Section 5: Basinwide Mitigation Strategy

The Basinwide strategy consists of three interdependent components; the Delaware River Basin, the State of New Jersey, and the counties and local municipalities. This strategy is directed at the following two objectives of the Flood Mitigation Plan:

- Increase the coordination and cooperation among intergovernmental entities in carrying out flood mitigation; and
- Leverage a wide array of funding opportunities to implement actions;

Conducting risk management and mitigation planning at multiple scales helps to ensure that the "top down" and "bottom up" strategies are harmonized and that there is ownership of mitigation actions at all levels of government. As concluded by the Delaware River Basin Interstate Flood Mitigation Task Force, convened by the Governors of New York, New Jersey, Pennsylvania and Delaware, **"There is no one set of mitigation measures that will stop flooding along the Delaware, it is only through a combination of local and regional measures that resiliency to flooding in the basin will be improved."**

Reducing flood loss is a responsibility shared by federal, interstate, state, and local agencies throughout the basin. One goal of the Delaware River Basin Compact, the enabling agreement creating the DRBC, is flood protection. After the 1955 flood, several options for flood protection were considered for the Basin. However, as the memory of the 1955 flood faded and almost 50 years elapsed between it and the recent major floods, flood mitigation was not a high priority within the Basin. After experiencing three major flood events in a 22 month period, the Governors of the four basin states – Delaware, New Jersey, New York and Pennsylvania – wanted to develop a strategy for flood mitigation and directed DRBC to organize a task force and develop an action plan. The Delaware River Basin Flood Mitigation Task Force was convened and developed 45 recommendations for flood mitigation that reflected the concerns of citizens, environmental groups and government officials among others.

Delaware River Basin Mitigation Strategy

The Delaware River Basin Commission was the obvious vehicle for developing flood loss reduction and mitigation strategies for the basin. In the Governors' request for DRBC to convene a task force they wrote "[i]individually, the Basin states can move forward with policies and regulations to reduce and mitigate the impacts of flooding, but we believe that through coordinated effort on a regional basis, we can do more to reduce flood loss within the Basin than we could accomplish acting separately, on our own."

Strategy

The Delaware River Basin Interstate Flood Mitigation Task Force was assembled in October 2006. It was comprised of 31 members from a geographically diverse array of government agencies (legislative, executive, federal, state and local) and not-for-profit organizations. The group identified a total of 45 consensus recommendations for a proactive, sustainable, and

systematic approach to flood damage reduction. The recommendations, identified in an Action Agenda forwarded to the governors in July 2007, were based upon a set of six guiding principles concerning floodplain restoration, floodplain protection, institutional and individual preparedness, local stormwater management and engineering standards, and the use of structural and non-structural measures. The guiding principles are reproduced below.

Guiding Principles

1. Preserve and Restore Floodplains Where Possible - to recognize, preserve and restore the beneficial functions of floodplains for hazard reduction, water quality enhancement, wetland protection, wildlife habitat, riparian corridors, recreation, environmental relief, aesthetics and greenway areas.

2. Be Prepared for Floods - by developing advanced floodplain mapping, detailed risk assessments, enhanced early warning systems, multiple emergency notification measures, understandable response plans, workable recovery plans, and ongoing storm monitoring.

3. Help People Protect Themselves from Flood Hazards - through public interaction and involvement, available flood information, community outreach and education, self-help measures, flood proofing options, affordable flood insurance, and emergency preparedness.

4. Prevent Adverse Impacts and Unwise Uses in the Floodplain - through appropriate regulation and land use, open land preservation, acquisition of structures and relocation assistance programs, relocation of infrastructure (such as wastewater disposal plants), multi-objective planning, prohibiting unacceptable encroachments, and establishing ongoing maintenance practices that preserve and enhance environmental functions.

5. Prevent Adverse Impacts from Development and Redevelopment – by preparing tributary and regional stormwater management plans, adopting appropriate engineering standards into local ordinances, consistently administering and enforcing ordinances and providing long-term maintenance of facilities.

6. Acknowledge the Values of Structural Flood Control Measures - after a careful analysis of the ecological, economic, long-term operation and maintenance, and social costs and benefits of all mitigation options; identify those situations where a combination of structural solutions, structural modifications, and non-structural solutions is the most beneficial option.

Organization of Interstate Flood Mitigation Task Force Report

To organize the recommendations, the Task Force decided to divide the recommendations into six priority management areas. Discussions of the six priority management areas are as follows:

Reservoir operations: The Task Force called for an evaluation of reservoir spill and discharge mitigation programs along with development of a flood analysis model to evaluate alternative reservoir operating plans and to assess the downstream effect of reservoir voids of different magnitudes. These recommendations call for releases that would reduce the likelihood and volume of spills from some basin reservoirs during storm events to help mitigate flooding.

Structural and non-structural measures: The Task Force called on policy-makers to assign higher priority and allocate greater funding to the acquisition of property and elevation and/or flood-proofing of structures within the floodplain. It offers strong support for state dam safety programs and recommends improved maintenance of other flood control structures. An evaluation of mitigation measures basinwide by the U.S. Army Corps of Engineers is recommended, to include an analysis of the ecological, economic, long-term operation and maintenance, and social costs and benefits of all flood mitigation options.

Stormwater management: The Task Force called for minimizing stormwater runoff from new development and reducing runoff from existing development through the implementation of watershed stormwater management plans, long-term maintenance of stormwater infrastructure (including detention ponds, inlets, catch basins, outfalls and other devices), the use of non-structural stormwater management options, expanded incentives for achieving stormwater management objectives, stronger enforcement of stormwater management regulations, and the development of stream restoration and debris removal guidelines.

