

**Report to the Governor:
Recommendations of the Passaic River Basin Flood Advisory Commission**

January 2011



Passaic River Basin Flood Advisory Commission
NJDEP Commissioner Bob Martin, Chairman

Passaic River Basin Flood Advisory Commission

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EXECUTIVE SUMMARY

Overview of Advisory Commission Recommendations and Costs

The Passaic River Basin Flood Advisory Commission has put together a realistic package of recommendations (15 recommendations in total) that will help to minimize the impact of flooding in the Passaic River Basin. There is no “silver bullet” that will solve the flooding in the Basin, especially for the 10- to 100-year flooding events. The Advisory Commission also acknowledges that none of its recommendations can change the reality of the Passaic River Basin: floodplains will continue to flood in this basin, as they do in all comparable basins. A package of small and large solutions must therefore be the path to a comprehensive, though not perfect plan for the mitigation of flood damage in the Passaic River Basin.

The continued development in the Passaic River Basin floodplains over the past 100 years has continued to compound an already long-term problem. The reality is that state and local governments have allowed development to continue in these floodplains, and so the consequences of flooding have become more severe and comprehensive flood mitigation more difficult. An additional reality is that any of the “big” solutions (e.g., a massive flood tunnel) will cost the federal government and the state billions of dollars—expenses that neither will embrace readily.

Recommendations

The Advisory Commission is making 15 recommendations as a comprehensive package to minimize the impact of flooding in the Passaic River Basin. Implementation of all of these recommendations can begin immediately.

1. Federal and State Floodway and Floodplain Property Acquisitions

The Advisory Commission recommends expanding and expediting floodway property buyouts. The close coordination of the NJDEP and NJOEM to effectively leverage available state Blue Acre funds with FEMA funds should continue to prioritize structures in those areas of the floodplains most susceptible to regular, chronic flooding.

2. Structure Elevations in Floodplains

The Advisory Commission believes that home elevation projects in flood prone areas should be encouraged if acquisition is not an option to either the homeowner or the municipality. The Advisory Commission recommends that a new, state-funded grant and/or low-interest loan program be established to effectively leverage available FEMA mitigation funds.

3. Federal Open Space Acquisition and Preservation

The Advisory Commission supports federal and state efforts to prevent Passaic River Basin flooding from increasing through flood storage area preservation. This would require the acquisition of undeveloped land, in some cases through condemnation, to increase flood storage areas.

4. Improved Operation of the Pompton Lakes Dam Floodgates

NJDEP will request that the U.S. Army Corps of Engineers (USACE) obtain the services of an independent consultant to undertake a more robust unsteady flow hydraulic model to evaluate the gate operation and downstream flow patterns. The goal is to minimize downstream flooding.

5. Desnagging and Shoal Dredging

The removal of flow constrictors such as fallen trees and sediment shoals may provide reductions in floodwater elevations by facilitating river flow and should become a routine activity. The large number of constrictions that have been identified initially by the most active municipality, Pompton Lakes, indicates that a systematic annual removal program may provide at least very localized relief to some floodplain residents.

6. Feeder Dam Removal

In order to provide some level of flood mitigation and relief to the communities of Pompton Lakes, Wayne and Pequannock, which are situated upstream of the Pompton and Pequannock Feeder Dams, it is recommended that these structures be removed.

7. State Adoption of National Flood Insurance Program Regulations

The New Jersey Department of Community Affairs should adopt the National Flood Insurance Program (NFIP) regulations in their entirety. State adoption of the NFIP regulations means that all state agency requirements would be at a minimum consistent with local flood damage prevention ordinance requirements, and would eliminate the risk of FEMA suspending its flood insurance program in New Jersey, as it has repeatedly threatened to do.

8. Expedited NJDEP Permit Process to allow towns to clear trees and repair river walls and shoals

The Advisory Commission recommends that the towns have the ability to quickly obtain a permit to be able to desnag and remove debris, to repair retaining walls and to remove shoals with a flexible permitting process. The NJDEP must develop a process to allow permits-by-rule or online general permits to accomplish this.

9. Improved Effectiveness of County and Local Emergency Response Plans

The NJOEM analysis indicated that further planning and training with the Red Cross for sheltering, planning for flash-flooding particularly in areas such as Woodland Park and Little Falls, and consistent use of the Reverse 911 System by county OEMs across the State to notify the municipal coordinators will improve implementation of the Emergency Operation Plans.

10. Enhanced Passaic River Flood Warning System

The Advisory Commission, assisted by its NJOEM members, recommends the implementation of a list of specific future actions to enhance flood management response in the Passaic River Basin. Additional stream gage data will enable earlier warning to NJOEM, towns and the public.

11. Inundation Mapping

The Advisory Commission supports the NJOEM proposal to contract with the National Weather Service (NWS) to create inundation maps for any NWS forecast point in the Passaic River Basin. Inundation maps provide critical information to emergency management officials, enabling greater flood preparedness and quicker action with flood projections. These maps enable emergency management officials and residents to see where the potential threat of flood waters is highest. Digital geospatial flood-inundation maps that show flood water extent and depth on the land surface are powerful tools for flood response and damage and loss mitigation.

12. Enhanced Public Involvement, Information and Outreach for Flood Response

The Advisory Commission learned from its public process that the NJDEP and the municipalities need to provide regular forums to the public, to explain the technicalities of the Passaic River flooding and of potential flood mitigation actions. The public needs to be informed with regularity what flood control projects are being planned and implemented, or why projects are not being considered. These meetings need to occur between flood events, not solely on the heels of flood events, so that the discussions can be more deliberate and less confrontational.

13. Reevaluation Request to U. S. Army Corps of Engineers

The Advisory Commission recommends that New Jersey submit a reevaluation request to the United States Army Corps of Engineers to study and analyze larger potential engineering projects for long-term flood damage reduction. This primarily includes levees and floodwalls, but would also include updating the cost/benefit analysis for a flood tunnel.

14. Updated Flood Risk Mapping

The majority of existing floodplain mapping within the Passaic River Basin is generally over three decades old. As such, most of the existing floodplain mapping is considered to be outdated or simply consists of approximate mapping with no detailed modeling available. NJDEP has already initiated this process and the Advisory Committee recommends the completion of this process.

15. Moratorium on All New Development within the Floodplain

Municipalities within the Passaic River Basin should pursue flood risk reduction changes to their existing Master Plans, their existing zoning ordinances and their existing local flood damage prevention ordinances. The goal of these changes is to reduce negative impacts from future flooding by guiding development away from the floodplains or by completely phasing out and preventing any future development in these high risk-prone areas.

Costs

The costs to implement all these recommendations vary significantly. The Advisory Commission has broken these cost demands into three categories:

- No funding required
- Adequate funding is available to begin implementation, but further funding may be required later
- Long-term significant Federal and State funding required

Five (of the 15) recommendations require no Federal or State Funding and can begin implementation immediately. They include:

- State adoption of National Flood Insurance Program regulations
- Expediting the DEP permit process to allow towns to clear trees and shoals and to repair retaining walls
- Improving the effectiveness of county and local emergency response plans
- Enhancing public involvement, information, and outreach for flood response
- Establishing a moratorium on all new development in the floodplain

Eight (of the 15) recommendations have adequate funding available to begin the implementation immediately, but may require additional State and Federal funding. They include:

- Improving the operation of the Pompton Lakes Dam Floodgates. The \$120,000 required to conduct this study can be funded through an existing General Fund capital appropriation.
- Desnagging and shoal dredging. This annual cost of about \$1.5 million can be started immediately and is supported through available balances in the 2003 Dam, Lake, Stream and Flood Control Bond Fund. Current available funds would cover years one and two, and General Funds annually would be required after that.
- Feeder Dam Removals. This one-time cost of about \$1.2 million can be covered by available CBT Parks Capital funding.
- Flood Warning System. Recommended improvements to the system will cost about \$295,000 and can be funded through the 2003 Dam, Lake, Stream and Flood Control Bond Fund.
- Inundation Mapping. This mapping will cost about \$500,000 and will be funded with remaining 1978 Emergency Flood Control Bond Fund.
- Flood Risk Mapping. This \$4 million cost is being covered by a grant from FEMA.
- Open Space Acquisition and Protection. Federal funding of about \$22 million is available. The State cost would be zero because New Jersey can apply Passaic River Wetlands Bank credits as a match to federal funding, but would require federal condemnation of open space properties.
- US Army Corps of Engineers Reevaluation Study. This reevaluation would cost \$15 million with a 50/50 Federal/State split. The NJDEP and Corps currently

The final two (of the 15) recommendations will require significant—and in the case of buying out floodplain properties, very significant costs. These long-term recommendations include:

- Floodway and Floodplain Buyouts. New Jersey has about \$8 million available today from the 2007 Blue Acres Bond Fund and \$24 million authorized in the 2009 Blue Acres Fund. This is insignificant compared to the projected \$3.4 billion cost of the buyouts in the 10-year floodplain, which assumes that all property owners in the floodplain are willing sellers. The Federal cost would be \$2.55 billion, while the State's share would be \$850 million. Federal appropriations would be required.
- Structure Elevations in Floodplains. This would cost about \$200 million, assuming the willing participation of all affected homeowners, with the Federal cost being \$150 million and the State's portion being \$50 million. FEMA grants are available to towns to begin this process.

Total costs, including the big ticket items for floodplain buyouts and structure elevations, are summarized in Table 1 below. Funding for these large projects will require significant support from New Jersey's Congressional delegation.

Passaic River Basin Flood Advisory Commission
Table 1 - Recommendation Overview

Recommendation	Funding Resource Needs		
	State ¹	Federal	Total
1 Floodway and Floodplain Buyouts	\$850,000,000	\$2,550,000,000	\$3,400,000,000
2 Structure Elevations in Floodplains	\$50,000,000	\$150,000,000	\$200,000,000
3 Open Space Acquisition and Preservation	\$0	\$22,100,000	\$22,100,000
4 Pompton Lake Dam Floodgate Performance and Modifications	\$120,000	\$0	\$120,000
5 Desnagging and Shoal Dredging	\$3,000,000	\$0	\$3,000,000
6 Feeder Dam Removals	\$1,250,000	\$0	\$1,250,000
7 State Adoption of the NFIP	\$0	\$0	\$0
8 Permit Expedition for Desnagging and Shoal Dredging	\$0	\$0	\$0
9 Emergency Preparedness and Response	\$0	\$0	\$0
10 Flood Warning System	\$295,000	\$0	\$295,000
11 Inundation Mapping	\$500,000	\$0	\$500,000
12 Public Outreach	\$0	\$0	\$0
13 USACE Reevaluation Study	\$7,500,000	\$7,500,000	\$15,000,000
14 Flood Risk Mapping	\$0	\$20,000,000	\$20,000,000
15 Moratorium on All New Development in Floodplain	\$0	\$0	\$0
Totals	\$912,665,000	\$2,749,600,000	\$3,662,265,000

¹ Floodway and Floodplain Buyouts: Assumes buyout of structures only within the 10-year floodplain. Total cost is based on 25% state share of federal funding of the \$3.4 billion dollar number that is the USACE estimate from 1995 adjusted for inflation to 2010. FEMA hazard mitigation funding cost share could be either 10% or 25%, while ACOE cost share is 35%.

Structure Elevations in Floodplain: Assumes elevation of structures between the 10-year and 25-year floodplain. Total cost is based on \$100,000 per structure and 2000 structures.

Pompton Lake Floodgate: Total cost based on \$75k unsteady flow hydraulic study, \$25k computer animation and \$20k flood gage adjustments.

Desnagging & Shoal Dredging: No total cost, assume \$1.5 million per year indefinitely.

Feeder Dam Removal: Totals cost is based upon the required engineering and construction costs for decommissioning of these structures.

Emergency Preparedness: Total cost is based upon \$35k upgrade of USGS gage 01389005, \$50k for raising two gages and installing phone service at eight gages, \$72k to modify rating curves at specific gages, and \$138 to install or reactivate gages.

Inundation Mapping: Total cost based \$500k for preparation of basin-wide inundation mapping.

USACE Reevaluation: Total cost is based 50% state cost share of ACOE estimate of \$15 million study.

I INTRODUCTION

A Authorization for Advisory Commission

Governor Chris Christie created the Passaic River Basin Flood Advisory Commission (“Advisory Commission”) by Executive Order 23 (Appendix A) on April 23, 2010 following to the severe nor'easter of March 12-15, 2010 and its flooding of the Central Passaic River basin. The Governor appointed Commissioner Bob Martin of the New Jersey Department of Environmental Protection (NJDEP) as the chairperson of the Advisory Commission. The Executive Order specified that the Advisory Commission also would include the Superintendent of the State Police or his designee; two mayors from municipalities in the basin; one state legislator representing municipalities in the basin; and two technical experts with relevant expertise.

Selected for the Advisory Commission were Assemblyman Scott Rumana of District 40; Mayor Katie Cole of Pompton Lakes and Mayor Mike DeFrancisci of Little Falls; Robert Prezant, Ph.D. of Montclair State University; and water resource engineer John Miller, P.E., CFM, CSM. In addition, New Jersey State Police Superintendent Col. Rick Fuentes designated Captain Chris Schulz and SFC Bob Little of the Office of Emergency Management as his representatives to the Commission.

The Executive Order directed the Advisory Commission to identify short-term and long-term recommendations to enhance flood mitigation efforts, emergency response planning, and the streamlining of regulatory and policy requirements that impede post-flooding recovery.

