The first is to determine more precisely the potential for flood damage in existing developed areas along the main stem Delaware River below the Tocks Island site. The second is to determine the costs, effectiveness, feasibility, and acceptability of nonstructural measures and local protection works for flood protection or damage reduction in that area.

16. Previous formulation and evaluation of structural and nonstructural local measures are considered approximate by current standards. This is because of the age and limited scope of the 1955/1958 basic data as well as the rapid advance of state-of-the-art evaluation techniques relative to previous methodologies employed. In addition, simplified procedures were often followed in past formulation and evaluation analyses which may have incorrectly grouped or bypassed potential solutions. The first part of the study develops new physical and economic data and tests its impact on benefits, costs and subsequently, on previous conclusions. Previous conclusions for not only structural but also nonstructural programs were often qualified to reflect the limited scope of the original data base. The second part of the study considers the nonstructural measures in light of more recent findings and state-of-the-art evaluation techniques.

PRIOR AND ON-GOING INVESTIGATIONS

17. Since the founding of this country, Congress has realized the importance of our natural resources as a basis for our national wealth. Consequently, development of these resources has always been of concern. Through the years, national policies have been established regarding their use. As the development of our nation's water resources began and progressed, the Federal Government, states, and local groups became concerned over the "best use" of our nation's water resources.

18. Since the "308" report mentioned previously, a number of investigations pertaining to the flood control and related water resource problems and needs of the Delaware River Basin have been made by the Corps of Engineers, the DRBC and others. These prior efforts have included post-flood studies, comprehensive water resources studies which included flood control, special project reports, multipurpose project studies, local or area-wide flood control studies and other general investigations. Table 1 presents 14 of the many prior investigations and reports which were used in varying degrees for this study. The prior investigations which are most pertinent to this study are discussed in the following paragraphs.

19. POST FLOOD REPORT, HURRICANES CONNIE AND DIANE. The August, 1955 storms produced the largest flood of record generally throughout the basin and provided an opportunity to secure data necessary to establish stage-damage relationships on a large number of streams not covered in earlier surveys. During, and immediately following, the 1955 flood, preliminary reconnaissance and aerial photographic surveys were made of the flooded areas in the basin. These were followed by a field survey made during the period October through December 1955. A supplemental survey of the August 1955 flood losses was conducted in August 1958 for the purpose of securing additional flood damage data throughout the basin in order to define more adequately the stage-damage relations for various river reaches and damage centers. That data was then used in the Comprehensive Basin Study described in the following paragraph.

20. COMPREHENSIVE BASIN STUDY (1962). As a result of extensive changes in the region's population and economy, Congress, in April 1950, asked for a

TABLE 1

PERTINENT STUDIES
DELAWARE RIVER BASIN

<u>Study</u>	<u>Publication</u>	<u>Remarks</u>
Delaware River Basin, NY, NJ, PA and DE	"308" Report by the Corps of Engineers, 1933	Preliminary study of water resources of the basin as part of a national survey.
Post-Flood Report, Hurricanes Connie and Diane	Report on Operation Noah by the Corps of Engineers, May 1957	Description of relief and emergency operations with estimate of flood damages.
Delaware River Basin, NY, NJ, PA and DE	Comprehensive Basin Study by the Corps of Engineers, House Document No. 522, 87th Congress, 2d Session, August 1962	Comprehensive plan for development of water resources of the Delaware River Basin. (Discussed in text.)
Delaware River Basin, NY, NJ, PA and DE	Report for Corps of Engineers by J. Mellan Co., Inc., March 1966	Update of 1955 flood damages utilizing aerial photography and sampling techniques.
Delaware River Basin, NY, NJ, PA and DE	Report for Delaware River Basin Commission by Tippetts, Abbett, McCarthy and Stratton, March 1972	Reviews potential impoundment sites for power and related water resources.
Delaware River Basin, PA and NJ	Report by Environmental Defense Fund, Inc., April 1973	Flood control study with emphasis on non- structural solutions.
State of Pennsylvania	Report prepared for the Common- wealth of Pennsylvania by Michael Baker, Jr., Inc., November 1974	Description of flood plain land use, population and damage estimates for flood prone communities in Pennsylvania aggregated by River Basin information plotted on USGS quads.