Floodplain mapping: Because the Delaware River is an interstate waterway, coordination is needed for development of a seamless floodplain map that is consistent throughout the basin. The Task Force called upon the states to coordinate flood study and mapping updates, incorporate existing and planned development and residual risk zones into new maps, and re-define and re-map the floodway along the main stem and its tributaries.

Floodplain regulation: Currently, the regulations applicable to floodplain areas in the Delaware Basin vary widely. The Task Force urged that existing floodplain regulations be catalogued, evaluated and updated and that uniform regulation of floodplains within the basin be established. It further recommends that a coordinated education, outreach and training program about floodplain protection and regulation be undertaken, that a flood hazard disclosure requirement be imposed, that a repetitive loss reduction strategy be adopted and that riparian zones be defined in accordance with uniform standards basinwide.

Flood warning: The task force recommends that development of an advanced basinwide flood warning system proceed in a coordinated fashion. The existing system is comprised of flow gages, flash flood and flood forecasting, and education and outreach components. It is coordinated and funded by multiple organizations at the federal, state and local levels. The Task Force urges that the river gage network and its forecast points be evaluated, that rating tables be extended, that gages be flood hardened (i.e., able to withstand larger flood events), that flash flood forecasting be improved, that flood inundation maps be developed, that up-to-date Dam Emergency Action Plans be maintained, that a coordinated flood education and outreach program be developed and that a comprehensive program be undertaken to address coastal flooding.

Recommendations

During the public review phase of the draft recommendations, there was a broad based request for immediate action to mitigate future flooding impacts. To address this sense of urgency the Task Force has identified several core recommendations to enhance the basin's resiliency—its capacity to prepare for and recover from flooding. The following immediate actions were proposed:

- Establish areas of priority funding for acquisition, elevation, and flood proofing. (Action S-6)
- Develop an interoperable reservoir operating plan. (Action R-2)
- Develop and implement a consistent set of comprehensive floodplain regulations beyond minimum NFIP standards across the entire Delaware River Basin. (Action FR-2)
- Enable stormwater utilities – This approach benefits both water quality and quantity. In addition it reinforces the states' existing momentum for stormwater management and control of nonpoint source pollution. (Action SM-2.3)

The Interstate Flood Mitigation Task Force concluded that no set of mitigation measures will entirely eliminate flooding along the Delaware River or its tributaries. However, the members believe that the combination of measures advocated in this report constitute a significant step in helping the Basin's increasingly vulnerable riverine and coastal communities to prepare for, respond to, and rebound from natural disasters.

Table 5-1 presents an overview of the 45 recommendations developed by the task force. The recommendations are not in any prioritized order, but instead are organized by priority management area. More detailed information about each recommendation can be found in the Task Force Report on the DRBC web site.

Table 5-1: Delaware River Basin Flood Mitigation Task Force Recommendation Overview

Recommendation			Ongoing	Short-term (1-3 Years)	Long-term (4+ Years)	Resources Needed	Lead Agency
Reservoir Operations							
#1	R-1	Develop a Flood Analysis Modeling Tool	X			$$	DRBC
#2	R-2	Develop an Interoperable Reservoir Operating Plan		X		$$	DRBC
#3	R-3	Evaluate Discharge Mitigation Programs for Reservoirs	X			$	DRBC
#4	R-4	Evaluate Snowpack Based Storage Management	X			$	DRBC
#5	R-5	Publish Information on the Basin's Existing Major Impoundments		X		$	DRBC
#6	R-6	Evaluate Availability and Accuracy of Data		X		$	DRBC
Structural and Non-Structural Measures							
#7	S-1	Fund a Comprehensive Flood Mitigation Study of the Entire Delaware River Basin			X	$$$$ per state	USACE
#8	S-2	Prioritize the Completion of State and Local Hazard Mitigation Plans	X			$$$	State EMO's
#9	S-3	Ensure Financial Assistance for State, County and Municipal Flood Mitigation Projects	X			$$$$	State EMO's
#10	S-4	Provide Training for Local Officials to Maximize Use of Available Mitigation Funding		X		$$	DRBC
#11	S-5	Create Partnering Programs for Floodplain Acquisition		X		$$$$	State DEP's
#12	S-6	Establish Funding Priority Areas for Acquisition, Elevation, and Floodproofing		X		$$$	Basin States
#13	S-7	Maintenance of Flood Control Structures, excluding dams		X		$$$$	State DEP's
#14	S-8	Dam Safety Programs	X			$$$$	State Dam Agencies
#15	S-9	Evaluate and Coordinate Flood Mitigation Plans and Strategies	X			$$$	DRBC
Stormwater							
#16	SM-1	Develop Regional and Tributary-Based Watershed Stormwater Management Plans		X		$$ per 100sq. mi.	Basin States
#17	SM-2	Long-term Management of Stormwater Best Management Practices (BMPs) and Infrastructure	X			$ per municipality	Basin States
#18	SM-3	Non-Structural Stormwater Management for New and Redevelopment	X			$	Basin States
#19	SM-4	Enforcement of Existing Stormwater Standards and Regulations		X		$	Basin States
#20	SM-5	Provide and Promote Incentives to Reduce Stormwater Runoff from Existing Development		X		$-$$$$	Basin States
#21	SM-6	Develop and Maintain Precipitation and Streamflow Data	X			$	USGS/NWS
#22	SM-7	Stream Restoration and Debris Removal Guidelines		X		$	DRBC
#23	SM-8	Stormwater Management through Special Protection Waters Designation	X			$	DRBC