The Advisory Commission's charge included providing recommendations to the Governor regarding:

- a. expanding and expediting Passaic River floodway property buyouts; strategically prioritizing land acquisition and leveraging State Blue Acres funding with Federal Emergency Management Agency and United States Army Corps of Engineers funding;
- b. acquiring natural flood storage areas and restoring or creating wetlands;
- c. operating the Pompton Lakes Dam floodgates;
- d. clearing the rivers of debris and sediments that reduce their carrying capacities;
- e. evaluating existing state regulatory programs for opportunities to expedite emergency permitting; streamlining technical requirements; increasing interagency coordination and consistency; increasing available financial assistance;
- f. reviewing the status and effectiveness of county and local emergency response plans;
- g. evaluating enhancements to the Passaic River Flood Warning System;
- h. enhancing public involvement, information, and outreach for flood response;
- i. reinvigorating the United States Army Corps of Engineers study and analysis of potential engineering projects for long-term flood damage reduction;

- j. evaluating historical river characteristics to identify changes to the river system to better understand, predict, and respond to changes in flood patterns; and
- k. identifying methods, including Master Plan and zoning changes, for municipalities to phase out or prevent future development in flood hazard areas.

The Advisory Commission held two public meetings, on July 28, 2010 in Pompton Lakes and on August 18, 2010 in Little Falls, to receive public comments (Appendix B) regarding the flooding and its individually experienced consequences. The Advisory Commission's statements and recommendations consider the Governor's directive and the public's issues and identify funding needs and project timeframes where they could reasonably be determined during its deliberations. In the preparation of this report, the Advisory Commission reviewed available studies and reports; supported NJDEP requests that agencies such as the United States Army Corps of Engineers (USACE) and the United States Geological Survey (USGS) to prepare new reports and reviews; and interviewed experts and staff of agencies including the National Oceanic and Atmospheric Administration's National Weather Service and the USGS. The Advisory Commission was assisted by agencies with responsibilities for flood damage mitigation, flood advisory and warning activities, and expertise relevant to the assessments presented herein.

B Previous Passaic Flooding Reports

Flooding within the Passaic River basin has been studied by the State of New Jersey and the Federal government for more than a century. From 1900 to 1940, the State of New Jersey produced eight comprehensive flood evaluation studies of the Passaic River basin, prompted by the occurrence of major floods within the basin. Major floods are those with extensive inundation, property damage and evacuations of people, and the closure of primary and secondary roads. Moderate floods require closure of secondary roads and property removals to higher elevations. Minor floods cause some public inconvenience with minimal or no property damage. The record flood of 1903 had the highest observed river stage and corresponding discharge during the period of record keeping.

Recommendations from these past reports included the construction of large structural flood control projects such as new flood control dams and reservoirs, the construction of levees and floodwalls, channel modifications and improvements, the construction of a flood tunnel, and various limitations on development within the floodplain. The large flood control reservoir proposals have included Two Bridges, Mountain View, Darlington and Whippanong Reservoirs.

Flood control storage was highlighted in the solutions presented, but none of the proposed dams, reservoirs, or other structural projects that were recommended in the plans to control the flood waters were ever constructed. The main reason for this was local opposition to the extensive and disruptive structural measures. The reports commonly cited control of development within the floodplains as a preferred flood damage mitigation approach. However, the Advisory Commission observes that considerate land use practices were not implemented as the state's population expanded into the area, with extensive residential and commercial intrusion into the floodplain. An

analysis using NJDEP Geographic Information System (GIS) datasets on Land Use/Land Cover from 1995/1997, 2002, and 2007 highlights the cumulative development trends within the floodplain. In approximately 20 years, between 1985 and 2007, the floodplain experienced an estimated 4.5 percent loss of wetlands and an additional 7.5 percent loss of forested areas within the floodplain.

The Flood Control Act of 1936 first authorized the USACE involvement in Passaic River Basin planning. Reports recommending plans of action were issued in the years 1939, 1948, 1962, 1969, 1972, 1973, 1987 and 1995. The technical experts on the Advisory Commission focused particularly on the detailed aspects of the 1987 (Appendix C) and 1995 reports.

Implementation of any of the action plans that have been deemed feasible for the mainstem of the Passaic River has not proceeded due to public objections to the use of the upstream floodplain to protect downstream flood damage areas; the impacts of intensive structural measures, including the flood tunnel, dams, and levees; the high implementation costs; or various other environmental, economic, and social arguments. The many levels of political jurisdiction within the basin have further complicated resolution of the multiple issues surrounding flood risk mitigation planning.

None of the basin-wide comprehensive plans were ever implemented on the main stem, yet projects have been completed in the tributaries to the Passaic River. These flood mitigation projects include channel modifications along Molly Ann's Brook, channel improvements to the Ramapo River upstream of the Pompton Dam, the flood gate installation on the Pompton Lake Dam, and bulkhead construction at the Joseph Minish Waterfront Park in the City of Newark. In addition, construction of levees and floodwalls at Long Hill Township is currently planned and there are also ongoing floodway buyouts and preservation of natural storage areas within the basin. Anticipated projects in the planning or design phases include those in the Lower Saddle River, Passaic River at Harrison, Jackson Brook, Malapardis Brook, Ramapo River at Mahwah and Suffern, and in the Peckman River. The USACE web site (<http://www.nan.usace.army.mil/project/index.php?NJ>) has detailed descriptions of these projects.

C Recent Flooding in Perspective

The Passaic River has seven major tributaries: the Whippany River, the Rockaway River, the Pompton River, the Pequannock River, the Wanaque River, the Ramapo River, and the Saddle River (Appendix D: Passaic River Basin Map).

The Passaic River watershed is an oval-shaped area of about 935 square miles, of which about 84 percent is located in New Jersey and the remainder in New York State. The drainage basin may be divided or described by the following three natural divisions having widely different topographic and hydrologic characteristics:

- The upper section is a mountainous area 10 to 15 miles wide at an average height of 1300 feet above sea level, which is characterized by a series of parallel ridges

- flanking the westerly and northerly limits of the drainage basin; these ridges are deeply dissected by a series of steep-sided transverse valleys which produce relatively extreme high-velocity and high-volume runoff;
- The central section is a crescent-shaped, broad, flat valley, 8 to 12 miles wide and approximately 30 miles long, which lies between the Highlands Region and the Watchung Mountains to the south and east, and which extends from Great Swamp on the south through Chatham to Pompton Lakes in the Pompton Valley on the north;
 - The lower section is between the central section and the river mouth at Newark Bay, and includes the tidal estuary to a few hundred feet downstream of Dundee Dam; the river gradient is slight and broken by grade drops at Little Falls, Great Falls and Dundee Dam.

Land use decisions within the Passaic River basin continue to exacerbate flooding and flood damage. Although development within the basin is not a recent phenomenon and many communities are close to being built-out, encroachment on the floodplain remains a salient issue. NJDEP GIS datasets on Land Use/Land Cover from 1995/1997, 2002, and 2007 provide evidence that continued development is occurring within the floodplain. As the basin is largely developed, these changes in land cover are not necessarily drastic shifts, but demonstrate the cumulative impact of site-by-site exemptions to floodplain regulations.

Between 2002 and 2007, only 17 percent of the land that increased in impervious surface coverage witnessed an increase greater than 50 percent. However, 35 percent of the increases witnessed a 5-10 percent increase in intensity, and these slight alterations can cumulatively increase runoff and sediment loading. In areas that do remain vegetated, development continues to threaten. Between 1985 and 1995, nearly 300 acres of forest turned to urban land—a trend repeated between 1995 and 2002, and again from 2002 to 2007. The result is a 7.5 percent loss of forest cover within the floodplain. Development in the floodplain increases future property losses, threatens the economic stability of communities and puts public health and safety at risk.

Flood damage is highest in the central section of the Passaic River basin, followed by the lower section, because of their extensive development immediately along the streams. The upper section has only limited flooding problems because of the narrowness of the floodplains and steepness of the channel, as well as less intensive development. Floodwater flows to the lower section from the “flashy” streams in the upper section are attenuated by the natural storage within the central section. The central section has had repeated flooding problems because of extensive development in the flood plains, the amount of lowlands and meadowlands, and the flat stream slopes and topography.¹

The October 1903 flood of record resulted in at least a 100-year flood event over most of the basin. In the modern era, the Passaic River at Little Falls has experienced 17 major flooding events since 1955. Major flooding has occurred along the Pompton River eight

¹ Phillips, M.O. & Schopp, R.D, 1986, Flood of April 5-7, 1984 in Northeastern New Jersey: U.S. Geological Survey Open-File Report 86-423W, p.112 (Appendix E)

times in the past 42 years (National Weather Service-Advanced Hydraulics Prediction Service). Some of the more recent floods in 1968, 1971, 1972, 1973, two in 1975, 1984, 1992, 1999, 2005, 2007 and 2010 were sufficiently devastating to warrant Federal Disaster declarations.²

Minor and moderate floods have occurred repeatedly within the Passaic River basin over the past 55 years. The Passaic River at Little Falls has reached flood stages 32 times since 1955. The storm of October 7-12, 1903 caused one of the worst floods in the history of the Passaic River basin. This storm followed three months of excessive rainfall, which left the ground saturated. The basin's maximum rainfall recorded was 15.5 inches in Paterson, New Jersey. The average rainfall over the Passaic River basin was 11.4 inches. No other flood event since 1903 has exceeded the flood stages experienced within the basin during that event.

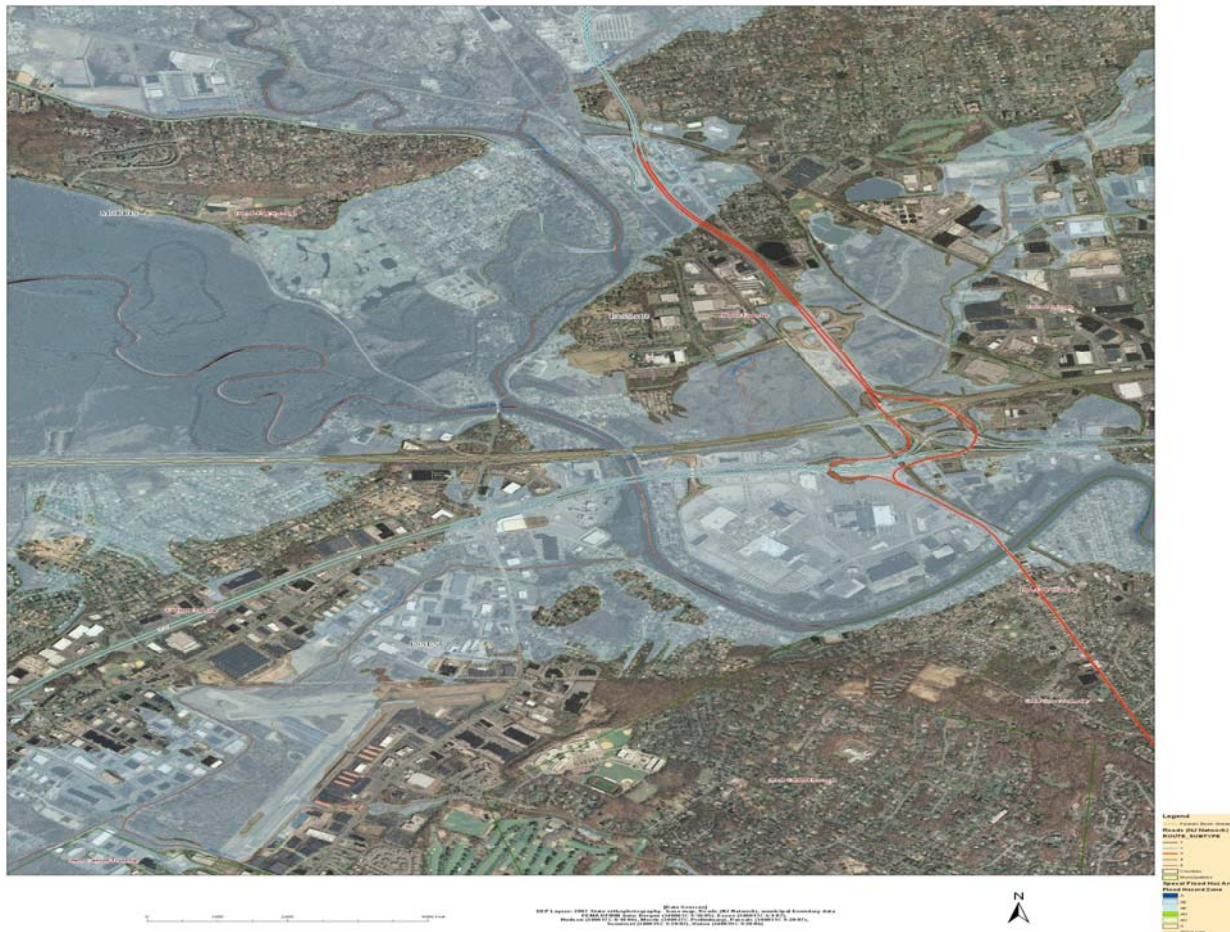
In contrast, the March 12-15, 2010 nor'easter produced 3.5 to 4.3 inches in the Passaic and Hackensack River basins. Precipitation was higher than normal in the month of February and in the 12 months leading up to March 2010. Snowmelt contributed to increasing stream flows at many stream gages in the northern part of the State for a period of 10 days to two weeks before this storm (USGS Summary) (Appendix F). The peak discharges on the Passaic River were 15,800 cubic feet second (cfs) at Little Falls. In comparison, the peak discharges on the Passaic River at Little Falls during the 1903 event were 31,700 cfs and 18,400 cfs during the 1984 event (USACE, December 1987)³ (Appendix C). The Ramapo River at Mahwah and Pompton River at Pompton Plains each experienced about 40-year events while the Passaic River stream gages along the main stem experienced from 20-year to 30-year events, as did the Rockaway River, Green Pond Brook, Ringwood creek, and Wanaque River tributaries (USGS).