TABLE 1 (Cont'd)

<u>Study</u>	<u>Publication</u>	<u>Remarks</u>
Delaware River Basin, NY, NJ, PA and DE	Report by Delaware River Basin Electric Utilities Group, Reservoir Contingency Study Subcommittee, May 1975	Reviewed alternative water supplies for power or consumptive use.
Comprehensive Study of the Tocks Island Lake Project & Alternatives	Report prepared for the Corps of Engineers by URS/Madigan- Praeger, Inc. and Conklin & Rossant, June 1975.	Identified various viable technical alternatives to the Tocks Island Lake project. (Discussed in text.)
Delaware River Basin, NY, NJ, PA and DE	Report for Delaware River Basin Commission by Tippetts, Abbett, McCarthy and Stratton, August 1976	Investigated water supply for power use or consumptive use.
Camden Metropolitan Urban Study	Survey study completed by the Corps of Engineers, April 1980	Flood control, water quality, water supply of Burlington, Camden and Gloucester Counties, NJ.
Delaware River Basin Comprehensive Study (Level B Study)	Final report completed for the Delaware River Basin Commission (DRBC), May 1981	To provide a basis for updating compre- hensive plan of DRBC for development of water resources. (Discussed in text)
Daily Flow Model of the Delaware River Basin	Report by Corps of Engineers in cooperation with DRBC and Commonwealth of PA, New York State and USGS, September 1981	Basin management - reservoir regulation model.
Delaware River Tribu- taries in New York State	Survey study by the Corps of Engineers, April 1981	Flood control, flood plain management.

review of the "308" report. A limited review was in progress in August 1955 when Hurricanes Connie and Diane moved up the eastern coast. The flood damage and other destruction resulting from these storms dramatically emphasized the need for a full appraisal of the water problems of the Delaware River Basin.

Subsequently, as a result of additional Congressional action, the Comprehensive Survey of the Water Resources of the Delaware River Basin was undertaken.

21. This comprehensive study was completed by the Corps in 1962, and recommended a plan for adoption as a guide to the timed and balanced development of the water resources of the basin. Throughout the study, it was apparent that the plan would require a program of participation by Federal and non-Federal interests. As a means for coordinating and integrating these interests, local agencies of the area were concurrently considering the nature and establishment of an appropriate lead organization. In 1961, an interstate Federal Compact was drawn up with concurrent legislation from Congress and the States of New York, New Jersey, Pennsylvania and Delaware. The Compact established the DRBC whose members are the governors of the four states and the Secretary of the Interior (the Federal Representative). The Commission was charged with the responsibility to oversee the planning, development, management and protection of the water resources of the four state river system, including all of its tributaries.

22. MADIGAN-PRAEGER REPORT. The largest project recommended by the 1962 Comprehensive Basin Study was the Tocks Island Lake project. Public controversy surrounding the project in the early 1970's, centered on the project's possible environmental, social, and economic impacts on the surrounding area. In response to the controversy, Congress directed the Corps, in cooperation with the DRBC, to conduct a comprehensive and impartial review of the project and its alternatives.

23. The resulting Comprehensive Review Study of the Tocks Island Lake Project and Alternatives did not make recommendations. It did, however, analyze the water related demands to be placed upon basin resources; investigate alternatives available to meet or modify those demands that would have been satisfied by the Tocks Island Lake project; and identify the potential impacts of both the Tocks Island project and its alternatives.

24. LEVEL B STUDY. The Level B Study did not devote much effort to flood control considerations since the basin states and DRBC are engaged in such studies under the National Flood Insurance Program grant assistance program.

25. DELAWARE RIVER BASIN ICE JAMS STUDY. This study was authorized by the Senate Committee on Environment and Public Works on March 26, 1982. Its purpose is to determine if improvements for those areas subjected to flooding from the formation and movement of ice along the main stem of Delaware River and its tributaries are warranted.