$ Key: $ = < $100,000 $$ = < $500,000 $$$ = < $1,000,000 $$$$ = > $1,000,000

Table 5-1: Delaware River Basin Flood Mitigation Task Force (Continued)
Recommendation Overview

Recommendation			Ongoing	Short-term (1-3 Years)	Long-term (4+ Years)	Resources Needed	Lead Agency
Floodplain Mapping							
#24	FM-1	Coordinated Flood Study and Mapping Updates	X			$$$$	Basin States
#25	FM-2	Incorporate Existing and Future Planned Development and Residual Risk Zones into New Mapping			X	$$$$	Basin States
#26	FM-3	Redefine and Remap the Floodway along the Delaware River Main Stem and its Tributaries			X	$$$$	Basin States
Floodplain Regulations							
#27	FR-1	Catalog, Evaluate and Update Existing Floodplain Regulations in the Basin		X		$	DRBC
#28	FR-2	Develop a Coordinated Education, Outreach and Training Program		X		$	DRBC
#29	FR-3	Repetitive Loss Reduction Strategy for the Basin		X		$$	FEMA
#30	FR-4	Flood Hazard Disclosure Requirements		X		$	DRBC
#31	FR-5	Standardized Riparian Corridors			X	$	DRBC
Flood Warning							
#32	FW-1	Inventory and Evaluate Precipitation Observing Stations in the Basin		X		$	USGS
#33	FW-2	Evaluate River Gage Network		X		$	USGS
#34	FW-3	Extend Rating Tables		X		$	USGS
#35	FW-4	Flood Harden Gages at Key Forecast Locations			X	$$	USGS
#36	FW-5	Improve Flash Flood Forecasting			X	$$	NWS
#37	FW-6	Develop an Implementation Plan for the NWS Site Specific Model		X		$	NWS
#38	FW-7	Evaluate River Forecast Points		X		$	NWS
#39	FW-8	Provide River Forecasts with Confidence Level Information		X		$	NWS
#40	FW-9	Develop Flood Forecast Inundation Maps		X		$$	NWS
#41	FW-10	Maintain Up-to-Date High Hazard Dam Emergency Action Plan (EAP) Documents	X			$	DRBC
#42	FW-11	Establish a Coordinated Flood Warning Education and Outreach Program		X		$	DRBC
#43	FW-12	Develop a Flood Coordination Mechanism		X		$	DRBC/ Basin States
#44	FW-13	Ice Jam Monitoring and Communications Plan	X			$	State EMS
#45	FW-14	Coastal Flooding Impacts			X	$$$$	MACOORA

$ Key: $ = < $100,000 $$ = < $500,000 $$$ = < $1,000,000 $$$$ = > $1,000,000

Implementation

Since the Interstate Flood Mitigation Task Force developed its recommendations, federal, state and local governments, as well as other organizations, have begun their implementation. Known implementation activities, directly or indirectly related to Task Force recommendations, follow below along with scheduled deadlines and agency or organizational lead for the projects.

Reservoir Operations:

1. Flood Analysis Model: Development of the model is ongoing by a multi-agency project team that includes the USGS, USACE, NWS and DRBC. Agreements were finalized in June 2007 and work began in August 2007. The flood analysis model is on schedule to be completed in January 2009. The four basin states committed a combined total of $500,000. The U.S. Geological Survey-Pennsylvania Water Science Center led the development of an interagency proposal, including additional funds and in-kind services from USGS, the National Weather Service and the U.S. Army Corps of Engineers totaling $265,000. Total Project Cost = $765,000.

   The model will be capable of evaluating the effects of reservoir voids and release operations on downstream flood crests for different storm events. It will provide a tool to inform the development of discharge mitigation plans for 15 basin reservoirs.

2. Spill Mitigation: PPL and NYC have developed spill mitigation programs for their reservoir operations. Spill mitigation programs do not guarantee voids, but are designed to reduce the magnitude and frequency of spills at through the controlled release of greater volumes of water than would have been called for under past conservation release programs.

   a. The PPL program is based on snowpack and the 48 hour precipitation forecast. The spill mitigation program for Lake Wallenpaupack was developed with input from floodplain residents along the Lackawaxen River and was implemented in 2007.

   b. Spill mitigation at the NYC reservoirs was first conducted for Pepacton Reservoir in early 1996, with an effort to maintain a 5 bg void. More recently, spill mitigation was conducted at Pepacton Reservoir based on snowpack in the winter of 2005, when an approximate 11 bg void was achieved prior to the flood of April 2005. In 2006, spill mitigation for Neversink and Pepacton Reservoirs was based on snowpack and expected precipitation in 2006. In early 2007, spill mitigation at Cannonsville, Pepacton, and Neversink reservoirs was based on a temporary snowpack and a storage based rule curve, and most recently as of late 2007/2008, spill mitigation was included in the Flexible Flow Management Program (FFMP).

3. Automatic Snowpack Monitors in the NYC Watershed: In 2006, DRBC received $22,000 through NOAA's automated flood warning system grant program to buy two automatic snowpack monitors for installation in the NYCDEP watershed. Soon after receiving the grant, NYCDEP found that the antifreeze used in the monitors to determine snow water equivalent leaked in some instances, so they discontinued that type of

monitor. DRBC held the funding while trying to figure out if there was a new type of sensor that could be used. In 2008, NYCDEP installed electronic load type sensors using the grant funds; the first in the Neversink watershed and the second in the Pepacton watershed. NYCDEP is responsible for maintenance and telemetry. These monitors are expected to supplement manual snow surveys working towards easier, quicker and more accurate snowpack data collection.