As previously mentioned, flooding has most recently occurred along the Pompton and Passaic Rivers in March 2010, April 2007, October 2005, April 2005, and September 1999. During Tropical Storm Floyd in September 1999, over \$328 million in flooding damages (in October 2009 dollars) occurred. In April 2007, the Passaic River basin was struck by a nor'easter which caused significant flooding, \$729 million in damages (in October 2009 dollars), the evacuation of about 5,000 people, and loss of life. Higher safety standards regulated through the Flood Hazard Area Control Action Rules (N.J.A.C 7:13) have set important restrictions on more recent building, redevelopment and reuse in the floodplain. Now and especially in the future, these rules will provide economic benefits by minimizing damages. Floodplain standards, above the minimum required by the Federal Emergency Management Agency (FEMA), have proven effective in making communities more resilient to flooding.

² U.S. Army Corps of Engineers, July 2010, Pompton Lake Dam March 12-15, 2010 Nor'easter Post Flood Report: U.S. Army Corps of Engineers New York District, 32 p. (Appendix G)

³ U.S. Army Corps of Engineers, December 1987, Flood Protection Feasibility Main Stem Passaic River: Volume 1. (Appendix C)

PASSAIC RIVER BASIN FLOOD ADVISORY COMMISSION MAP - LOWER WAYNE TWP



II ADVISORY COMMISSION STATEMENTS AND RECOMMENDATIONS

The Advisory Commission's statements and recommendations with accompanying explanatory background aim to clarify the flood issues and to present to the Governor realistic flood damage reduction measures that the State of New Jersey may choose to pursue. Short-term and long-term actions have been evaluated and recommended or rejected. Some considered actions will require further engineering studies before implementation, if implementation is shown to be economically and technically feasible.

The Advisory Commission has put together a realistic package of recommendations that will help to minimize the impact of flooding in the Passaic River Basin. There is no “silver bullet” that will solve the flooding in the Basin, especially for the 30- to 100-year flooding events. The Advisory Commission acknowledges that none of its recommendations can change the reality of the Passaic River Basin: floodplains will continue to flood in this basin, as they do in all comparable basins. The continued development in the Passaic River Basin floodplain over the past 100 years has continued to compound an already long-term problem. The reality is that state and local governments have allowed development to continue in floodplains, and so the consequences of flooding have become more severe and comprehensive flood mitigation more elusive. The other reality is that any of the “big” solutions will cost the federal government and the state billions of dollars—expenses that neither will embrace readily. A package of small and large solutions must therefore be the path to an optimal, but not perfect, mitigation of flood damage in the Passaic River basin.

The Advisory Commission, which by Executive Order ends its service on December 31, 2010, must rely on the priorities of the Governor, NJDEP, the New Jersey Office of Emergency Management (NJOEM) and the local governments to advance the Advisory Commission's recommendations for the benefit of the residents in the floodplains. And the residents in the floodplains must participate in the programs that have been designed to reduce their flood risks and their costs of flood recovery.

The Advisory Commission initially focused on the communities from the area just upstream of the confluences of the Ramapo, Pequannock, and Wanaque Rivers to just downstream of the Pompton and Passaic Rivers. The NJDEP's and public's concern for the operation of the floodgates at the dam in Pompton Lakes directed this focus. The Advisory Commission also surveyed 26 municipalities with the highest repetitive loss claims to FEMA's National Flood Insurance Program (NFIP) for flood and floodplain information to guide its deliberations. As the Advisory Commission expires, it looks to the NJDEP and NJOEM to expand the survey to the other 93 municipalities and to use the information to develop stream segment-specific actions.

1. Federal and State Floodway and Floodplain Property Acquisitions

Statement

Given that the most effective flood mitigation measure would have been not to have allowed development in the floodplain, the Advisory Commission recognizes that the removal of commercial and residential structures from the floodway and other floodplain areas should be given the highest priority by all agencies and municipalities. We recommend that New Jersey strategically prioritize land acquisitions and leverage state Blue Acres with Federal Emergency Management Agency and United States Army Corps of Engineers funding. The Advisory Commission acknowledges that this mitigation approach raises local concern as it will negatively and immediately impact the tax revenues of the municipalities, but expects that the loss to the municipalities will be at least partially offset by the decrease in emergency and other local services provided for these properties. A study on the actual economic impacts of this mitigation strategy could demonstrate the savings and assuage local concerns for tax base loss. These property removals also will significantly decrease the repetitive costs that FEMA's NFIP must absorb with the repetitive flood damage claims from these property owners.

Recommendation

The Advisory Commission recommends expanding and expediting floodway property buyouts. The close coordination of the NJDEP and NJOEM to effectively leverage available state Blue Acre funds with FEMA funds should continue to prioritize structures in those areas of the floodplains most susceptible to regular, chronic flooding. State agencies must be mindful of the unpredictability of future flooding given that climate change and potential changes in weather patterns could influence the expansion of flood zones. New Jersey should adopt a strategy of acquisition of certain properties within these areas that are contiguous to tracts of public land already designated as open space. Monies made available from the Green Acres, Water Supply and Floodplain Protection, and Farmland and Historic Preservation of 2009 should be appropriated.

Federal Cost	\$2.55 billion required for buyout to the 10-year floodplain (75% of \$3.4 billion)
State Cost	\$850 million required for leverage of federal dollars and for state buyout projects.
Funding	New Jersey has about \$8 million available today from the 2007 Blue Acres Bond Fund and \$24 million authorized in the 2009 Blue Acres Fund.
Schedule	Ongoing

Background

New Jersey, and the Passaic River basin in particular, has an extremely high number of Severe Repetitive Loss and Repetitive Loss properties in comparison with the rest of the United States. FEMA works closely with New Jersey to reduce those numbers through its Hazard Mitigation Grants. The Advisory Commission recognizes the value of these programs and supports FEMA and NJOEM's continuation of these efforts.

New Jersey has established a program to acquire, from willing sellers, those properties in the floodways of the coastlines, rivers, and tributaries around the state that are prone to flooding and to dedicate those lands that are purchased for open space uses, such as recreation and conservation. Property acquisition is only one method of hazard mitigation, but it is the most effective and most permanent, removing people from the flood zone. Because buyouts are strictly voluntary and no homeowners are ever forced to relinquish their property, state condemnation is not an option. In a property acquisition project, the State purchases private property and removes all buildings from it. By law, that property, which is then public property, must forever remain open space. The community can use it to create public parks, wildlife refuges, etc., but the land cannot be sold to private individuals nor be developed in unapproved ways. Property acquisition is the primary opportunity for people who live on or near hazard areas to relocate to safer ground. The state and the communities work together to identify areas where buyouts make the most sense and are cost effective. Since 1993, participating communities with FEMA have purchased more than 20,000 properties nationwide to prevent future damages.

The community must support the application for a property to be purchased with FEMA Hazard Mitigation Grant Program (Appendix H) funds, yet little literature or research currently exists to guide local officials on this issue. For many communities buyouts present a concern with tax base loss. A study that examines the economic costs and benefits of this strategy could provide relief to New Jersey municipalities that currently are forced to weigh budgetary concerns with the safety and well-being of floodplain residents who experience repetitive flood losses. Understanding the actual implications of tax base loss within flood-prone areas may reduce resistance to this proposed mitigation strategy within the Passaic River Basin.

Buyouts are an important way to reduce the risk of future disasters, however, federal dollars are limited and in most cases the amount of money set aside for mitigation cannot meet all the mitigation needs following a disaster. States prioritize mitigation programs with input from the communities and the use of a 'Benefit Cost Analysis' tool. For this reason, New Jersey has developed a partnership between two agencies in an effort to make mitigation funding go further. The NJOEM Hazard Mitigation Office and the NJDEP Green Acres and Blue Acres Programs have combined federal and state flood mitigation funding to do just that. This partnership has allowed NJDEP to fund more projects than anticipated by using state-appropriated monies for the non-federal match on FEMA Severe Repetitive Loss, Flood Mitigation Assistance, or Pre-Disaster Mitigation acquisition grant projects, and provides communities and homeowners with 100 percent of the appraised value of their homes. New Jersey's Green and Blue Acres funds are allotted for the creation of open space, so acquisition projects are the single form of mitigation eligible for this federal-state partnership.

FEMA uses four non-disaster grants and one grant opened after a Presidential Disaster Declaration to continue to provide funding for many types of hazard mitigation projects, including acquisition and elevation of residences. New Jersey has worked diligently in the development, application, and administration of these grants over the years. The

NJOEM spearheaded this process by promoting the all-hazards mitigation planning that makes communities eligible for these grant programs. Recent property acquisition projects funded through these FEMA Hazard Mitigation Grants include 183 homes in Wayne, 31 homes in Lincoln Park, 10 homes in Little Falls, and 6 homes in Pompton Lakes.

The Advisory Commission Buyout Memorandum of August 30, 2010 (Appendix I) complements the program commitments of New Jersey's Hazard Mitigation process. The memorandum outlines findings from the 1995 USACE Buyout Study (Appendix J) that recommended a planned approach to cost-effective buyouts in high-risk areas in the Region, since all structures within a floodway do not experience the same level of vulnerability to flood damage. The state agencies must work closely with communities and private citizens to develop a comprehensive plan of acquiring the properties of willing owners in a manner, and at a rate, that does not hinder the municipality's ability to function economically.

Acquisition projects must have the approval and cooperation of the municipality. Acquisition or buyout projects, while 75-, 90-, or 100-percent funded by FEMA, are administered by the state and municipalities, working together to identify areas where buyouts make the most sense. Individuals may not apply directly to the State, but the community may sponsor an application on the owner's behalf.

Buyouts of approximately 800 residential properties within the existing floodway, on the current Flood Insurance Rate Maps, would cost an estimated \$0.3 billion. These properties are usually those contiguous to the waterway and experience the most frequent damages from flooding on a regular basis. Within the Passaic River basin, the floodway is relatively narrow and contains a limited number of structures.

Buyouts of approximately 6,300 residential properties in the 10-year floodplain would cost an estimated \$3.4 billion. A cost-effective strategy for implementation of a combination of acquisition and elevation projects is the Advisory Commission's recommendation. New Jersey should focus on acquisition, from willing owners, of any property within this portion of the flood plain.

Table 2
Floodway/10-Year Floodplain Buyouts

Buyout Plan	Buyout Costs	Approximate Number of Structures
10-year Floodplain Buyouts	\$3,400,000,000	6,300
Floodway Buyouts	\$300,000,000	800

The above table listing numbers of structures and associates costs are based upon the two 1995 USACE buyout studies⁴ (Appendices J & K). The original 1995 cost estimates have been updated using an inflation adjuster to 2010 figures.

2 Structure Elevations in Floodplains

Statement

The Advisory Commission understands that to ask floodplain residents to volunteer for government home acquisition programs and to expect communities to radically alter their tax bases by supporting those programs is not always desirable or feasible. In many communities, structure elevations are an alternative to preserve those homes, communities, and municipalities without the hardships that buyouts may cause. Elevation does, however, preclude the use of the properties as future flood water storage area or for placement of structural flood control projects. No state funding is currently available to elevate structures or to leverage the federal FEMA dollars available to elevate structures; this must be rectified.

Recommendations

NJOEM has requested and the Advisory Commission concurs that New Jersey should fund a mitigation program to provide structure elevation for homes in the floodplain. The Advisory Commission believes that removing structures from flood prone areas is the state's highest priority; elevation projects are encouraged if acquisition is not an option to either the homeowner or the municipality. The Advisory Commission recommends that a new state funded grant and/or low interest loan program be established to effectively leverage available FEMA mitigation funds. The estimated number of homes that should be included in the program at this time is 2000.

Federal Cost	\$150 million required for elevations within the 100-year floodplain
State Cost	\$50 million required for leverage of federal dollars to facilitate state elevations
Funding	FEMA grants are available to towns to begin this process.
Schedule	Ongoing

⁴ Passaic River Buyout Study, US Army Corps of Engineers, September 1995
Passaic River Floodway Buyout Study, US Army Corps of Engineers, October 1995



Elevated Home in Stockton

Background

Although New Jersey maintains the strategy of removing structures from flood prone areas as its highest priority, elevation projects are encouraged if acquisition is not an option. Among the various structure elevation techniques used to meet the required level of protection, the most common are extending the walls upward and raising the lowest floor; converting the existing lower area of the house to non-habitable space and building a new second story for living space; and lifting the entire house with the concrete floor slab attached and building a new foundation to elevate the house. Another mitigation strategy aimed towards improving severe repetitive loss properties includes the reconstruction of the partially or completely demolished structure to an improved, elevated building on the same site as the original structure. Mitigation reconstruction is only permitted if there is evidence that elevation is not a viable option because of structural feasibility.

New Jersey has established a program to elevate properties in the floodways of the coastlines, rivers, and tributaries around the state that are prone to flooding and whose owners are willing. New Jersey has implemented this property elevation program to mitigate those repetitive loss structures that cannot meet the cost benefit threshold through acquisition, or have property owners reluctant to sell. One of the most common retrofitting methods is elevating a house to a required or desired flood protection elevation. When a house is properly elevated, the living area will be above all but the most severe floods, such as the 500-year flood. Communities may apply to FEMA Mitigation Grant Programs, through NJOEM, for funding for elevation projects. Structure elevation is one of many forms of hazard mitigation, but it is the most cost effective way of getting people out of harm's way during flood events. By elevating a home above the Base Flood Elevation, persons and belongings are kept safe from damage or harm during a flood event. Homeowners are still encouraged to leave the area prior to a forecasted high water event, but the peace of mind they are afforded, from knowing their home and belongings will be intact when they return, is priceless. Home elevations are strictly voluntary and no homeowner is ever forced to participate in the program. In structure elevation projects, the community works closely with the homeowners, hires qualified construction companies, and oversees the raising, building, and finishing of the elevation, as well as the temporary housing needs of the property owners. Costs

associated with these responsibilities are all reimbursable through the FEMA mitigation grants coordinated by NJOEM.

