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PASSAIC FLOOD WARNING SYSTEM

INTRODUCTION

Flooding has long been a problem in the Passaic River Basin of New York and New Jersey. Floods in the basin have claimed lives and caused extensive property damage. During the 1950's and 1960's, residential and industrial development expanded dramatically; as a result, damage from flooding costs the public and industries within the basin about $116 million (1994 dollars) annually (U.S. Army Corps of Engineers, 1995). The flood of April 1984 resulted in three deaths, caused $462 million (1994 dollars) in damage, and displaced 6,000 residents (U.S. Army Corps of Engineers, 1995). Structural methods of flood control have been investigated; however, because the basin is highly populated and developed, a satisfactory structural solution, such as a dam or levee, could not be found.

In 1976 the Congress authorized the U.S. Army Corps of Engineers (COE) to study nonstructural solutions to the flooding problem in the Passaic River Basin (U.S. Army Corps of Engineers, 1984). At the conclusion of the study, the COE recommended an expansion and modernization of the existing National Weather Service (NWS) flood-warning and response system that would allow collection and rapid dissemination of "real-time" stream-level and precipitation data to alert State and county agencies to impending floods, thereby reducing or eliminating loss of life and minimizing property damage (U.S. Army Corps of Engineers, 1984). In response to the need for real-time data, the U.S. Geological Survey (USGS), in cooperation with the COE and NWS, designed and implemented the Passaic Flood Warning System (PFWS). This fact sheet describes the flood-warning system and identifies its benefits.

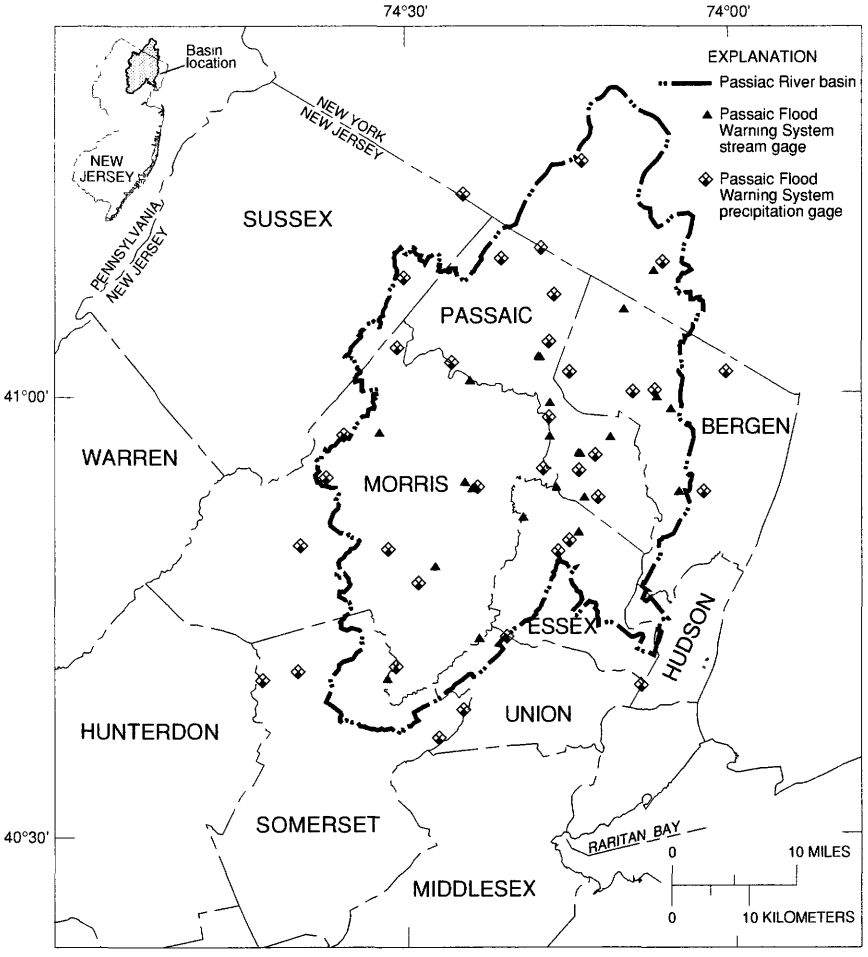

Figure 1. Locations of gages associated with the Passaic Flood Warning System in the Passaic River Basin and vicinity.

DESCRIPTION OF THE STUDY AREA

The Passaic River Basin (fig. 1), which is located in northeastern New Jersey and southeastern New York, covers about 2,400 square kilometers and has a population of more than 2 million. The basin encompasses parts of 10 counties and 132 municipalities, and includes parts of the most developed metropolitan area in the United States.