Structural and Non-Structural Measures:

1. Task 2 of the Multi-jurisdictional Use and Management of Water Resources for the Delaware River Basin by the Army Corps of Engineers: This study includes identification of flood prone areas within the Delaware Basin, development of a potential solution matrix (including both structural and non-structural solutions), application of the matrix to identified major damage centers (New Hope, Yardley, Easton and Upper Makefield PA; Lambertville, Stockton, Harmony and Belvidere NJ; and Rockland and Colchester, NY), updating stage-frequency relationships for main stem Delaware gages plus selected tributaries to reflect the recent floods, assembling stage-damage data for the damage centers on the Delaware River main stem and selected tributaries and conducting structure inventories at the identified damage centers with ground/first floor and zero damage elevations for all commercial/residential and industrial structures within the 100 year floodplain.

2. Northampton and Lehigh Counties received a $1M in pre-disaster mitigation earmark funding (through FEMA's PDM program, FY-08) for flood mitigation in Northampton and Lehigh Counties. This funding will be used to complete high and medium priority projects, as identified by their Hazard Mitigation Plan.

3. New Jersey Blue Acres Program (Acquisition Funding): Governor Corzine signed into law the "Green Acres, Farmland, Blue Acres, and Historic Preservation Bond Act of 2007" which was presented to the voters and approved at the November 2007 election. The bond act will provide $12M for the state to acquire, for recreation and conservation purposes, lands in the floodway of the Delaware River, Passaic River, and Raritan River, and their respective tributaries, that have been damaged by, or may be prone to incurring damage caused by storm-related flooding or that may buffer or protect lands from such damage.

4. New York State (Acquisition Funding): New York State is providing $15.25M through the State Department of Communities and Development to buy out homes in flood-prone areas. Sullivan will receive $4 million; Ulster, Orange and Delaware counties, $2 million each. Other counties receiving money include: Broome, $750,000; Chenango, $750,000; Herkimer, $750,000; Montgomery, $750,000; Otsego, $750,000; Schoharie, $750,000; and Tioga, $750,000. To qualify for the program, homes must be primary residences appraised at under $250,000. Preference would be given to homes that have been flooded twice since April 1, 2004, and are appraised at under $100,000. The county's emergency management director and a town building official will certify that homes qualify.

5. Federal Emergency Management Agency's Severe Repetitive Loss (SRL) program: Both State and local plans are a pre-requisite for Federal Emergency Management Agency's

Severe Repetitive Loss (SRL) program. In the first year of the program (2008), FEMA set aside $160 million for properties nationwide.

a. Pennsylvania, which has 243 properties on the SRL list, is slated to receive $4.7 million in funding to be used towards acquisitions and elevations. PA municipalities (through PEMA) have a May 30 deadline to apply for SRL funds. 32 homes in Yardley Borough, the most in any town in Pennsylvania, qualify for funding under the Federal Emergency Management Agency's Severe Repetitive Loss (SRL) program. Along with Yardley, 57 other Bucks County properties are on the list, including 14 in Upper Makefield, 7 in Solebury, 6 in Lower Makefield, 4 in New Hope and 1 in Bristol Township.

b. In comparison, NJ is slated to be eligible to receive $11.4M for its 590 SRL properties. While NJ has an approved State Plan, only two of its communities (and none in the basin) have FEMA-approved local hazard mitigation plans in place. Therefore, only properties in these two towns are eligible for FY-08 SRL funds.

6. Yardley Borough received hazard mitigation funding (under a separate FEMA grant program than SRL) to elevate five homes. Homeowners and business owners in Yardley also elevated 17 homes with individual funds, 14 of the 17 using $30,000 of Increased Cost of Compliance (ICC) money from FEMA. Yardley Borough received federal funding for stormwater backflow preventors. Yardley Borough has also recently identified the debris that collects along staggered, abandoned bridge piers at the Yardley RR bridge as causing backwater effects. DRBC, PEMA, CSX and Yardley borough are investigating the possibilities of removing the debris and abandoned piers.

7. Acquisition Funding, Town of Rockland, NY: The town has used a $1 million grant through the FEMA PDM program to buy eight homes in Livingston Manor.

8. Model programs on tributaries - such as the co-sponsoring by Bucks County, FEMA, and the NRCS has resulted in the successful elevation and acquisition of over 300 properties along the Neshaminy Creek.

9. Multi-Jurisdictional Flood Mitigation Plan. FEMA has awarded the Delaware River Basin Commission (DRBC) a grant under the Flood Mitigation Assistance program for the preparation of a multi-jurisdictional Flood Mitigation Plan (FMP) for a possible 64 municipalities located within Sussex, Warren, Hunterdon and Mercer Counties that have boundaries either partially or entirely within the Delaware River drainage basin. This plan will be finalized in Spring 2008 and will provide the four counties with a valuable asset that could be incorporated into a future All-Hazards Plan.