In addition to greater peace of mind, advantages to structural elevation include:

- Elevation to, or above, the Base Flood Elevation (BFE) allows a substantially damaged or substantially improved house to be brought into compliance with a community's floodplain management ordinance or law. The Base Flood is a flood having a 1 percent chance of being equaled or exceeded in any given year (commonly referred to as the 100-year flood);
- Elevation reduces the flood risk to the structure and its contents;
- Except where a lower floor is used for storage, elevation eliminates the need to move vulnerable contents to areas above the water level during flooding;
- Elevation techniques are well known, and qualified contractors are often readily available;
- Elevation reduces the physical, financial, and emotional strain that accompanies floods;
- Elevation provides homeowners with additional parking and storage space within their home;
- Elevation often reduces flood insurance premiums.

FEMA uses four non-disaster grants and one grant opened after a Presidential Disaster Declaration to continue to provide funding for many types of hazard mitigation projects, including acquisition and elevation of residences. New Jersey has worked diligently in the development, application, and administration of those grants over the years. Recent property elevation projects funded through these FEMA Hazard Mitigation Grants include eight elevations in Fairfield Township and 39 in Little Falls. These grants represent the few Passaic River Basin elevations within the statewide program of elevations. Elevation project applications, due in part to their appeal to municipalities as an alternative to acquisition, have shown a surge in New Jersey with an anticipation of significantly larger number of projects in the near future.

3. Federal Open Space Acquisition and Preservation

Statement

The Advisory Commission supports federal and state efforts to prevent Passaic River Basin flooding from increasing through flood storage area preservation. The USACE has identified approximately 5,350 acres of natural flood storage areas for future purchase and maintenance as undeveloped open space. This effort will also enhance groundwater recharge of stormwater and limit additional construction in high-risk flood areas.

Recommendation

Unlike the state process for the acquisition of residential and commercial properties, the USACE open space acquisition program can use condemnation if voluntary sales are not forthcoming. Due to the current purchase impasse with several major property owners, the NJDEP needs to coordinate with the USACE on the development of a condemnation

plan to acquire, preserve and maintain the identified lands. The Advisory Commission would like New Jersey's Congressional delegation to become involved to facilitate moving the condemnations through the federal approval process.

Federal Cost	\$22.1 million (October 2003 dollars)
State Cost	Acquisitions have <u>no cost</u> to the state when applying Passaic River wetlands bank credits as match to federal funding
Funding	NJDEP has \$8,000,000 of credit remaining with USACE
Schedule	Immediately



Background

The USACE has been working on plans to reduce flooding in the basin since 1936, but no comprehensive plan has yet been implemented. The US Congress authorized a new study of the Passaic River Basin for the State of New Jersey in the Water Resources Development Act (WRDA) of 1976 (Public Law 94-587) (Appendix L) which led to a plan authorized in WRDA 1990 and modified in WRDA 1992, WRDA 1996, and WRDA 2000.

The element described herein is the Preservation of Natural Flood Storage Areas, which NJDEP asked the USACE to implement. The Preservation element includes the acquisition of approximately 5,350 acres of natural storage areas, 5,200 acres of which are wetlands and could conceivably be developed, resulting in worsening the existing flood problems. NJDEP has agreed to continue to protect 6,300 floodway acres, thus avoiding any secondary development. About 9,500 acres of the Central Basin are already protected as designated parkland, bringing the total of natural flood storage areas that would be permanently protected with the project to 21,000 acres. The Preservation element will prevent flood damages from becoming worse, but will not reduce flooding in the Passaic River basin. The cost sharing is set at 75 percent federal and 25 percent state. NJDEP, as non-federal sponsor, may reduce its share by applying credits included in the authorization.

The General Design Memorandum for the element was completed in July 1996 and the NDJEP requested that the USACE proceed with its implementation at a current cost of

\$22.1 million (October 2003 dollars). The USACE and NJDEP executed a Project Cooperation Agreement in June 1999 for purchasing the natural flood storage lands. To date, more than 3,440 acres have been acquired in fee, by conservation easement, or already held under state protection. The USACE plans to acquire lands with completion funds received in FY10, continue its development of a condemnation process, update property appraisals, and send new offers to all the landowners.

In 2004 the USACE and the NJDEP met to discuss the need to condemn certain properties due to reaching an impasse with several property owners, usually over price rather than willingness to sell. The NJDEP in October 2004 agreed that the condemnation process was needed and the USACE proceeded to notify owners that eminent domain was being implemented. The USACE has had extensive internal dialogue concerning the appropriateness of condemning these properties. The USACE has encouragement that the condemnation packages will be approved and forwarded to the Justice Department for filing. This will improve the rate of property acquisition, and therefore advance the preservation of flood storage area in the basin. To be clear, this condemnation process will only be used for vacant property acquisition, not developed properties.

4 Improved Operation of the Pompton Lakes Dam Floodgates

Statement

Currently available information used by the USACE preliminarily indicates that the floodgates performed as designed during the March 2010 flood, protecting the upstream Oakland community, without adversely affecting the communities downstream. The volume of water from upstream of the dam would have caused significant flooding in the downstream communities where flooding was observed regardless of the presence or absence of the floodgates. Public and local professional observations of unanticipated, downstream water surges during floodgate operations give reason to continue to evaluate refinements in the opening and closing procedures. Floodgate operations should not be modified until the recommended, additional data is available for review.

Recommendation

NJDEP should request the USACE to obtain the services of an independent consultant to undertake a more robust unsteady flow hydraulic model, including HEC-RAS⁵ and/or HEC-ResSim⁶, to evaluate the gate operation and downstream flow patterns. Based on the improved modeling, computer animations should be developed to assist in public outreach to the downstream communities to increase public understanding of the mechanics of the gate operation and water flow.

⁵ The U.S. Army Corps of Engineers River Analysis System (Hec-RAS) is software that allows you to perform one-dimensional steady and unsteady flow river hydraulic calculations.

⁶ The U.S. Army Corps of Engineers Reservoir System Simulation (HEC-ResSim) program has been developed by the Hydrologic Engineering Center of the US Army Corps of Engineers to aid engineers and planners performing water resources studies in predicting the behavior of reservoirs and to help reservoir operators plan releases in real-time during day-to-day and emergency operations.

If subsequent analyses indicate a measurable benefit to downstream communities, NJDEP, USACE, and NJDWSC should implement alternative operational plans that can be incorporated into the gate operation. As requested by various local emergency management offices, NJDEP should work with USGS to increase flood gage readings from every 15 minutes to every 5 minutes and to install a camera at the Dawes Avenue gage to accurately record flow observations.

Federal Cost No Cost

State Cost \$120,000 for an independent consultant to perform a more robust unsteady flow hydraulic modeling to evaluate the gate operation and downstream flow patterns; create graphic animations of gate operation and water flow for public outreach; to increase frequency of flood gage readings from 15 minutes to 5 minutes; and to install a camera at Dawes Avenue gage to record flow observations

Funding This study can be funded through an existing General Fund capital appropriation

Schedule 6 months to 1 year



Floodgates and Dam on Ramapo River at Pompton Lakes

Background

The Pompton floodgates located within Bergen and Passaic Counties provides a 40-year level of flood protection to approximately 300 homes along the Ramapo River within the Borough of Oakland. The project consisted of installing two floodgates at Pompton Lake Dam, as well as widening and deepening approximately one mile of the Ramapo River upstream of Pompton Lake.

The USACE, in partnership with the NJDEP, permitted and managed construction of the project. On August 1, 2007, under the terms of the Project Cooperation Agreement, the NJDEP assumed all responsibility for maintaining and operating the completed floodgate facility. The North Jersey District Water Supply Commission (NJDWSC) performs

operation and maintenance tasks at the floodgates facility on behalf of and at the expense of the NJDEP.

One of the primary causes of flooding within the Pompton Floodgates project area had been due to water backing up behind Pompton Lake Dam during high river flow. This caused developed areas at the upper end of the lake to be flooded on a frequent basis. During the design phase of the project, it was determined that the most efficient way to correct this problem was to replace a 90-foot section of the existing Pompton Lake Dam with a structure containing two 18-foot-high by 35-foot-long steel floodgates.

The floodgates are designed to regulate water releases from the dam to provide flood damage reduction benefits to structures upstream of the dam, as well as to maintain the existing water supply capabilities of the lake. Regulation of water releases to prevent upstream damages is unique, in that the majority of flood damage reduction dams are used to prevent downstream damages. Because of this, the operational requirements for the Pompton Lake Dam floodgates are quite different from conventional flood control structures.

To provide the maximum flood reduction benefits to upstream residences, while at the same time not increasing downstream flooding, a customized computer system automatically operates the floodgates in strict accordance with operating procedures developed by the USACE. These operating procedures were developed to maintain the lake below an elevation that would have caused flooding within Oakland before the project was constructed.

The automated system reads the lake level at 15-minute intervals. When the lake rises to approximately 1.5 feet above its normal level, the floodgates open 3 inches. Depending upon how quickly the lake level is rising, the floodgates will open in concert on 3-, 6-, or 12-inch intervals. The computer will continue to read the lake level every 15 minutes and raise, lower, or maintain the gate height accordingly. After the initial flood wave has passed, the system will begin to close the gates. The length of time the gates will remain open will vary from a few hours to several days, depending upon the intensity of the particular flood event.

In response to the March 2010 flood, NJDEP requested that the USACE undertake a post-flood report on the operation of the floodgates facility at Pompton Lake Dam. The report was completed in July 2010 (Appendix G). The report concluded that the operation of the floodgates during the March 2010 flood had no significant impact downstream of Pompton Lake Dam. A minor, 214 cubic feet-per-second increase in discharge in the river attributed to the operation of the gates resulted in a 0.25-foot increase in the peak flood stage immediately downstream of the river. A less than 0.10-foot increase in the flood height on the Ramapo River at Dawes Highway was negligible and within the USACE model's margin of accuracy. With the volume of water flowing through the upstream drainage area, significant flooding would have occurred throughout the downstream communities regardless of gate operations. The effect of the gate operations on the timing of peak flows downstream of the floodgates, ranging from 1.5 to

3.25 hours from what would have occurred without the gates, is not considered a significant hazard increase in an event that lasts several days.

While some members of the Advisory Commission were critical of the USACE's findings and thus the Advisory Commission overall believes that a more robust independent hydraulic analysis recommended in this report would confirm and clarify the actual minimal downstream consequences of the gate operation.

5. Desnagging and Shoal Dredging

Statement

The removal of flow constrictors such as fallen trees and sediment shoals may provide reductions in floodwater elevations by facilitating river flow. The large number of constrictions that have been identified by initially the most active municipality, Pompton Lakes, indicates that a systematic removal program may provide at least very localized relief to some floodplain residents. There should be no expectation, however, that the main stem flooding that will be experienced in a March 2010 storm event will be significantly mitigated by these activities.

Recommendation

The stewardship of the Passaic River tributaries through desnagging and shoal dredging should become a routine activity, especially targeting areas of river constrictions, such as at bridges and culverts. Ancillary projects such as stream bank stabilization should be conducted to decrease the frequency of tree falls and to interrupt the sediment scouring and deposition cycle. Contracting could be managed either by the NJDEP or through direct state funding to the municipalities. NJDEP should explore the cost efficiencies of one contract for an area versus individual municipal contracts.

Federal Cost	No Cost
State Cost	\$1,500,000 for the first year and \$1,500,000 each subsequent year
Funding	This can be started immediately and is supported through available balances in the 2003 Dam, lake, Stream and Flood Control Bond fund. Current available funds would cover years one and two, and General Funds annually would be required after that.
Schedule	Immediately

WANAQUE RIVER OBSTRUCTION AND HAZARD PLAN

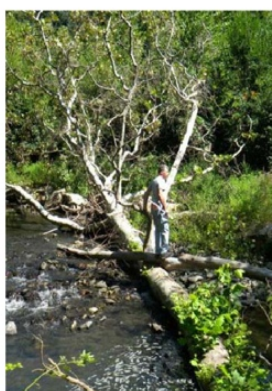


LEGEND

NORTH ←

- D DOWNED TREE**
- L LEANING TREE**
- S SHOAL / HEAVY SILT DEPOSIT**
- E ERODED AREAS IN NEED OF STABILIZATION**

NOTE: PHOTOS REPRESENT TYPICAL PROBLEM CONDITIONS



① DOWNED TREE ALONG WANAQUE RIVER



② SHOAL AND DOWNED TREE ALONG WANAQUE RIVER

Background

One of the primary functions of the Passaic River system is to carry floodwaters from the upper reaches of the basin down to its outlet in Newark Bay. This function is often impeded or compromised by natural or human causes. Trees age and die or have their roots undermined by erosion and fall into the river channels. Debris such as shopping carts, abandoned boats, docks, and trash are deposited into the channels intentionally or accidentally. Erosion and natural sediment transport occur, creating shoals and sand bars; often the river naturally meanders over time. All of these occurrences reduce the hydraulic capacity of the stream channel to carry floodwaters.

In 1986 municipalities performed clearing of the Pompton River and Beaver Dam Brook. The municipalities of Pequannock, Lincoln Park and Wayne signed agreements with a contractor to clear approximately six miles of the Pompton River and almost one mile of the Ramapo River. State funding of \$800,000 for these projects was administered by NJDEP. These three local projects removed sediments and debris that accumulated in the river during and subsequent to the April 1984 flood. Such projects may partially mitigate local effects of the nuisance floods that occur several times each year (i.e., floods with frequencies greater or equal to the annual event). The maintenance of the rivers and future needs are dependent on how many floods may occur during a year.