The study was initiated in October 1984 and is being conducted in two phases. The initial phase is the Reconnaissance Study which will be completed by October 1984. The Reconnaissance Study will establish the definition of the problems, present an array of potential solutions, update the estimated study cost and, if appropriate, establish a project cost sharing agreement

with the non-Federal sponsors. A portion of the Reconnaissance Study is being devoted to solving the ice related problems in the vicinity of Port Jervis, New York; Metamoras, Pennsylvania; and Westfall Township, Pennsylvania. These are the communities in the basin which have historically experienced the most severe ice related damages. The balance of the Reconnaissance Study considers other potential problem areas. In fiscal year 1985, the second phase, the Detailed Feasibility Study, will be initiated.

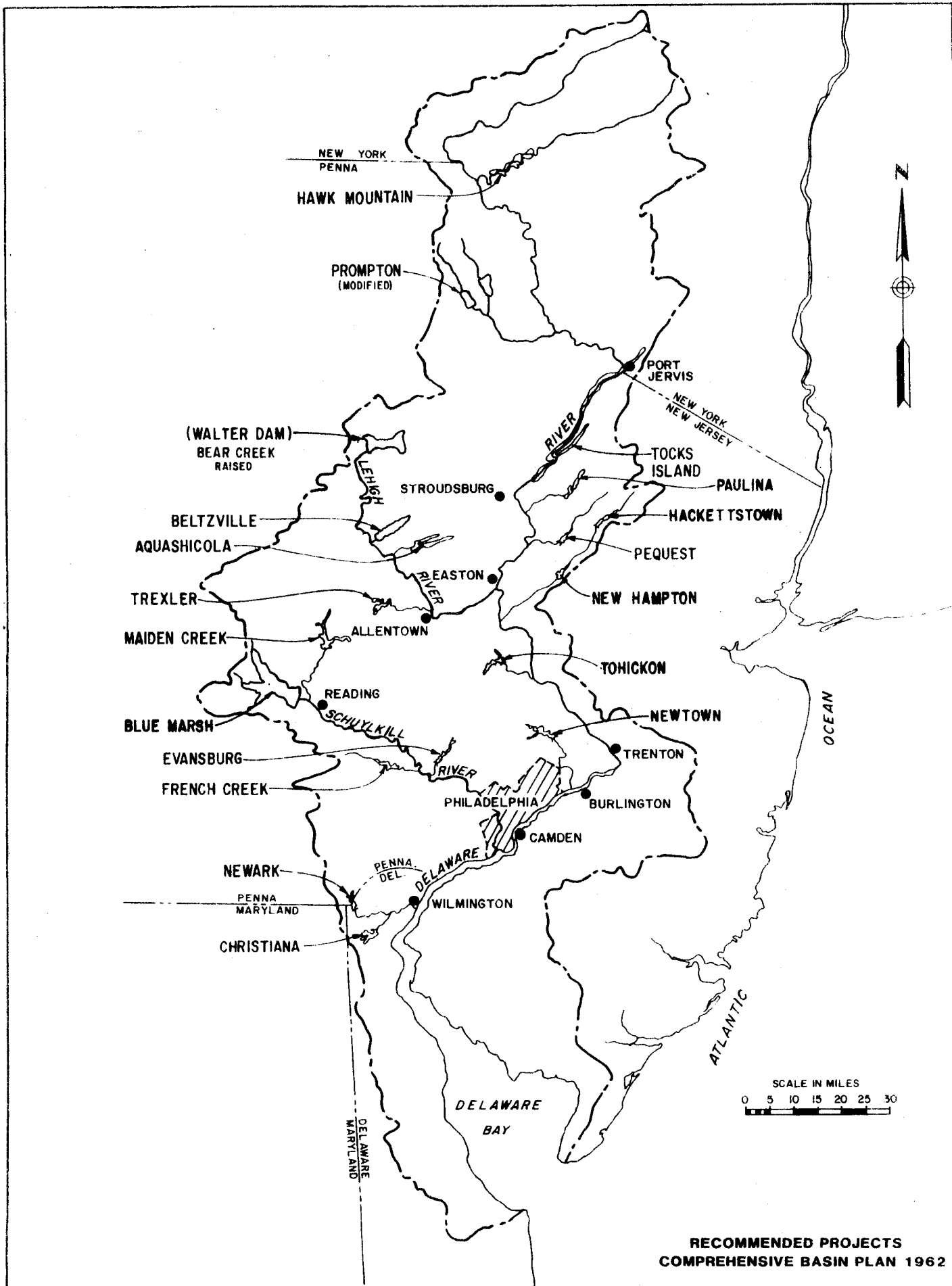
EXISTING PROJECTS AND PROGRAMS

26. This section presents a description of existing projects and programs used to prevent or limit flood damages in the study area. Basically, structural protective works are projects that prevent or protect against flooding. Nonstructural programs attempt to manage or control the level or type of development of flood plain areas in order to minimize property damages and human suffering when flooding occurs. The following discussion is limited to major projects and programs which have an impact on the main stem of the Delaware River between Stroudsburg, Pennsylvania and Burlington, New Jersey.

27. EXISTING FEDERAL FLOOD CONTROL PROJECTS. Construction of the flood control (impoundment) projects recommended in the Comprehensive Plan of the Corps of Engineers was authorized by the Flood Control Act of 1962 (Public Law 87-874). The locations of those projects are shown on Figure 1 and their current status is listed in Table 2. As shown in Table 2, this Comprehensive Plan has yet to be fully implemented with construction to date of only the Beltzville