10. Dam Safety: New York State Department of Environmental Conservation (DEC) proposed new draft regulations that requires more dam inspections, regular maintenance, better recordkeeping, and emergency planning. Recent efforts to enhance the program include:
    - Additional staff: dam safety staffing has increased from three to 20 people statewide;

- Enforcement: DEC has issued formal complaints for nine dams, and has entered into Orders on Consent for remedial work at 10 dams;
- Inspections: In recent years, DEC has completed inspections of all 389 high hazard dams in the state, and in 2007, completed more than 250 dam inspections;
- Funding: $15 million in Bond Act Dam Safety funds were awarded to help municipalities address dam safety deficiencies; and
- Education and Training: Classes and seminars have been offered by DEC staff to dam owners and other stakeholders to help increase their knowledge and implementation of dam safety guidelines.

a. In regards to the Emergency Action Plan, the new regulations state that within 12 months of the effective date of these regulations, all Class B and Class C (Intermediate and High Hazard) dam owners shall develop and submit an Emergency Action Plan to the department, the State Emergency Management Office, and the chief executive officer of the municipality in which the dam is located. The dam owner will also send the Emergency Action Plan to any other municipality within the inundation area.

b. In addition, NYCDEP has made a New York State Dams Inventory available that depicts the location of dams in the New York State Inventory of Dams. While the DEC tries to maintain an accurate inventory, this data should not be relied upon for emergency response decision-making. The inventory can be viewed through a google maps download (kmz file) at http://www.dec.ny.gov/pubs/42978.html

Stormwater Management:

1. New Jersey: Creation of Stormwater Utility Systems – S-1166 (Smith/D-17): Committee passed, referred to the Senate Budget and Appropriations Committee. Permits municipalities and counties to finance the creation, operation and maintenance of stormwater utility systems through the imposition of tax on residential and commercial properties.

2. Pennsylvania: Completing work on storm water legislation that will entirely revamp the authority and responsibility for planning and implementing a storm water management system.

Floodplain Mapping:

1. Updated Hydrologic Information for the Main Stem of the Delaware River: On May 2007, the USGS recommended flood magnitude and frequencies for the 8 gaging stations along the main stem Delaware River in New Jersey, New York, and Pennsylvania. These figures were developed by Bob Schopp, USGS NJ Water Science Center and Gary Firda, USGS NY Water Science Center. These figures were developed in consultation with the U.S Army Corps of Engineers Philadelphia District, FEMA Regions II and III, NJDEP-State NFIP Coordinator's Office and DRBC. USGS plans to post a web-based report documenting the assumptions that were made in determining these discharges. These updates discharges will be used in future mapping updates.

2. Updated Floodplain Study & Mapping Delineation: The NJDEP has set aside $1,000,000 for the preparation of new floodplain delineations and associated mapping for the main stem of the Delaware River on the NJ side. On May 16, 2006, the NJDEP executed a Collaborative Technical Partnership (CTP) agreement with the Federal Emergency Management Agency (FEMA) Region II in order to leverage NJDEP funding with the current federal Flood Map Modernization Program resources. FEMA will also be contributing an additional $2,500,000 dollars towards completion of this effort.

   Medina Consultants, the flood mapping contractor, is currently in the process of performing field surveys of river cross-sections along a 126 miles reach of the main stem of the Delaware River. In addition, various stages of LiDAR acquisitions are planned for the four New Jersey counties along the Delaware River. LiDAR (Light Detection and Ranging) is an optical remote sensing technology that is being used to collect high-accuracy elevation data. The surveyed river cross-sections, LiDAR information and the updated hydrology will be incorporated into updated hydraulic modeling for preparation of new floodplain mapping along the New Jersey side of the Delaware. The goal of this mapping effort is to more accurately define the limits of the flood hazard area and associated base flood elevation.

3. The Corps of Engineers will be producing digital flood inundation maps for the main stem Delaware using existing data. These maps will be available through NWS AHPS website and to County Emergency Managers. Funding for this work was made possible by using the $500,000 provided by the basin states for the flood analysis model as a local cost share to leverage federal funding. The mapping is expected to be completed by close of 2008.

4. Using FEMA funding, 160 high water marks in PA and NJ from the June 2006 in PA and NJ were collected by USACE and verified against existing flood insurance study flood profiles.

5. Flood mapping and stormwater mitigation work was conducted for the Pennypack watershed by the Center for Sustainable Communities at Temple. This higher precision mapping is a valuable planning tool for local officials for defining flood inundation and vulnerability of evacuation routes. It can also be used to administrate floodplain regulations if a community chooses to use it and FEMA approves.

6. The State of Pennsylvania is acquiring LIDAR data for the state. The remaining portion of the state to be collected is in the eastern portion of the state (Delaware River Basin). The collection of LiDAR has been funded, but funding for processing still needs to be allocated.

7. In response to the June 2006 flood, FEMA Region II is conducting a flood hazard analysis of the flooding sources identified in the Delaware River Basin in New York State. This includes but is not limited to the Delaware River from Port Jervis to Hancock, NY and portions of the Beaverkill, Willowemoc, East Branch, West Branch and Callicoon Creek. The scope of the effort includes: LiDAR acquisition, field survey of structure and wet sections, hydrologic and hydraulic modeling, and the development of

flood recovery maps. As of the beginning of August, the LiDAR has been flown, field surveys are underway, and the hydrologic analysis is being finalized.

Floodplain Regulations:

1. Updated Flood Hazard Area Control Act Rules – New Jersey: On November 5, 2007, the NJ Department of Environmental Protection adopted new Flood Hazard Area Control Act rules (N.J.A.C. 7:13), which incorporate more stringent standards for development in flood hazard areas and riparian zones adjacent to surface waters throughout the State.

2. In order to minimize the impacts of development on flooding, a 0% net-fill requirement now applies to all non-tidal flood hazard areas of the State. The new rules also expand the preservation of near-stream vegetation by implementing new riparian zones that are 50, 150 or 300 feet in width along each side of surface waters throughout the State. The riparian zone width depends on the environmental resources being protected, with the most protective 300-ft riparian zone applicable to waters designated as Category One and certain upstream tributaries.