The Advisory Commission requested each of the 26 municipalities with the highest repetitive flood damage to present the status of the river system in their respective communities. Only Wayne and Pompton Lakes identified sections of the rivers that need maintenance stream cleaning. A copy of Pompton Lakes' Waterway Assessment Presentation (Appendix M) is included as an attachment to this report and will be used by NJDEP as a model as it seeks similar information from municipalities throughout the Passaic River Basin.

6. Feeder Dam Removal

Statement

The Pompton and Pequannock Feeder Dams are located on the Ramapo River and the Pequannock River, respectively, within Wayne Township, Passaic County and Pequannock Township, Morris County. The existence of these obstructions creates backwater or an increase to the water surface during normal and rain events along both the Pequannock River and the Ramapo River just upstream of the dams.

Recommendation

In order to provide some level of flood mitigation and relief to the communities of Pompton Lakes, Wayne and Pequannock, which are situated upstream of the Pompton and Pequannock Feeder Dams, it is recommended that these structures be removed and the dams be permanently taken out of service.

Federal Cost	No Cost
State Cost	\$1,250,000
Funding	This one-time cost of about \$1.2 million can be covered by available CBT Parks Capital funding.
Schedule	Two years for engineering and construction



Pompton River



Pequannock River

Background

The Pompton and Pequannock Dams consist of a combination of concrete overflow gravity structures constructed across the Ramapo River and Pequannock River, respectively, with an earthen dike embankment connecting the two structures. The Pompton overflow spillway is 270 feet long, the Pequannock overflow spillway is 300 feet long, and the earthen embankment connecting the two is about 1,500 feet long. These dams are located approximately 1,600 feet upstream of the confluence of both rivers, which join to form the Pompton River.

Both the spillways and the earthen dike embankment are owned, operated and maintained by the NJDEP Division of Parks and Forestry and are located within the Ramapo Mountain State Forest area. The structures are considered to be significant (Class II) hazard potential dams⁷. The Pompton and Pequannock Dams were constructed in 1928, to replace the old Morris Canal Dam that was used to supply water to the old Morris Canal.

The NJDEP has not pursued the removal of these dams in the past since both structures are already submerged during the 10-year, 10-percent-annual-chance flood event and above. Because of the high tail water conditions⁸ in this area, the NJDEP has only applied for a dam repair permit to undertake limited tree removal, bank stabilization and repairs of the concrete structures. If dam removal is pursued, it is understood that it would have only minimal flood mitigation benefits for flood events that are less than the 10-year flood.

Potential problems associated with the removal of these dams include the significant sediment accumulation upstream from both dams, which would need to be removed since

⁷ As per the NJ Dam Safety Standards (N.J.A.C. 7:20), Class II – Significant Hazard Potential classification includes those dams, the failure of which may cause significant damage to property and project operation, but loss of human life is not envisioned. This classification applies to predominantly rural, agricultural areas, where dam failure may damage isolated homes, major highways or railroads or cause interruption of service of relatively important public utilities.

⁸ Tailwater is water along the river below the dam.

both of the dams are run of the river structures⁹. In addition, there are public access issues and historical preservation issues since this dam was once part of the old Morris Canal Dam.

7. State Adoption of National Flood Insurance Program Regulations

Statement

Some building rehabilitation and construction in New Jersey is not fully compliant with FEMA requirements under the National Flood Insurance Program. Flood damaged structures are rebuilt in the same location without meeting the minimum standards of the NFIP. This can exacerbate future flooding and does not maximize the ability to reduce flood risks.

Recommendation

The New Jersey Department of Community Affairs should adopt the National Flood Insurance Program regulations in their entirety. State adoption of the NFIP regulations means that state agency requirements would be at a minimum consistent with local flood damage prevention ordinance requirements. Also, the state should provide technical assistance to communities that wish to adopt more stringent flood risk reduction regulatory standards.

Federal Cost	No Cost
State Cost	No Cost
Funding	None Required
Schedule	Immediate

Background

New Jersey is among the top four states in the United States for the number of repetitive flood loss (RL) and severe repetitive flood loss (SRL) properties, as designated by FEMA. This keeps the public at risk of loss of life and property damage, is an economic handicap to property owners and government, creates a financial drain on the NFIP and keeps premiums high for all policyholders nationwide. FEMA has a high national priority to reduce the numbers of repetitive loss properties.

Local Floodplain Administrators, who often have dual roles as building and code officials, are charged through local ordinances with enforcing NFIP requirements. In addition, the adoption of higher flood risk reduction regulatory standards is promoted by the NFIP and the Community Rating System (CRS). The Community Rating System (CRS) is a voluntary incentive program (similar to a “Good Driver” auto insurance program) that recognizes and encourages community floodplain management activities that exceed the minimum NFIP requirements. As a result, flood insurance premium rates are discounted to reflect the reduced flood risk resulting from the community actions.

⁹ Run-of-the-River dam is a dam built across a river or stream for the purposes of impounding water where the impoundment at normal flow levels is completely within the banks and all flow passes directly over the entire dam structure within the banks, excluding abutments, to a natural channel downstream.

Often, Local Floodplain Administrators lack the training and experience required to fully understand the NFIP requirements, to identify whether proposed construction is located in a floodplain and if the proposed renovation or expansion is a substantial improvement, or how to perform substantial damage inspections. Compounding this problem is the frequent turnover of this position. Substantial damage declarations are key to ending the flood-rebuild-flood cycle of repetitive loss. Damage is substantial when the cost of restoring a structure to its pre-damaged condition would equal or exceed 50 percent of the market value of the structure before the damage occurred. Substantial improvement means any reconstruction, rehabilitation, addition or other improvement to a structure, the total cost of which equals or exceeds 50 percent of the market value of the structure before the start of construction of the improvement.

NJDEP should provide training to local officials in floodplain administration and in doing substantial improvement evaluations for building permits and substantial damage inspections after a flood. Training should be provided through the New Jersey Department of Community Affairs (NJDEP) code official licensure and continuing education program and through FEMA's Emergency Management Institute (EMI) in Emmitsburg, MD. EMI is a highly regarded instructional facility and provides training at minimal cost to local officials. Tuition, travel, and lodging are paid by EMI (trainees must pay only meal tickets). Once trained, the official's administration as a local floodplain manager can be evaluated during Community Assistance Visits/Contacts (CAV/CAC) conducted by the NFIP Coordinator's office in the NJDEP. Local floodplain administration is required for a community to enter the NFIP. Additionally, the national Association of State Floodplain Managers (ASFPM) administers a Certified Floodplain Manager (CFM) program. Local officials that serve in the position of Local Floodplain Administrator should be encouraged or even required to obtain the CFM designation. Alternatively, local officials that enforce a local flood damage prevention ordinance should be required to be licensed in floodplain management through the NJDEP licensure program. This would ensure a minimum level of knowledge and understanding of the NFIP requirements.

Local construction permits should not be issued until prior approval, called a floodplain development permit, by the Local Floodplain Administrator has been obtained. This prior approval must be in writing and ensure that the project fulfills the requirements of the NFIP. After a flood, the Local Floodplain Administrator should perform substantial damage inspections.

Enforcement of the Local Floodplain Administrator's responsibilities under the NFIP should be a coordinated effort between the community, the NFIP Coordinator's office within NJDEP, FEMA, and NJDEP. Instances of violations of local ordinance or state law, such as unpermitted fill in the regulated floodway shall be dealt with immediately and forcefully. Illegal actions by property owners have known downstream consequences that should not be tolerated.

8. Expedite NJDEP Permit Process to allow towns to clear trees and repair river walls and shoals.

Statement

Towns must have the ability to quickly obtain a permit to be able to desnag and remove debris, to repair river walls and to remove shoals with a flexible permitting process. NJDEP needs to develop a process to allow permit by rules or on-line general rules to accomplish this.

Recommendation

The NJDEP should review its existing regulatory process and adopt flexible regulations to allow towns to quickly permit to clear trees, repair river walls, remove shoals, and engage in other stream cleaning and flood control measures. The NJDEP should establish procedures so that permit applications for stream cleaning and flood control within the Passaic River Basin are handled on an expedited basis. The NJDEP also should engage in outreach to impacted municipalities so that they understand the regulatory process, how best to obtain expedited approvals, and their ability to engage in certain activities with no or minimal oversight.

Federal Cost	No Cost
State Cost	No Cost
Funding	None Required
Schedule	Immediate

Background

One of the primary functions of the Passaic River system is to carry floodwaters from the upper reaches of the basin down to its outlet in Newark Bay. This function is often impeded or compromised by natural or human causes. Trees age and die or have their roots undermined by erosion and fall into the river channels. Debris such as shopping carts, abandoned boats, docks, and trash are deposited into the channels intentionally or accidentally. Erosion and natural sediment transport occur, creating shoals and sand bars; often the river naturally meanders over time. All of these occurrences reduce the hydraulic capacity of the stream channel to carry floodwaters.

During the public hearing process, many municipal officials indicated to the Advisory Commission that the NJDEP permit process delays communities from undertaking much-needed stream maintenance activities. The removal of flow constrictors such as fallen trees and sediment shoals may provide reductions in floodwater elevations by facilitating river flow.

While the NJDEP already has adopted permit-by-rule and general permit provisions for many stream cleaning and desnagging activities, these rules may still be too prescriptive and should be reviewed through stakeholder processes to determine whether further flexibility should be provided. Also, given the serious nature of flooding in the Passaic River Basin, any application for a permit should be handled on an expedited basis.

9. Improved Effectiveness of County and Local Emergency Response Plans

Statement

The Advisory Commission has reviewed the analysis performed by the NJOEM of four major areas of concern to the offices of emergency management during the March 2010 flooding in the Passaic River basin: Situation, Operations & Control, Responsibilities, and Administration. Within the four areas, the NJOEM-facilitated discussion between the state, county, and municipal offices of emergency management considered Alert/Warning/Communications, Evacuation, Sheltering, Public Information, Damage Assessment, and Mitigation. The Advisory Commission accepts the conclusion of the NJOEM analysis that current local Emergency Operation plans are adequate for the flood events that have been recently experienced.

Recommendation

The NJOEM analysis indicated that further planning and training with the Red Cross for sheltering, planning for flash-flooding particularly in areas such as Woodland Park and Little Falls, and consistent use of the Reverse 911 System by county OEMs to notify the municipal coordinators will improve implementation of the Emergency Operation Plans.

Federal Cost	No Cost
State Costs	Existing Program Cost
Funding	Emergency Management Program Grant (EMPG ¹⁰) & collaboration between NJOEM Field Training Unit and Red Cross
Schedule	By July 2011

Background

The NJOEM will continue its training and exercising with the American Red Cross and collaborate on project proposals which would fund additional American Red Cross Shelter Manager Training Courses and a on a Regional Shelter Exercise using the UASI Shelter Trailers.

The NJOEM North Region coordinated meetings with the NJOEM Public Information Officer and representatives within the Passaic River Basin to discuss the NJ Alert System. The NJ Alert System is a free system, similar to the Reverse 911 System, which can send text and email message alerts for public information or emergency action. The NJ Alert System is not a replacement for any existing Reverse 911 Systems, but a supplementary system to provide redundancy in the jurisdictions' communications systems. The NJ Alert System could be used within the Passaic River Basin to quickly notify residents and businesses of impending floods.

The NJOEM North Region conducted two presentations on the NJ Alert System in Passaic County. The first presentation on September 9, 2010, included Little Falls and Woodland Park OEMs specifically to address the flash flood planning. The second presentation was provided on October 21, 2010 at the Passaic County Municipal

¹⁰ Emergency Management Program Grant is a 50-50% Federal Grant and is responsible for much of the NJOEM budget.

Coordinator/County Local Emergency Planning Committee (LEPC) Meeting. The meeting included all the Passaic County municipal OEM coordinators and the Passaic County LEPC members.

On December 9, 2010, the NJOEM provided another presentation on the NJ Alert System to the municipal OEM coordinators at Essex County's Municipal Coordinators Meeting. Presently, Essex County does not have a county-wide Reverse 911 System and the NJ Alert System would be a cost-effective first step to enhance Essex County's Alert/Warning & Communications capabilities. At the time of this report, the NJOEM North Region is working with Morris County OEM to schedule a presentation of the NJ Alert System to the municipal OEM coordinators in Morris County.