Lake and Blue Marsh Lake Projects. (Blue Marsh Lake is in the Schuylkill River Basin and does not impact the study area.) In addition to the projects recommended by the Comprehensive Plan for construction and modification, other projects for purposes of flood damage reduction have been authorized and constructed under earlier Flood Control Acts. Those projects impacting on the study area are the General E. Jadwin Dam and Prompton Reservoir projects in the Lackawaxen River Basin, and the Francis E. Walter Dam in the Lehigh River Basin. A description of each project and its current status is given in the following paragraphs.

. Beltzville Lake. Beltzville Lake project was placed in operation in February 1971. The project is located on Pohopoco Creek in Carbon County, Pennsylvania, about four miles upstream from the confluence of that stream with the Lehigh River, a major tributary to the Delaware River. This is a multipurpose development project to provide flood control, water supply, water quality and recreation. Its primary purpose is to reduce flood stages on the Lehigh River below the confluence of that river with Pohopoco Creek, and secondarily to the main stem Delaware River.

. General E. Jadwin Dam. The Jadwin Dam project authorized and completed prior to passage of Public Law 87-874 is located on Dyberry Creek, in Wayne County, northeastern Pennsylvania, about three miles above the confluence of that stream with the Lackawaxen River in Honesdale. Jadwin Dam is a single-purpose flood control reservoir which, during normal flow conditions, is a "dry dam" providing complete release of flows within the stream channel limits. The reservoir was designed with an uncontrolled outlet works for short term storage of water. Its primary purpose is to reduce flood stages in the Lackawaxen River at Honesdale and Hawley, Pennsylvania.



**RECOMMENDED PROJECTS
COMPREHENSIVE BASIN PLAN 1962**

FIGURE 1

TABLE 2
 MAJOR PROJECTS AUTHORIZED BY
 FEDERAL FLOOD CONTROL ACT OF 1962
 (Public Law 87-874)