3. Some of the other highlights of the new rule include allowing the use of Federal flood mapping in communities where no State flood mapping is available, and providing a simplified method to approximate flood depths in communities where no State or Federal flood mapping is available; requiring floor elevations and roadway surfaces to be set at least one foot above the State's flood hazard area design flood elevation (125% of the 100-year flow rate reported by FEMA) in order to provide increased flood protection for buildings and public roadways; creating 46 permits-by-rule and 16 general permits to both facilitate and encourage projects that have no adverse impact on flooding and the environment, including a permit-by-rule for elevating homes, which requires no prior NJDEP approval, and a free, expedited general permit for the reconstruction and elevation of homes damaged by flooding; and Amending the Coastal Permit Program rules (N.J.A.C. 7:7) and Coastal Zone Management rules (N.J.A.C. 7:7E) to incorporate equivalent flood protection and stream buffers to all waters and flood hazard areas Statewide.

4. A Subcommittee to DRBC's Flood Advisory Committee (FAC) has been established to examine the potential for more consistent floodplain management in the basin.

Flood Warning:

1. FY-08 Flood Warning Improvements: With DRBC assistance, and promotion by members of Congress (Sponsors: Dent, Holt Lautenberg, Menendez), $235,000 in federal funds were directed to NOAA-NWS for work on improved flood warning in the Delaware River Basin. This will include an evaluation and improvement of existing precipitation and stream gage networks, flood hardening of some gages prioritized by USGS, implementation of flood inundation mapping into AHPS at flood forecast points and an education and outreach component.

2. NJDEP Upgrades to USGS Streamgaging Program: The NJDEP has committed funding for the upgrade, replacement, and addition of streamgages along the Delaware River.

Along the Delaware River, the scope of work includes the addition of high-data rate satellite transmitters to provide better aerial data coverage on a real-time basis and to develop flood data for use in design of flood control measures, major gage repairs in order to improve streamflow data accuracy, and the addition of raingages to aid the National Weather Service (NWS) in flood-forecasting and refinement of their radar estimates of precipitation. To date, major gage repairs and upgrades have been accomplished to the existing gages at the Delaware River at Montague, Riegelsville, and Trenton. In addition, a radar stage gage has been installed and a tipping-bucket rain gage has been re-installed at the Delaware River at Stockton and a radar stage and rain gage has been installed at the Delaware River at Lambertville.

Education/Outreach:

1. The Easton Flood Museum and Resource Center is currently in construction and will be devoted to educating the public on the causes and effects of floods and how communities can work together to prevent flooding and relieve flood damage. http://www.floodproject.org/

2. Pennsylvania is in the process of forming a PA chapter of the Association of State Floodplain Managers (ASFPM) to address the impacts of flooding and stormwater issues in Pennsylvania and the need to plan and educate PA residents on a watershed basis.

3. Both NJAFM and NYSFSMA, NJ and NY chapters of the Association of State Floodplain Managers (ASFPM), are active in addressing and educating sound floodplain management.

New Jersey Mitigation Strategy

The State of New Jersey recently received approval from FEMA on its updated State Hazard Mitigation Plan. The plan outlined four goals: Protect life, Protect property, Increase public preparedness, and Develop and maintain an understanding of risks. Details of the State Hazard Mitigation Plan can be found at www.njflood.org.

After the 2005 flood event, then Acting Governor Richard J. Codey announced the formation of a statewide Flood Mitigation Task Force to study and implement measures to reduce future impacts of flooding in New Jersey Communities. On August 22, 2006, Governor Jon Corzine released the final report of the Flood Mitigation Task Force and proposed new Flood Hazard Area Control Act Rules in response to Task Force recommendations and chronic flooding.

In a letter dated March 21, 2008 to Carol Collier, Executive Director of the DRBC, Lisa Jackson, NJDEP Commissioner indicated that New Jersey agreed with the action agenda developed by the Delaware River Basin Interstate Flood Mitigation Task Force. She also noted that New Jersey's own Delaware River Flood Mitigation Task Force had presented 37 similar recommendations for flood damage reduction and mitigation.

New Jersey is in the process of implementing several of their task force recommendations. The findings and recommendations of New Jersey's Delaware River Flood Mitigation Task Force are reproduced below along with New Jersey's ongoing flood mitigation activities. The

full report can be accessed online at www.njflood.org.

Findings

The New Jersey Delaware River Flood Mitigation Task Force listed the following findings from their deliberations:

- The Floodplains Should Be Expected to Flood
- No one set of measures, alone or in combination, will stop or eliminate flooding in the Delaware River Floodplain.
- The potential for hurricanes to be more intense and more frequent means that the risks and foreseeable consequences of flooding are increasing in magnitude.
- Timely and accurate Flood Watches and Warnings issued by the National Weather Service (NWS) are critical to saving lives and property, and improvements in communications, and in precipitation and stream gage density and technology, are needed to support the NWS mission.
- Better planning, stricter protection of flood plains, increased efforts to restore disturbed and developed floodplain areas, and more rational rebuilding standards can significantly reduce economic loss to New Jersey from flooding when it occurs.
- The current patchwork of floodplain delineations, many of them long out of date, must be updated if risk reduction strategies are to be effective in reducing losses.
- The Delaware River Basin Commission's (DRBC) "Recommendations to Address Flood Warning Deficiencies" must be fully implemented to provide the public with adequate response time and information as incorporated in the recommendations below.