10. Enhanced Passaic River Flood Warning System

Statement

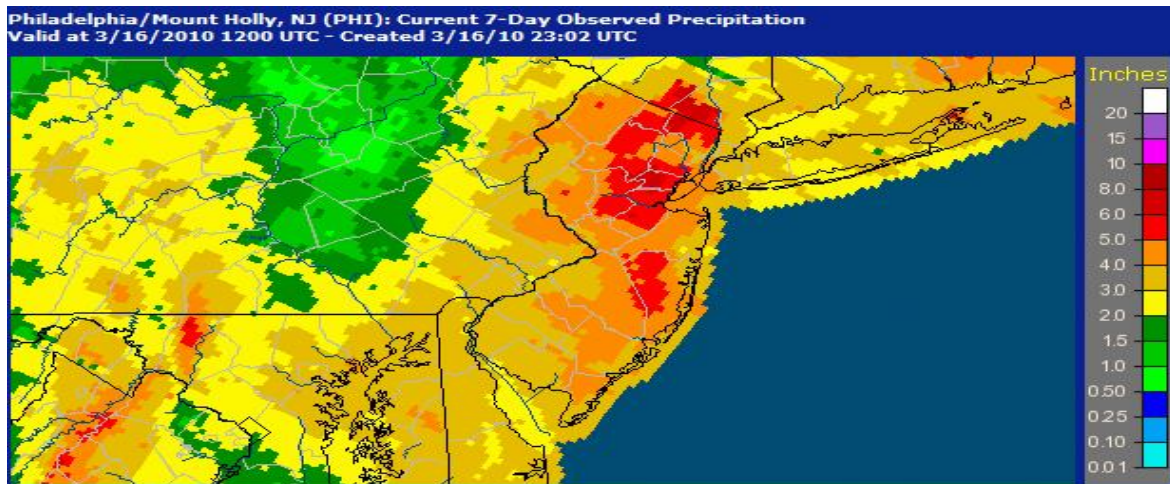
The USACE operates and maintains the Passaic River Flood Warning System (PFWS) through an Economy Act Agreement with the National Oceanographic and Atmospheric Administration-National Weather Service (NOAA-NWS) and other federal and state agencies. The PFWS protects the 935 square mile flood basin with 132 communities in New Jersey and Orange and Rockland Counties in New York. The system integrates information from precipitation and flow gage data for mitigation activities for emergency response officials within high risk communities. The system provides 24/7 operational support hardware and computer software.

Recommendation

The Advisory Commission, assisted by its NJOEM members, has compiled the following list of specific future actions, the planning for which is already in progress. The Advisory Commission recognizes the importance of these actions to flood management and response in the Passaic River basin, and therefore recommends an appropriate state effort to ensure their completion.

- a. NJOEM should use the Meteorological Model-based Ensemble Forecast System (MMEFS) when it becomes available. This forecast system will produce probabilistic hydrologic forecasts out to seven days from the current three days. A Customer Advisory Board is now reviewing the already constructed system, which may be available as experimental in early 2011.

Federal Cost	No Cost
State Cost	Not yet determined
Funding	Not yet determined
Schedule	By July 2011



- b. Upgrade USGS Gage 01389005 Passaic River below Pompton River at Two Bridges to allow the station to be a NWS flood forecast point.

Federal Cost	No Cost
State Cost	\$35,000
Funding	Funded through the 2003 Dam, Lake, Stream and Flood control Bond Fund
Schedule	Six months



Ramapo River at Pompton Lakes gage, old gage upstream

- c. All gages in the basin should be operated to USGS standard, which would require hardening of the NWS gages. Ensure the gage shelf (maximum operable level of gage) is higher than either 125 percent of the existing record flow or the 500-year flood stage, whichever is greater. Ensure each gage has a redundant phone line or other communication pathway as well as primary satellite communications. USGS typically installs and maintains these gages using cooperator funds.

Federal Cost	No Cost
State Cost	\$50,000 for raising two gages and installing phone service at eight gages
Funding	Funded through the 2003 Dam, Lake, Stream and Flood Control Bond Fund
Schedule	One year



Gage on S.B. Raritan River at Four Bridges; a traffic control box raised on a pipe, above flood stage

- d. Modify rating curves at USGS Gage 01381900 Passaic River at Pine Brook, 01387000 Wanaque River at Wanaque, 01387500 Ramapo River at Mahwah, 01388000 Ramapo River at Pompton Lake, 01388500 Pompton River at Pompton Plains, and 01389500 Passaic River at Little Falls.

Federal Cost	No Cost
State Cost	\$72,000

Funding	Funded through the 2003 Dam, Lake, Stream and Flood Control Bond Fund
Schedule	One Year

- e. Install or reactivate the following USGS gages: reactivate 01388910 Pompton River at US202, 0182800 Pequannock River at Riverdale, 01392500 Second River at Belleville, and 01378690 Passaic River near Bernardsville; install 013388700 Beaver Dam Brook at Comly Road in Lincoln Park, and 01382380 Charlotteburg Reservoir at Charlotteburg.

Federal Cost	No Cost
State Cost	\$138,000
Funding	Funded through the 2003 Dam, Lake, Stream and Flood Control Bond Fund
Schedule	One Year

Background

The NJOEM works in close coordination with the USGS, the USACE, the NJDEP, the National Weather Service (NWS), the County OEMs, and the State Climatologist on flood warning systems statewide. The NJOEM's primary charge is the readiness of the State Emergency Operations Center, and coordination of the four phases of Emergency Management: mitigation, preparedness, response and recovery. While NJOEM is not the lead for oversight of flood warning systems throughout the state, it does utilize data from these systems to monitor and provide watch and warning alerts to emergency services communities and emergency operations centers.

The Passaic River Basin Flood Warning System (PRBFWS) is one of several flood warning systems in New Jersey. The system contains gages operated and maintained by USGS, some of which are viewable via the NWS's Advanced Hydrologic Prediction Service (<http://water.weather.gov/ahps2/index.php?wfo=phi>). An additional set of gages are maintained locally by Jay Jonach Associates for Lincoln Park Borough. Each system is a standalone, however, all are monitored by multiple sources and available through multiple means. In addition to the PRBFWS, there are the following:

- The NJ Tide Telemetry System (NJTTS) – A series of USGS tide and weather gages located around the coast of the State where tides are experienced, from Bergen County to Cape May County, and around through Delaware Bay and up the Delaware River to Mercer County.
- Somerset County Flood Warning System – A series of USGS river and precipitation gages located on waterways within the County.
- The Burlington County Flood Warning System – A series of USGS river and precipitation gages located in key locations in the County.
- The Pascack Brook Flood Warning System – A series of USGS river and precipitation gages located along the reach of the Pascack Brook.
- The Rahway River Basin Flood Warning System – A series of USGS river and precipitation gages located in the Rahway River Basin.

- The Shrewsbury River Flood Warning System – A tide gage warning system owned and operated by Monmouth County, serving ten municipalities along the southern end of Raritan Bay and the Shrewsbury and Navesink Rivers.

The multiple gaging systems, while providing reasonably comprehensive coverage of the state, could be more effective if one system, such as AHPS, USGS or USACE's Advanced Flood Warning System (AFWS), listed all of the gages. In the Passaic River Basin Flood Warning System, the USGS operates and maintains 59 stage gages, of which only 17 are listed on AHPS. Neither the NJTTS nor Shrewsbury sites are on AHPS, and very few of the Somerset and Burlington systems are on AHPS (only NWS forecast points).

All of these systems share several features in common in that as each was designed, the components chosen have been fully compatible with monitoring and transmission systems of the emergency services communities and NWS, USGS, Rutgers and other users. As new gages and systems are designed and built, they will always have the ability to add their data to the collective already being monitored statewide. This is particularly critical for users like the NWS, State Emergency Operation Center and the State Climatologist's Office, which monitor from a statewide perspective.

Perhaps the most well known of all these, and the most universally utilized system, is the NWS Advanced Hydrologic Prediction Service (AHPS). The NWS State Hydrologist coordinates AHPS as part of NWS's product line. On the NWS website, the AHPS page provides an interactive set of menus to drill down to individual gages to get specifics on flood prediction, timing and severity.

The NJOEM will be increasing the use of NWS AHPSmobile and iNWS, and USGS WaterAlert and USGS StreaMail notification technologies, which allow users to be notified on mobile and non-mobile devices via email and text messages directly from NWS and/or USGS monitoring systems.

11. Inundation Mapping

Statement

Inundation maps provide critical information to emergency management officials enabling greater flood preparedness and quicker action with flood projections. These maps enable emergency management officials and residents to see where the potential threat of flood waters is highest. Digital geospatial flood-inundation maps that show flood water extent and depth on the land surface are powerful tools for flood response and damage and loss mitigation.

Recommendation

The Advisory Commission supports the NJOEM proposal to contract with the NWS to create inundation maps for any NWS existing forecast point in the Passaic River basin at a cost estimated between \$14,000 to \$60,000 per point (depending on the amount of hydrology and hydrography data available). Another \$7,500 should be used to create the

necessary links to the gage data and forecasts to allow the maps to be hosted on the Advanced Hydrologic Prediction Service website.

Federal Cost	No Cost
State Cost	\$500,000
Funding	This will be funded with remaining 1978 Emergency Flood Control Bond Fund
Schedule	Two years

Background

Inundation mapping is an evolving technology that improves local decisions and response to impending flooding. With locations in the Passaic River Basin that are influenced by tributary tailwater or backwater, along with the advent of dynamic flood inundation mapping displaying real-time modeling during a storm event, select locations should be considered to implement this newest technology being developed by NOAA-NWS and USGS.

On August 26, 2010, members of NJOEM, NWS, USGS, and John Miller representing the Passaic River Basin Flood Advisory Commission, met to discuss the development of inundation mapping that could be used by responders.

Flood Warning Based on Forecast Points: NWS prepares flood warning forecasts in collaboration with many partners. In the Passaic River basin, NWS uses real time river data taken from gages owned and maintained by USGS and the USACE. NWS plugs this data into forecast models which estimate the amount and level of water flowing in the river, compute how the water will move downstream, and then predict the flow of water at forecast points throughout the forecast period (every six hours, three days out). The results are then posted on the AHPS portion of the Mt. Holly and Upton NWS (<http://water.weather.gov/ahps2/index.php?wfo=phi>).

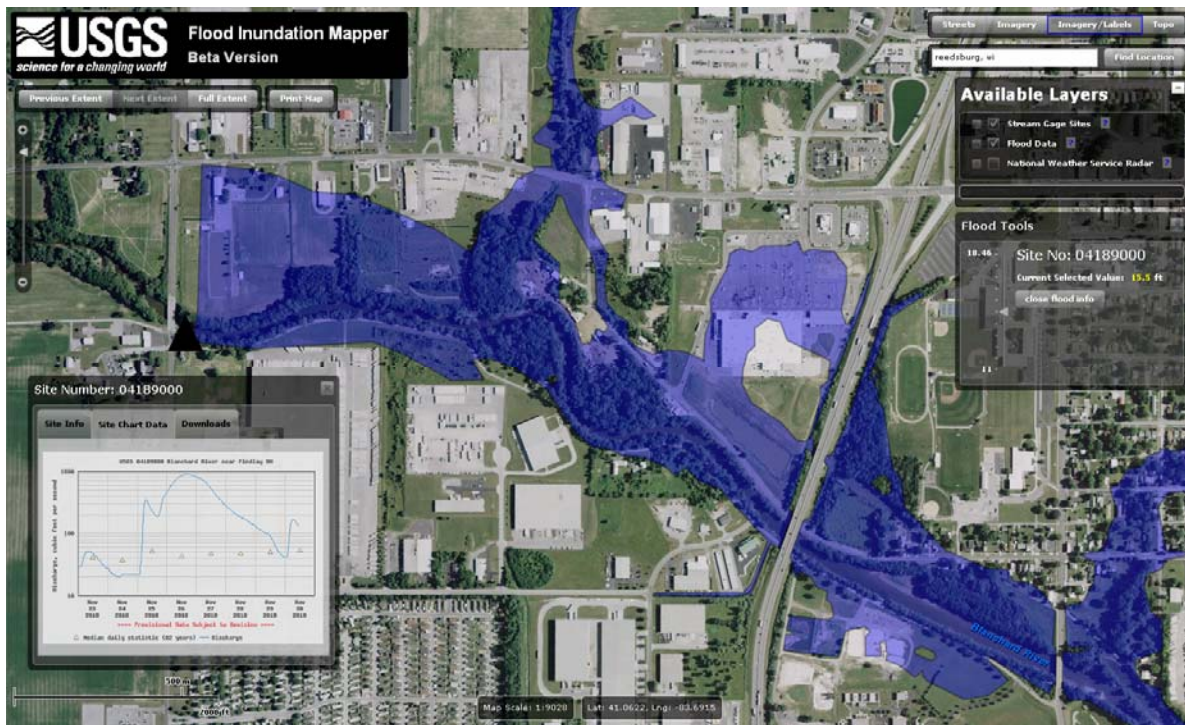
Flood Warning Based on River Reach: There are currently 24 gages linked to AHPS within the Passaic River Basin. Of those, 12 are forecast points where the modeling described above occurs. With the withdrawal of the DIADVisor system, which monitored and provided superior display capabilities for all gages in the PRBFWS, emergency managers and other users have to look in at least three different sites to get a full picture of flood status in the basin. Since the implementation of the AFWS as a standardized national tool, modifications have not been allowed as they were with the state's DIADVisor system. To date, NJOEM requests for bringing back the one-stop shop concept of DIADVisor has received no positive action. The Advisory Commission supports NJOEM's position that a centralized viewing platform that for all flood data is critically important to the state and local offices that must respond to floods.

The current forecast model is only valid for each individual point. On September 15, 2010, NWS added new flood inundation maps to AHPS associated with five forecast points along the Delaware River. The inundation maps provide information on the spatial extent and depth of flood waters in the vicinity of NWS forecast points. First responders

are now able to display flood inundation maps for various levels ranging from minor flooding though and/or above the largest observed flood. They can then make informed decisions for road closures, evacuations and utility shutoffs. The maps, combined with river observations and forecasts, enhance the communication of flood risk, provide users with additional information to better mitigate the impacts of flooding, and build more resilient communities. These inundation maps have been created in other parts of the country, but this is the first time inundation maps have been implemented in the Mid-Atlantic region.

The USGS is in the final stages of producing a library of detailed GIS-derived flood inundation maps for the Saddle River in Lodi, NJ. The maps will outline the extent and depth of flooding at one-foot increments from bankfull (minor flooding) to above the recorded instantaneous peak stage at the USGS stream gage 01391500 Saddle River at Lodi. This gage is also a NWS flood forecast point. The maps will be made available online to the public.