Project Name	Location	Purposes	Original Construction Schedule	Status
Hawk Mountain	E. Br. Delaware R. near Hancock, NY	S,P,R	2001	Development Precluded
Prompton* (modification)	Lackawaxen R. near Honesdale, PA	S,R,F	1974	Need confirmed by DRBC Level B Study
Tocks Island*	Delaware R. Near Del. Water Gap, PA	S,P,R,F	1974	Deferred
Walter* (modification)	Lehigh R. Near White Haven, PA	S,R,F	1989	AE & D Study Underway
Beltzville*	Pohopoco Cr. near Lehighton, PA	S,R,F	1965	Constructed
Aquashicola*	Aquashicola Cr. near Palmerton, PA	S,R,F	1981	Deferred
Trexler*	Jordan Cr. near Allentown, PA	S,R,F	1972	Inactive
Maiden Creek*	Maiden Cr. near Reading, PA	S,R,F	1982	Deferred
Blue Marsh*	Tulpehocken Cr. near Reading, PA	S,R,F	1969	Constructed
Newark	White Clay Cr. near Newark, DE	S,R	1975	Development Unlikely
Christiana	Christina R. near Christiana, DE	S,R	1980	Development Unlikely
Paulina	Paulina Kill Near Blairstown, NJ	S,R	**	Development Unlikely
Pequest	Pequest R. near Oxford, NJ	S,R	**	Development Unlikely
Hackettstown	Musconetcong R. near Hackettstown, NJ	S,R	**	Under Consideration by NJ
New Hampton	Musconetcong R. near Washington, NJ	S,R	**	Development Unlikely
Tohickon	Tohickon Cr. near Ottsville, PA	S,R	**	Constructed (Nockamixon)
Newtown	Neshaminy Cr. near Newtown, PA	S,R	**	Development Unlikely
French Creek	French Cr. near Phoenixville, PA	S,R	**	Development Unlikely
Evansburg	Skippack Cr. near Collegeville, PA	S,R	**	Inactive

* Recommended for Federal Development in House Document 522-87-2 and authorized for construction by PL 87-874

** 1st stage construction for recreation prior to 2010 with 2nd stage construction for other purposes after 2010.

S = Supplies of water to augment low flows
 P = Hydroelectric power
 R = Recreation
 F = Flood control
 AE & D = Advanced Engineering & Design

. Prompton Reservoir. The Prompton Reservoir project is located in Wayne County in northeastern Pennsylvania. The dam is located approximately 30 miles above the confluence of the Lackawaxen River with the Delaware River at Lackawaxen, Pennsylvania. Construction of the existing project was completed in November 1960, with incidental recreation facilities constructed at later dates. Prompton Dam is an earthfill structure with uncontrolled outlet works and was designed primarily for flood control purposes. The dam is designed to hold flood water for a short period after a flood. Its primary purpose is to reduce flood stages in the Lackawaxen River at Honesdale and Hawley.

Recreation was not an original project purpose and the existing facilities provide limited opportunities for swimming, fishing, boating and picnicking. These resources do not actually accommodate the recreational demand in the project area. Modification of the existing project was recommended in the Comprehensive Plan. The proposed modifications would convert the project to a multipurpose development providing long term storage for water supply and recreational use as well as maintain flood control protection. DRBC has recently confirmed the need for this modification in its Level B study and has recommended that construction be expedited.

. Francis E. Walter Dam. The Francis E. Walter project is located on the Lehigh River in Carbon and Luzerne Counties, approximately 75 river miles above its confluence with the Delaware River. Construction of the existing project was completed in 1961 with limited minor recreational facilities constructed at later dates. The dam is a rolled earthfill flood-control structure with gate controlled outlet works. The existing dam is operated primarily for flood control, and secondarily for recreation and water quality purposes. Its primary purpose is to provide flood control along the entire Lehigh River and secondarily along the main stem Delaware River. Recreation was not an original project purpose and the existing facilities provide limited opportunities for swimming, fishing, boating and picnicking. These resources do not actually accommodate the recreational demand in the project area. Modification of the existing project was recommended in the Comprehensive Plan. The proposed modification of the existing dam would convert the project to a multipurpose development providing long term storage for water supply and recreational use as well as maintain flood control protection. At the request of DRBC through Congress, advanced planning, engineering and design has been initiated for the modification by the Corps.

28. AUTHORIZED FEDERAL FLOOD CONTROL PROJECTS NOT CONSTRUCTED. As indicated in Table 2, in addition to the Tocks Island project, two other major projects recommended in the Comprehensive Plan which would provide some flood control were never funded for construction. These projects are Aquashicola Lake and Trexler Lake.