Recommendations of the NJ Delaware River Flood Mitigation Task Force

The New Jersey Delaware River Flood Mitigation Task Force made the following recommendations:

1. Regulatory Protection of Flood Plains and Homes Must Be Strengthened
   a. The State should develop updated flood inundation maps for the Delaware River.
   b. The State should evaluate its existing flood hazard mapping in order to determine whether a more stringent standard should be used to define floodway boundaries.
   c. Regulatory stream buffers of 300 feet should be established in flood-prone areas between tributaries and any new development.
   d. The Delaware and Raritan Canal, currently a C1 candidate, should be reclassified on an expedited basis.
   e. DRBC should extend the "Outstanding Basin Waters" classification to remaining segments of the non-tidal Delaware and its tributaries as a bulwark against additional development.
   f. The State must adopt floodplain regulations consistent with the "No Adverse Impact" recommendations by the Association of State Floodplain Managers.

g. Building rehabilitation and construction in New Jersey must be fully compliant and consistent with FEMA requirements under the National Flood Insurance Program (NFIP).

2. Mitigation and Control Measures Should Be Pursued

a. The State, in partnership with federal and local entities, should coordinate the implementation of improvements to flood forecasting and flood warning system capabilities.

b. The Task Force supports additional work by the US Army Corps of Engineers (USACE), the Federal Emergency Management Agency (FEMA), the US Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS), the NJ Office of Emergency Management (NJOEM) and the New Jersey Department of Environmental Protection (NJDEP) to conduct studies to determine the viability of Federal interest to construct or implement appropriate flood control mitigation measures. Any study should focus on local nonstructural and structural measures, and should not revisit the federal and state policy and funding decisions that terminated the proposed Tocks Island dam project.

c. Engineering controls and small-scale structural controls with significant benefits in specific tributaries or river segments should be identified. Nonstructural strategies should be given a priority during consideration of flood protection solutions.

d. Snowpack storage provides seasonal flood mitigation benefits downstream from reservoirs. The State should work through the DRBC's Flood Advisory Committee and the Parties to the 1954 Supreme Court Decree to foster multiparty snowpack storage agreements and to explore other opportunities for assessing the effectiveness of potential reservoir management changes.

e. Buy-outs of substantially damaged properties and floodplain restoration should be more readily available to property-owners in repetitive loss areas of the flood plain. An expanded Blue Acres program, in partnership with the USACE and FEMA should be established when the Garden State Preservation Trust Act (GSPT) is reauthorized.

f. It is important to maintain the structural integrity of the Delaware and Raritan Canal and to avoid increased flooding along its length. The NJ Water Supply Authority (NJWSA) should continue to work with the Delaware River towns to investigate and implement operational plans that may reduce flooding attributable to the Alexauken and Swan Creeks without adversely affecting the canal.

3. Planning and Additional Resources are Needed to Reduce Flood Risk

a. The State must develop a robust hazard mitigation program through the addition of staffing for the NJOEM Mitigation Unit, in order to qualify for an Enhanced State Hazard Mitigation Plan under FEMA guidelines. Additional resources would also allow NJ to be more aggressive in its approach to FEMA mitigation grants and would ensure proper oversight and management of all current and future mitigation projects.

b. The State must more effectively utilize available FEMA mitigation grant funding under the Hazard Mitigation Grant Program (HMGP), the Flood Mitigation Assistance Program (FMA), and the Competitive Pre-Disaster Mitigation (PDM-C) grant programs, so that available funding does not continue to remain unused, as it has in the past.

c. The State needs to develop its in-house capabilities to promote local hazard mitigation planning throughout the state. Currently there is a severe limitation on the number of New Jersey communities since only two are eligible for HMGP and PDM-C project grants. NJDEP should develop a Statewide Flood Prevention Master Plan to inventory flood prone areas and assess community vulnerabilities.

d. The State's municipal authorities law must be amended to give municipalities the option of establishing a stormwater management utility or similar entity to manage and improve stormwater runoff from existing developments, and to facilitate access to the New Jersey Environmental Infrastructure Trust for local flood control projects.

4. Homeowners Need Focused Assistance Before and After Flooding

a. FEMA, NJOEM, NJDEP, and local municipalities should improve coordination prior to and after flooding through homeowner assistance centers.

b. The services of the New Jersey Association for Floodplain Management (NJAFM) should be utilized for public training and community outreach activities.

c. NJDEP should adopt a permit-by-rule that will spare residents who rebuild their homes or other structures on residential property the expense and delay of the permitting process provided the project meets NFIP standards.

d. The NJOEM, in coordination with other agencies, should develop both a user-friendly publication and a web page that explain relevant funding sources and provide commonsense help to homeowners after a flood.

e. Realtors should be required to disclose at the time of sale whether a home is in a flood plain and whether it has had prior flood damage.

Implementation

The following represents a summary of some of the initiatives to mitigate Delaware River flooding that are currently being undertaken by the New Jersey Department of Environmental Protection (NJDEP).

Updated Flood Hazard Area Control Act Rules:

On November 5, 2007, the NJ Department of Environmental Protection adopted new Flood Hazard Area Control Act rules (N.J.A.C. 7:13), which incorporates more stringent standards for development in flood hazard areas and riparian zones adjacent to surface waters throughout the State. The Department has adopted these new rules to better protect the public from the hazards of flooding, preserve the quality of surface waters, and protect the wildlife and vegetation that exist within and depend upon such areas for sustenance and habitat.

To minimize the impacts of development on flooding, a zero percent net-fill requirement (which was previously implemented only in the Highlands Preservation Area and Central Passaic Basin) will now apply to all non-tidal flood hazard areas of the State. The new rules also expand the preservation of near-stream vegetation (previously protected within 25 or 50 feet of streams) by implementing new riparian zones that are 50, 150 or 300 feet in width along each side of surface waters throughout the State. The riparian zone width depends on the environmental resources being protected, with the most protective 300-ft riparian zone applicable to waters

designated as Category One and certain upstream tributaries. Certain waters supporting trout, or habitats of threatened or endangered species critically dependant on the watercourse to survive, or watercourses which flow through areas that contain acid-producing soil deposits, receive a 150-ft riparian zone.