The NJOEM intends to develop web-based flood forecast (inundation) map libraries at NWS flood forecast points and USGS stream gages, especially at river forecast locations in close proximity to high-risk municipalities. A work group made up of USACE, USGS, NWS, NJDEP and NJOEM has been investigating the concept of inundation mapping. Federal funding is used to support the acquisition of LIDAR data on a regular basis, and the updating of mapping put out by NJDEP, FEMA, and USACE. In 2011, NJOEM proposes contributing \$250,000 in federal funds for this purpose.



USGS flood inundation map

12. Enhanced Public Involvement, Information and Outreach for Flood Response

Statement

The Advisory Commission heard the flood-affected communities' concerns at its public meetings in Pompton Lakes and Little Falls in July and August 2010. The NJDEP summarized the public comments at <http://www.nj.gov/dep/passaicriver/>. The categories of comments included localized and basin-wide flood mitigation, funding assistance, and flood emergency response and recovery assistance, and regulatory reform. The Advisory Commission used these public interactions to guide its discussions and recommendations.

What the Advisory Commission learned from this public process was that the NJDEP and the municipalities need to provide regular forums to the public to explain the technicalities of the Passaic River flooding and of potential flood mitigation actions. The public needs to be informed with regularity what flood control projects are being planned and implemented, or why projects are not being considered. These meetings need to be at times between flood events so that the discussions can be more deliberate and less confrontational.

Recommendation

The Advisory Commission suggests that NJDEP attend regularly scheduled municipal council meetings throughout the Passaic River basin to discuss in those forums the flood issues that are of particular concern to particular towns' residents. The Advisory Commission also would like NJDEP to provide informal training for newly elected municipal officials regarding their respective roles and responsibilities in pre- and post-flood activities, including enforcement of their local flood damage prevention ordinances.

Federal Cost	No Cost
State Cost	No Cost, Use Existing Program Funding
Funding	Annual FEMA grant to NJDEP
Schedule	Ongoing beginning January 2011

Background

The Advisory Commission, in suggesting this public outreach, acknowledges that NJDEP already performs significant outreach to communities. Existing NJDEP flood-related community outreach consists of providing technical assistance to municipalities in the adoption and enforcement of floodplain management practices. NJDEP evaluates communities' existing floodplain management programs for conformance with the federally required NFIP standards.

Community Assistance Visits (CAVs) by NJDEP for FEMA are prioritized on an annual basis in consultation with the FEMA Region II office based upon length of time since the previous CAV; size of community and number of flood insurance policies; number of claims and repetitive losses; flood experience; knowledge of the local administrator or existence of a new local administrator; community requests; potential development; and communities interested in joining the Community Rating System program. Community

Assistance Contacts (CACs) by NJDEP occur in towns impacted by recent flooding and with communities that have had little or no program contact in the last 7-10 year period.

Communities participating in the NFIP must adopt and enforce an ordinance that regulates floodplain activities. NJDEP's ordinance assistance includes contacting those communities in need of ordinance updates to explain the process and offer assistance; work with the community through the adoption process; to review draft ordinance revisions; to certify ordinances and compliance; monitor communities to ensure adoption process is on track; and to encourage communities to complete early adoption prior to the 30-day letter being issued.

While the above activities are productive and reach municipal staff, the Passaic Commission believes that contact with the elected and highest level local government officials would benefit municipalities. Periodic meetings would increase flood risk awareness, reinforce the local actions required to participate in the NFIP and provide a forum on recommendations to improve community resilience through mitigation grants and risk-considerate land use practices. An open dialogue between flood events will reinforce the unified efforts by local, state and federal offices to reduce future flood losses.

13. Reevaluation Request to the U.S. Army Corps of Engineers

The NJDEP requested in January 2010 that the USACE initiate a reevaluation of the Passaic River project. At the subsequent establishment of the Advisory Commission and the outset of its deliberations, the NJDEP placed a hold on the request until the Advisory Commission could offer its advice on how the reevaluation could best be used to assist in its recommendations. This section is the Advisory Commission's direction to the NJDEP on how its request to the USACE will best complement the flood mitigation measures that it has proposed.

Summary of the Federal Procedure

The comprehensive USACE Passaic River Basin project was authorized for construction under Section 101(a)(18) of the Water Resources Act (WRDA) of 1990 (Appendix N), as amended in WRDA 1992, 1996, and 2000. As the project was previously authorized for construction, Section 4-1(b) of ER 1105-2-100 allows USACE to undertake a reevaluation study on the basis of that authorization.

Federal funds for the reevaluation are available from the FY2008 and FY2009 Energy and Water Appropriations bills to reevaluate the project for the Passaic Mainstem River Basin in New Jersey and New York. As per ER 1105-2-100 §4.1 (b) dated April 22, 2000, post-authorization change reports are required when conditions of economics, engineering, or environment have changed in the project area. In the 15 years that have passed since completion of the General Design Memorandum (Appendix C) for this project, changes are evident. The purpose of the General Reevaluation Report (GRR) is to reformulate the project similar to the feasibility study process. Since the passage of WRDA 2007 (P.L. 110-114—November 8, 2007), a reevaluation is considered a

“feasibility study” and follows the same principles and guidelines as a feasibility study, including the 50/50 cost-share requirement. The legislation includes the following:

SEC. 2031. WATER RESOURCES PRINCIPLES AND GUIDELINES.

APPLICABILITY.—After the date of issuance of the revisions to the principles and guidelines, the revisions shall apply... to the reevaluation or modification of a water resources project, other than a reevaluation or modification that has been commenced by the Secretary before the date of such issuance.

SEC. 2043. STUDIES AND REPORTS FOR WATER RESOURCES PROJECTS.

FEASIBILITY STUDY.—The term ‘feasibility study’ means a study that results in a feasibility report under section 905, and any associated environmental impact statement and mitigation plan, prepared by the Corps of Engineers for a water resources project. The term includes a study that results in a project implementation report prepared under title VI of the Water Resources Development Act of 2000 (114 Stat. 2680–2694), a general reevaluation report, and a limited reevaluation report.’’.

FEASIBILITY REPORT DEFINED.—In this subsection, the term ‘feasibility report’ means each feasibility report, and any associated environmental impact statement and mitigation plan, prepared by the Corps of Engineers for a water resources project. The term includes a project implementation report prepared under title VI of the Water Resources Development Act of 2000 (114 Stat. 2680–2694), a general reevaluation report, and a limited reevaluation report.’’.

The major changes in this project that have occurred are changes to the basin hydrology and hydraulics and to federal plan formulation guidance, which will have a significant impact on the economic analysis for this reevaluation. Any alternative plan may be selected and recommended for implementation if it has, on balance, net beneficial effects after considering all plan effects, beneficial and adverse, in the four Principles and Guidelines evaluation accounts: National Economic Development, Environmental Quality, Regional Economic Development, and Other Social Effects. In accordance with ER 1105-2-100 § 2-3 (d)(3), dated 22 April 2000, the four accounts are defined as (a) the national economic development account displays changes in the economic value of the national output of goods and services; (b) the environmental quality account displays non-monetary effects on ecological, cultural, and aesthetic resources including the positive and adverse effects of ecosystem restoration plans; (c) the regional economic development (RED) account displays changes in the distribution of regional economic activity (e.g., income and employment); (d) the other social effects (OSE) account displays plan effects on social aspects such as community impacts, health and safety, displacement, energy conservation and others.

The USACE expects to analyze the direct benefit (NED) of flood risk management, in accordance with ER 1105-2-100 § 2-3 (d)(3), dated 22 April 2000, as well benefits ascribed to the other accounts (OSE, RED, and EQ) as described in EC 1105-2-409 § 4.c.3.

The USACE North Atlantic Division approved New York District's request to proceed with a Reevaluation of the Passaic Mainstem River Basin on 27 May 2010. A reevaluation will demonstrate either that the plan authorized for construction by WRDA 1990, as amended, is still the most appropriate plan from an engineering and economical perspective and one that would not have long term negative impact upon the environment or that another plan for flood risk management is more appropriate in the basin.

Ultimately, the final GRR will detail the optimal plan for flood risk management in the Passaic River Basin, based on NED plan criteria. The reevaluation report will serve to document the reevaluation of the recommended plan (including any adjustments or variations of said plan), will provide a basis for a decision on construction authorization of the project (if needed), and will serve as the decision document for execution of a Project Partnership Agreement.

Projects the Advisory Commission Supports for Inclusion in the Request for Reevaluation

Federal Cost	\$7.5 million (50 percent cost-share based on a projected total cost of \$15 million over a maximum of five years)
State Cost	\$1.4 million for year 1 based on 50-50 cost share
Funding	The NJDEP and Corps currently have \$200,000 to begin the study. Future State and Federal funding would be required.
Schedule	Three to five years for the full reevaluation

a. Passaic Flood Tunnel

The Advisory Commission recommends a very limited update of information for this ambitious flood mitigation alternative and that NJDEP carefully monitor the USACE progress. The Advisory Commission doubts that it could ever recommend the proposed flood tunnel given the monumental size and cost of the project, the significant uncertainties in its environmental impacts and in the abilities of the federal and state governments to provide consistent funding necessary for its completion. This latter concern should stimulate the state and local governments to become serious about broad scale design and implementation of property-specific stormwater retention systems to help alleviate localized flooding. NJDEP should limit its cost share to \$300,000 for this part of the reevaluation.

The Advisory Commission offers the following brief description of the proposed flood tunnel to illustrate the complexity of the system and the monumental engineering undertaking it would require. The flood tunnel's maximum inside diameter was proposed for 42 feet, requiring a 45 foot tunnel boring machine (TBM). At the time of the USACE 1995 draft report release, this was just over the largest diameter TBM of record at 40 feet. For comparison, the recently cost-based rejected ARC or Trans-Hudson Rail Tunnels to Manhattan were designed with finished inside diameters of 24 feet, 6 inches.

The flood tunnel would not outlet at grade in Newark Bay. An almost 400-foot deep vertical riser would convey the floodwater discharge to the surface in Newark Bay where

it would release a huge volume of freshwater into this estuarine system. Since this would not be positive drainage, when the flood flow skimmed from the Passaic River ended, the riser and lower section of the tunnel would store water. This water would need to be evacuated to prevent it from going septic; debris removal would also be required. A large dewatering facility is proposed with access to the tunnel below. This would dewater the tunnel in approximately two weeks out of a 42-inch discharge pipe to Newark Bay. Debris and sediment would need to be removed from the Tunnel after dewatering. The tunnel's run under water would have a reverse slope to encourage material to deposit at the low point at the access location landward of Newark Bay. Equipment and workers would be lowered to the tunnel by crane through the work shaft that is on the mainland. The USACE estimated the tunnel would skim floodwater every other year on average.

In its draft report, the USACE estimated annual operation and maintenance of \$2,000,000. The NJDEP experience with USACE cost estimates are that they are usually lower than those actually encountered; though this cost would be borne by the USACE because this project, unlike other flood control projects, would remain under the USACE control and not be turned over to the NJDEP. Under the USACE project authorization NJDEP would be required to obtain all real estate (via easements or purchase) required for the tunnel and all associated structures. This real estate requirement for NJDEP will be part of all elements of the USACE comprehensive plan, including construction of the tunnel, levees, and floodwalls.

The voluminous environmental impact statement (EIS) for the flood tunnel is comprehensive, yet some of it is superficial considering the scope of the project and potential impacts. The Advisory Commission would like the following potential issues more thoroughly evaluated: the loss of water quality affecting biotic systems; the loss of wildlife habitat and issues concerning wetlands replacement; impacts to groundwater recharge as water is unnaturally diverted into Newark Bay; and the loss of recreational opportunities and public access to the waterways. There also is a need for a detailed analysis of possible localized environmental impacts that could arise along the service access routes or dewatering facility that would accompany the tunnel.

Major USACE projects have been important in resolving an array of hydrologic issues. A major project, such as the proposed flood tunnel can lead to the need for subsequent, additional projects. The substantial time (15 years minimum) required for flood tunnel construction, and the unpredictability of the funds which, based on current and projected appropriations to the USACE, will be insufficient to keep that schedule, could be better spent on options that will have shorter-term, if less dramatic, results. All other options under consideration have fewer and less severe environmental concerns, and some, in fact, are beneficial to environmental stability.

b. Beatties Dam

The Advisory Commission recommends that the NJDEP request an analysis of Beatties Dam to be included in a reevaluation study by the USACE, to determine whether there is a federal interest in participating in a flood control project in the vicinity of Beatties Dam. The study will consist of technical analyses of the flood problem and potential solutions

along the Passaic River in the vicinity of Beatties Dam. Hydrologic, hydraulic, and preliminary structural analyses; foundation and material considerations; assessment of environmental effects; cost estimating and economic impacts of alternative flood control plans will be evaluated. All alternatives will include modifications of the Beatties Dam.

Beatties Dam is located on the Passaic River in the Townships of Little Falls and Wayne, Passaic County, New Jersey. This masonry dam has a 267-foot-long spillway with a 152-foot arched center section, a 55-foot straight section on the right, and a 60-foot straight section on the left. The potential project area is 3.2 miles in length, extending along the Passaic River from Beatties Dam to Two Bridges, including the municipalities of Totowa, Little Falls, Wayne, North Caldwell and Fairfield. To assess potential impacts to both downstream and upstream areas, the reevaluation study area will extend along the Passaic River from Dundee Dam upstream to Pine Brook, a distance of 28.3 miles.