COLLECTING HYDROLOGIC DATA

Information needed for flood forecasting includes stream stage (the height of the water level in the stream above an arbitrary datum) and the amount and distribution of precipitation. Stream stage is measured at a streamflow-gaging station, where automated equipment is used to continuously monitor and record water levels. Because stream discharge, or the volume of water that flows past a point on the stream during a specific time interval, is difficult to measure accurately and continuously, discharge is commonly estimated from preestablished stage-discharge relations, or rating curves. The rating curves are developed by USGS personnel who visit the gaging station periodically to measure discharge manually under a variety of flow conditions. The rating curve also allows stream stage to be determined from an esti-

mate of stream discharge.

Precipitation gages distributed throughout a drainage basin are used to measure and record the amount of precipitation that falls during a given storm. This information, together with the NWS's Doppler radar, allows the amount and distribution of precipitation to be accurately estimated. From this estimate, stream discharge at a given location can be predicted and converted to an estimate of stream stage.

PASSAIC FLOOD WARNING SYSTEM

In 1902 the USGS and NWS jointly began operating a flood-warning and response system in the Passaic River Basin. By 1984, this initial system consisted of 18 streamflow-gaging stations and 18 rain gages located throughout the basin. The rain gages and 8 of the streamflow gages were read manually, whereas the other 10 streamflow-gaging stations could be called to transmit their data by telephone. Although the NWS system facilitated flood forecasting and the issuing of flood warnings, the number of stream and rain gages and the speed of data transmission were insufficient to optimize the system's effectiveness (U.S. Army Corps of Engineers, 1984).

The current PFWS, installed in 1988, consists of 35 rain gages and 21 streamflow gages located throughout the Passaic River Basin (fig. 1) and linked by radio, telephone, or satellite to 12 computer base stations. The base stations are located at five Federal, two State, and five county offices.

Three of the streamflow gages and all of the rain gages transmit real-time data to the computer base stations by use of a VHF-radio link. The other 18 streamflow gages transmit data by satellite and (or) telephone. The base-station computers receive, translate, and store the data, which then are retransmitted to the other base-station computers in the network by UHF terrestrial radio and (or) a satellite link. In addition to real-time streamflow and precipitation data, the base stations exchange weather forecasts, storm watches, and storm warnings. Flood watches and warnings are automatically transmitted to 15 high-risk municipalities (HRM's) from the county base-station computers.

LINKS WITH OTHER SYSTEMS

The PFWS has been linked to the Somerset County Flood Information System (SCFIS) by UHF radio since February 1990, enabling it to monitor storms in Somerset County, N.J., as well. The SCFIS consists of 23 streamflow and 19 rain gages located throughout Somerset County, 1 rain gage in Morris County and 1 rain gage in Union County. These gages are linked to a computer base station located in the Somerset County Engineering Division in the Somerset County Administration Building in Somerville, N.J.

BENEFITS OF THE PASSAIC FLOOD WARNING SYSTEM

The PFWS provides valuable information that benefits the residents of the Passaic River Basin, the State of New Jersey, and Federal agencies that regulate and monitor the County's waterways.

- The hydrologic data collected aids the NWS in developing timely and accurate flood forecasts.

- The availability of real-time stream-stage and precipitation data along with the NWS severe weather and flood forecasts, watches, and warnings allow the State, county, and HRM's to develop efficient emergency evacuation procedures.

- The real-time stream-stage data could be used in conjunction with other time-of-travel data as part of an early response system for hazardous waste spills. Such a system would give emergency-response agencies and water-supply utilities a tool to plan actions in accordance with the location of the spill.

- Real-time knowledge of stream-stage can allow commercial business and industry to take actions to reduce inventory and structural losses during a storm event.

- The hydrologic data collected can be used to optimize the design and operation of dams, levees, bridges, and water- and wastewater-treatment facilities.

- The hydrologic data collected can be used to plan future public water supplies, assist in monitoring water quality, and aid in the assessment of the effects of environmental regulations.

- The public and private sectors can utilize the data for development and environmental concerns.

REFERENCES CITED

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- William M. Summer

For Additional Information Contact:

- **U.S. Geological Survey**

District Chief
U.S. Geological Survey
810 Bear Tavern Road
West Trenton, NJ 08628
(609) 771-3900
(609) 771-3915 (FAX)

USGS "Home Page":
http://www.usgs.gov

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