. Tocks Island Lake. Tocks Island Lake is the largest project recommended in the Comprehensive Plan. It is designed as a multi-purpose project for flood control, water supply, hydroelectric power and recreation. The damsite is located at the downstream end of Tocks Island in the main stem of the Delaware River about five miles upstream from the Delaware Water Gap. The project would reduce flooding on the main stem Delaware River in the reach from Tocks Island to Burlington, New Jersey. From a hydrologic point

of view, the Tocks Island site would have significance because of its strategic location within the basin relative to total drainage area intercepted (3,827 square miles) all of which is located upstream from the eight major damage centers and in that area of the basin which has historically produced the highest rates of runoff. The drainage area above the Tocks Island site represents better than 56 percent of the total drainage area above Trenton (6,780 square miles), and normally contributes better than 75 percent of the runoff passing Trenton.

. Aquashicola Lake. Aquashicola Lake is authorized as a multiple purpose development for flood control, water supply and recreation. The damsite is located on Aquashicola Creek in Carbon County, Pennsylvania, about four and a half miles from the confluence of that stream with the Lehigh River. Based on escalating old benefits and costs, the project has marginal economic justification and has been placed in a deferred category for restudy.

. Trexler Lake. Trexler Lake is authorized as a multipurpose project for flood control, water supply and recreation. The damsite is located on Jordan Creek in Lehigh County, Pennsylvania, about 12 miles above the confluence of that stream with the Lehigh River. Its primary flood control effects would be along the Jordan Creek and Lehigh River.

Strong local opposition to this project culminated with an expression by the voters of Lehigh County in November 1977, when they voted almost three to one on a nonbidding referendum against the project. This led to nonappropriation of funds by Congress and the subsequent suspension of engineering and design. Resumption of construction planning and engineering is dependent upon Congressional appropriation of funds. The project has been retained in the Comprehensive Plan of the DRBC.

29. EXISTING LOCAL FLOOD CONTROL PROJECTS. The Commonwealth of Pennsylvania constructed local protective works consisting of levees and floodwalls in Stroudsburg and East Stroudsburg after the August 1955 flood. That flood event caused extensive damage in both areas. The local protective works are designed to protect against the recurrence of the damages resulting from a similar future event. These two projects are the only major state protective works affecting the study area.

30. The City of Burlington, New Jersey, also constructed levees. These were to have provided protection against approximately a 100 year event. The levees have fallen into disrepair, do not adequately tie into high ground, contain extensive breaches, and do not sufficiently provide for interior drainage.

31. EXISTING MANAGEMENT PROGRAMS. There are existing programs in the basin for properly managing flood plains and storm-water runoff. These programs involve participation at all levels of government; Federal, Interstate, state and local.

. Federal Programs. The most significant of these programs was created by the Federal Flood Disaster Protection Act of 1973. This act required every community identified by the Department of Housing and Urban Development (HUD) as having areas within a flood hazard zone to participate in the National Flood Insurance Program by 1 July 1975, or one year after identification. While participation in the program is not mandatory by law,

it is a prerequisite for Federal or Federally-related financial assistance for acquisition or construction of structures in these flood prone areas. Additionally, Federally regulated lending institutions must require flood insurance as a condition for a loan for property located in flood hazard areas. A major intent of the Act is to "Require states or local communities, as a condition of future Federal Financial Assistance,...to adopt adequate flood plain ordinances with effective enforcement provisions consistent with Federal standards to reduce or avoid future losses..."

Because of the strict sanctions associated with noncompliance, national, state and local officials feel that the Act is an effective instrument in controlling land use in floodplains. Almost all communities in the study area are participating to some extent. Some of the provisions of the Act are ambiguous and some are considered overly stringent by some communities. This has delayed or diluted proper implementation by a number of communities. Enforcement of adopted regulations remains to be proven.