Floodwall along Middle Brook in Somerset County



Beatties Dam at Little Falls

Downstream of Beatties Dam

c. Activities from the USACE General Design Memorandum of 1987

The following three plan alternatives all include structural modifications of levees and floodwalls and some combination of non-structural and/or channel modification measures. These options and the flood tunnel in combination with levees and floodwalls described above were investigated as part of the 1987 USACE plan formulation and flood protection feasibility study for the mainstem Passaic River. At that time, the USACE did not prioritize or further pursue these alternatives because it determined that the economic analysis of the flood tunnel alternative produced the maximum excess and net benefits. However, it is possible that some combination of levees, floodwalls and/or non-structural

measures could result in a beneficial project alternative at this time, independent of the flood tunnel. Therefore, future efforts for project evaluations should explore and be concentrated within hotspot areas or in locations of high flood damage occurrences. These areas would include locations of repetitive loss (RL) and/or severe repetitive loss (SRL) properties. At this time, the Advisory Commission recommends that the NJDEP request that an analysis of these alternatives be included in reevaluation study by the USACE:

Levee/Floodwall/Non-Structural consisted of a combination of levees, floodwalls, floodproofing, raising and removal of structures from flood prone areas. The Lower Valley and the Central Basin above the upstream reach of Deepavaal Brook would be protected against a 100-year flood by a levee/floodwall.

In the Pompton Valley and along the Passaic River between Beatties Dam and the upstream limit of Deepavaal Brook, the use of levees and floodwalls to contain the flood flows within the river's banks would constrict the water, and increase flood stages to the point where such works are not economically feasible. They would also increase flooding both upstream and downstream. Therefore, levees and floodwalls by themselves cannot function in these reaches. The only economical measures which would not impact on the features of the rest of the plan were non-structural. In this case, this was the floodproofing, elevation, and evacuation of structures from the area inundated by the 10-year flood along the Pompton, Pequannock, Ramapo and Wanaque Rivers and the Passaic River between Beatties Dam and the upstream limit of Deepavaal Brook.

Levee/Floodwall/Channel Modification was developed to provide a 100-year level of protection for the Passaic mainstem. It encompassed the reaches from the mouth at Newark Bay upstream to Beatties Dam in Little Falls, from Beatties Dam to Chatham and along the Upper Rockaway, Whippany, Pompton, Pequannock, Ramapo and Wanaque Rivers. The Lower Valley reaches would be protected by a series of intermittent levees and floodwalls on the Passaic River combined with the channel modifications which would extend from downstream of Route 3 upstream to Beatties Dam. This Lower Valley portion included approximately 87,300 feet of levees ranging in height from 3.5 to 10.0 feet and approximately 93,600 feet of floodwalls ranging from 4.0 to 10.0 feet in height.

Levee/Floodwall/Non-Structural/Channel Modification included 16.4-mile long channel modification; 10.5 miles of levees; and 5.0 miles of floodwalls. Non-structural measures would only provide protection for the 10-year event. This alternative is a combination of levees, floodwalls, channel modifications and nonstructural measures. The central feature of the plan was the channel modification which extended along the Passaic River from Route 3 upstream to Beatties Dam, a distance of approximately 16.1 miles, and would protect against a 100-year event. The remaining elements in this alternative were identical to the plan described above, with levees and floodwalls along the lower Passaic River downstream of Route 3, and in the Central Basin above the upstream limit of Deepavaal Brook; however, no levee/floodwall systems would be located between Route 3 and Beatties Dam along the lower Passaic River, the location of the channel improvement. These levees again would protect against a 100-year flood. The Pompton

Valley and Passaic River between Beatties Dam and the upper limit of Deepavaal Brook would be protected against a 10-year flood through the floodproofing, elevating, and evacuation of structures.

14. Updated Flood Risk Mapping

Statement

The majority of existing floodplain mapping within the Passaic River Basin is generally over three decades old. As such, most of the existing floodplain mapping is considered to be outdated or simply consists of approximate mapping with no detailed modeling available. In the past, the approximate studies may have been appropriate at certain locations within the basin; however, as a result of increased development, additional detailed studies are warranted at this time. The NJDEP and FEMA had prepared the original hydrologic and hydraulic modeling that is the basis for the existing floodplain mapping.

Recommendation

The NJDEP should pursue the annual funding from FEMA over the expected four-year period and prioritize the appropriate stream segments in the Passaic River basin.

Federal Cost	\$4 million per year
State Cost	No Additional Cost, leverage of existing state resources
Funding	Annual FEMA grant to NJDEP
Schedule	Four years

Background

FEMA Region II is planning to provide the NJDEP with \$4 million in funding per year for the next five years, through their existing Cooperating Technical Partners (CTP) Partnership Agreement. This would fund a completely new program within the NJDEP Office of Engineering and Construction's (OEC) Bureau of Dam Safety and Flood Control which would complement existing flood risk mitigation programs: the NJ State NFIP Coordinators Office; the Community Assistance Program; the Floodplain Mapping Program; and the Flood Control Project Development Program. NJDEP will develop a detailed five-year plan to update and map flood hazard risk areas throughout the state of NJ. Over 30 percent of the state is located within a special flood hazard area, and NJ ranks fifth in the U.S. for the number of flood insurance policies. The tasks for OEC will include:

- Updating existing hydrologic and hydraulic studies and flood risk mapping delineations that are up to 40 years old and in need of revision;
- Performing hydrologic and hydraulic modeling and flood risk mapping delineations for flood hazard areas in developed areas that either are not currently mapped at all or are mapped by approximate methods;
- Performing hydrologic and hydraulic analyses and flood risk mapping delineations to map the NJ Flood Hazard Area Design Flood delineation and

To secure this funding, OEC developed a FY 2010 Mapping Activity Statement (MAS) for FEMA which includes OEC's immediate plan and flood risk mapping goals for use of the first year funding. OEC will initially focus on some of the streams and rivers that are located within the Passaic River Basin, because of its densely populated floodplains and the outdated engineering data underlying the existing floodplain mapping delineations. The basin has experienced the most severe and repetitive flood losses in the state over the past several years.

Included in the FY2011 MAS plan proposal is updating hydrologic and hydraulic modeling and flood risk mapping for a combined approximately 82-mile stream reach. This includes portions of Acid Brook, Buttermilk Falls, Haycock Brook, Mahwah River, Masonicus Brook, Packanack Brook, Pequannock River, Plog Brook, Pompton River, Ramapo River, Third River, Wanaque River and Wolf Creek. These reaches are all located within the Passaic River Basin.

As part of FEMA Risk Mapping, Assessment, and Planning ("Risk MAP")¹¹ (Appendix O) initiatives, a suite of flood risk products will be developed for this project, including: a flood risk report to provide stakeholders with a comprehensive understanding of flood hazard and risk exposure within their community and watershed; a flood risk map that depicts county and community boundaries in relation to areas of risk within the study area; and a flood risk database that will be the primary source to access information collected and developed during the flood risk assessment process. Additional products that may be included that will be useful to municipalities, homeowners, emergency management offices, and insurance companies are a summary of changes to the new FIRM (flood insurance rate map) since the last FIRM; flood depth and analysis grids; flood risk assessments; and the identification of areas of mitigation potential.

¹¹ Risk MAP is a FEMA program that provides communities with flood information and tools they can use to enhance their mitigation plans and better protect their citizens. Through more accurate flood maps, risk assessment tools, and outreach support, Risk MAP builds on Map Modernization and strengthens local ability to make informed decisions about reducing risk.

or by completely phasing out and preventing any future development of these high risk-prone areas.

Federal Cost	No Cost
State Cost	No Cost
Funding	No Funding Required
Schedule	Immediate

Background

Adverse floodplain impacts can be avoided or minimized if communities within the state have the authority, tools, and political will to guide development to less hazard-prone areas. By guiding development away from flood-prone areas, communities and the state protect landowners by requiring that their development activities meet certain standards to avoid flood damages to their properties, and protect the entire community by requiring that those activities do not adversely affect others.

A municipal Master Plan identifies a comprehensive planning and guidance for the long-term strategy of development within a community. Municipal zoning ordinances provide written regulations and laws that define how property in specific geographic zones within the community can or cannot be utilized. Local flood damage prevention ordinances clearly define floodplain management requirements. Phase-out and prevention of future development within high risk flood prone areas can be achieved via a combination of Master Plan, zoning and flood damage prevention ordinance adjustments. Programs such as the Transfer of Development Rights should be evaluated for implementation to direct development from at-risk areas to higher density appropriate development.

III PROJECTS NOT RECOMMENDED

Reservoirs

The USACE, in the General Design Memorandum dated December 1987(Appendix C), evaluated existing and new reservoirs both as a flood damage reduction measure and with consideration to fulfilling water supply objectives. The measures evaluated included: a review of the management and operation of existing reservoirs; investigation of the potential for structural modification of these reservoirs including the raising of the dam structures or their replacement, and/or the dredging or removal of material below the elevation of the existing reservoir beds to increase the storage capacity for flood control or water supply purposes; and the development of new reservoirs, both single and multipurpose, to achieve these objectives.

Several potential reservoir sites and existing reservoirs were evaluated hydrologically to determine their potential flood damage reduction effectiveness by reducing flood flows within their sub-basins. These included the Two Bridges Reservoir and the Darlington Reservoir. All sites had minimal beneficial effects on downstream flood damage areas. There are few developable sites in the Passaic River Basin that are large enough or favorably situated geographically to provide significant flood control benefits at downstream problem areas.

There are possible systems that could be developed utilizing a trade-off of flood control and water supply development. However, the proposed use of reservoir storage was also evaluated by NJIT in 1987, after the 1984 flood in the Passaic Basin. A review of these reports by the Advisory Commission, found that the regulation of existing sub-basin reservoirs for a water supply/floodwater detention trade-off scheme did not produce the significant flow reductions which would be expected for a comprehensive basin-wide plan. In addition, any loss in water supply storage would need to replace the water safe yield lost by the change of purpose. No further recommendation for evaluating reservoir storage should be considered.

Channelization

The purpose of a channel modification alternative is to increase the capacity of the stream channel to contain and move flood flows downstream.

Potential channel modifications, consisting of several configurations including earthen/trapezoidal and/or concrete/rectangular configurations, were evaluated by the USACE under the General Design Memorandum of 1987. The effectiveness of channelization to solve mainstem Passaic River flooding depends upon engineering and economic efficiency, as well as environmental effects. Initially the USCAE under the GDM intended to utilize the 10-year and 50-year flows as design flows for the development of alternative plans. However, more detailed information regarding the capacity of existing channel configurations to contain flood flows, the location and extent of the major damage areas, and the number of structures located in the various floodplains, made it clear that the cost of a 10-year channel and 50-year channel plan for

the Passaic mainstem was in excess of the benefits it would provide. Subsequent investigations by the USACE used the 100-year flood flow as the design flood.

Ultimately, the USACE determined that channelization would not provide mainstem protection without requiring levees and/or floodwalls or removal of structures. In addition, channel modification projects independent of a basin-wide plan will result in elevated flood levels downstream from the area being protected. Because of hydraulic concerns, economics, and environmental reasons, the Advisory Commission cannot recommend channelization as an alternative.

IV ADVISORY COMMISSION CLOSING STATEMENT

During its deliberations, the Advisory Commission invited Gerry Galloway, P.E., Ph.D. of the Water Policy Collaborative, University of Maryland and formerly Brigadier General, United States Army Corps of Engineers, to present his views on the Passaic River flooding. Dr. Galloway served in President Clinton's White House as a senior policy advisor during the flooding of the Mississippi in 1993 and frequently advises governments worldwide on the realities of flooding in the 21st Century.

Dr. Galloway referenced 74 years of attempted flood control, 42 years of flood insurance, continually increasing flood damages, and consistently inadequate flood protection and flood structure maintenance. Changing climate with sea level rise and increases in hurricane intensity, floods, and droughts bring an increasing degree of uncertainty as local, state, and federal government agencies attempt to mitigate flood damage and reduce flood risk. Dr. Galloway pointed to decreasing federal water resource development appropriations at precisely the time when they should be increasing significantly to repair and maintain existing infrastructure, notwithstanding additional flood control structures previously planned and designed nationwide. The approach to flooding has necessarily changed from structural flood control to structural and nonstructural flood damage reduction to comprehensive flood risk management.

Flood risk management is a complex array of shared responsibilities which reduces the initial risk to a residual risk. Policy development and risk communication, building codes and land use controls, hydraulic modeling and engineered structures, as well as insurance, combine to reduce risk to a residual level that is always uncertain except that it is never zero. Acceptable flood risk must be defined, understood, and communicated, yet acceptable risk is rarely discussed in public as a driver of flood risk mitigation strategies. The belief that doing something—doing anything, regardless of value—is better than doing nothing too often passes as a basis for strategy.

The Advisory Commission began its discussions focused on two high-profile issues: the Ramapo River floodgates at Pompton Lakes and the proposed USACE flood tunnel. Extensive stakeholder input, methodical review of existing data, and consultation with other experts informed the Advisory Commission and ultimately refocused its attention to more comprehensive flood mitigation measures.

While there is still more information to be analyzed to fully exonerate the floodgates operation, there is no doubt that the extreme river flows alone were sufficient to cause the flooding in March 2010 as well as the floods in the immediately preceding years. And while the flood tunnel's promise of protection from the 100-year flood is appealing, the Advisory Commission found the promise dubious in light of technical, environmental, and economic uncertainties.

The Advisory Commission considers its evaluation of the Passaic River Basin flooding to be preliminary—perhaps surprising perspective considering the number of previous studies of the longtime problem. Conditions in the basin have changed dramatically and

in ways that contribute to, rather than alleviate flooding: more development in the floodplains and in the headwater areas, higher populations now in harm's way, and a more variable and extreme climate. The implementation of previous study recommendations could have reduced property damages, but flooding still would have occurred. The recommendations presented here are crucial but only initial steps to begin to reduce the current, significant residual risks, under still worsening conditions.