. Interstate Program. The DRBC adopted its Flood Plain Regulations on November 10, 1976, and they became effective on January 1, 1977. The standards of flood plain use contained in these regulations apply to the non-tidal portions of the Delaware River and its tributaries. They are utilized by the DRBC in reviewing certain categories of water-related projects. They are also designed as minimum compliance standards to be followed by local units of government in the promulgation of flood plain regulation ordinances.

Additional information concerning these regulations may be obtained from the Executive Director, Delaware River Basin Commission, P. O. Box 7360, West Trenton, New Jersey 08628.

. State Programs. State laws affecting flood plain development are in effect in both New Jersey and Pennsylvania. New Jersey State Act 58:16A-50 et seq. authorizes the State Department of Environmental Protection to delineate the state's flood hazard areas and after delineation, to adopt floodway land use regulations. It also directs the Department to delineate the flood fringe areas and to promulgate minimum standards for local rules and regulations governing uses and development in the area.

The implementation of these and similar laws in New Jersey has resulted in the general limitation of floodways for open-space uses, with the exception of needed bridges and utilities. The law accomplishes this by setting up a system requiring permits for all construction with the municipalities having jurisdiction over development of the flood fringe. New Jersey's program will serve to control land use in the future but has little impact on existing structures.

The potential of the New Jersey law is to greatly decrease future development in both the floodway and the flood fringe. Structures, both temporary and permanent, are required to obtain permits. These permits are intended to be given only if they do not have undue or significant effects on flood flows, velocities, or heights; local runoff; erosion or sedimentation; or ground water or surface water quality. Additionally, any structures in the floodway or flood fringe damaged beyond repair will need a permit to be replaced.

The stated purpose of the Pennsylvania Flood Plain Management Act is to: 1) encourage planning and development in flood plains which are consistent with sound land use practices, and 2) authorize a comprehensive and coordinated program of flood plain management. The Act gives the Department of Community Affairs and the Department of Environmental Resources the authority to review and process municipal flood plain management programs and, where municipal plans are inadequate, to implement the provisions of the Act. A major mechanism of control in the Act is the regulation of particular obstructions in the flood plain.

Section 301 of the Act states that no construction, enlargement, or expansion of certain obstructions listed in the Act can be undertaken unless a special permit has been issued. Section 205 requires the state to adopt regulations establishing criteria and standards for the coordination and uniform enforcement of municipal flood plain management regulations. Thus, the Act requires the state to develop minimum standards for land use management in floodways.

The intent of the Pennsylvania law is similar to that of the New Jersey law. That is, to regulate or prohibit structures in the "flood area". The enforcement of the law is given primarily to the local governments. The implementation of this law would result in a significant slowing of any growth in the "flood area" which would have otherwise occurred.

Another flood related program in Pennsylvania is for the management of storm water runoff. Pennsylvania has recently passed legislation requiring municipal and countywide storm water management planning, however, funding for this legislation has not yet been appropriated. This program would be critical in urbanizing areas on a scale from individual buildings to entire watersheds, to prevent increased future flood risks. Upstream development outside the flood plain often leads to increased flood damage potential downstream. Greater areas of impervious surface lead to less absorption, faster storm runoff, and sharper, more intense flood crests. Increased sedimentation and erosion associated with such development reduces stream channel capacity, resulting in more frequent local flooding; existing reservoirs downstream will suffer from increased siltation.

. Local Programs. In general, the local programs are the communities' implementation of, and compliance with, the Federal and state programs. The actual application and administration of the programs vary greatly. Some communities have truly established exemplary programs. In terms of local government control of flood plain management, some counties have taken a strong lead and, in other cases, strong municipalities overshadow their county and the rest of the communities. Local programs and activities will be further discussed later in this report.

EXISTING CONDITIONS

32. Contained in this section is a concise discussion of the existing natural and human-influenced conditions in the study area. For a more detailed discussion as well as projections of future conditions see Appendix A.

33. The Delaware River Basin extends approximately 265 miles southward from the western slopes of the Catskill Mountains in New York to the Atlantic Ocean at the mouth of Delaware Bay. The basin width varies from 40 miles to 80