Some of the other highlights of the new rule include allowing the use of Federal flood mapping in communities where no State flood mapping is available, and providing a simplified method to approximate flood depths in communities where no State or Federal flood mapping is available; requiring floor elevations and roadway surfaces to be set at least one foot above the State's flood hazard area design flood elevation in order to provide increased flood protection for buildings and public roadways; creating 46 permits-by-rule and 16 general permits to both facilitate and encourage projects that have no adverse impact on flooding and the environment, including a permit-by-rule for elevating homes, which requires no prior NJDEP approval, and a free, expedited general permit for the reconstruction and elevation of homes damaged by flooding; and Amending the Coastal Permit Program rules (N.J.A.C. 7:7) and Coastal Zone Management rules (N.J.A.C. 7:7E) to incorporate equivalent flood protection and stream buffers to all waters and flood hazard areas Statewide.

Updated Floodplain Study & Mapping Delineation:

The NJDEP has set aside $1,000,000 to begin the preparation of new floodplain delineations and associated mapping for the main stem of the Delaware River. On May 16, 2006, the NJDEP executed a Collaborative Technical Partnership (CTP) agreement with the Federal Emergency Management Agency (FEMA) in order to leverage NJDEP funding with the current federal Flood Map Modernization Program resources. FEMA will also be contributing an additional $2,500,000 dollars towards completion of this effort.

The NJDEP coordinated with USGS and FEMA on the development of updated hydrologic information for the main stem of the Delaware River. On May 2007, the USGS recommended flood magnitude and frequencies for the 8 gaging stations along the main stem Delaware River in New Jersey, New York, and Pennsylvania. These figures were developed by Bob Schopp, USGS NJ Water Science Center and Gary Firda, USGS NY Water Science Center and in consultation with the U.S Army Corps of Engineers Philadelphia District, FEMA Regions II and III, NJDEP-State NFIP Coordinator's Office and DRBC. The report, OFR 2008-1203 Flood Magnitude and Frequency of the Delaware River in New Jersey, New York, and Pennsylvania, can be accessed online at http://pubs.er.usgs.gov/usgspubs/ofr/ofr20081203.

Medina Consultants, the flood mapping contractor, is currently in the process of performing field surveys of river cross-sections along a 126 miles reach of the main stem of the Delaware River. In addition, various stages of LiDAR acquisitions are planned for the four counties along the Delaware River. The surveyed river cross-sections, the LiDAR information and the updated hydrology will be incorporated into updated hydraulic modeling for preparation of the new mapping. This state of the art new mapping will be a valuable resource during times of emergency and for the regulation of land use along the floodplain area. The goal of this mapping effort is to more accurately define the limits of the flood hazard area and associated base flood elevation. The anticipated date of completion for this mapping is 2009.

Flood Mitigation Feasibility Study:

The NJDEP has committed funding to be cost shared with the US Army Corps of Engineers (USACE) for the preparation of a feasibility study to evaluate possible flood mitigation options, including flood-proofing and removing or relocating structures within the floodplain of the Mid-Delaware River Basin. The Feasibility Cost Share Agreement between NJDEP and the USACE was signed on July 27, 2006. The NJDEP and USACE have met with Delaware River town residents and local officials to perform visual inspections and gather information on the 2004, 2005 and 2006 flooding. NJ continues to provide cost-share funding and the USACE continues to move forward on the study.

Upgrades to USGS Stream Gaging Program:

The NJDEP has committed funding for the upgrade, replacement, and addition of streamgages along the Delaware River. On June 9, 2006, the NJDEP signed a joint funding agreement with the United States Geological Survey (USGS) to provide various upgrades to streamgaging programs in NJ. Along the Delaware River, the scope of work includes the addition of high-data rate satellite transmitters to provide better aerial data coverage on a real-time basis and to develop flood data for use in design of flood control measures, major gage repairs in order to improve streamflow data accuracy, and the addition of raingages to aid the National Weather Service (NWS) in flood-forecasting and refinement of their radar estimates of precipitation.

To date, major gage repairs and upgrades have been accomplished to the existing gages at the Delaware River at Montague, Riegelsville, and Trenton. In addition, a radar stage gage has been installed and a tipping-bucket rain gage has been re-installed at the Delaware River at Stockton and a radar stage and rain gage has been installed at the Delaware River at Lambertville.

Develop a Flood Analysis Modeling Tool:

The NJDEP has committed funding to the DRBC for development of a flood analysis model. This model will allow the evaluation of existing reservoirs for flood mitigation purposes by providing data to evaluate the effects of various reservoir operating alternatives on flooding at locations downstream of the reservoirs. The scope of work for this project has been finalized and USGS has signed an agreement with DRBC on June 20, 2007. Development of the model will be by a multi-agency project team which will include participation of the National Weather Service (NWS), the USACE, and USGS. The flood analysis model is scheduled to be completed within eighteen months, or in January 2009.

Blue Acres Program for New Jersey:

Governor Corzine signed into law the "Green Acres, Farmland, Blue Acres, and Historic Preservation Bond Act of 2007" which was presented to the voters and approved at the November 2007 election. The bond act will provide $12,000,000 for the state to acquire, for recreation and conservation purposes, lands in the floodway of the Delaware River, Passaic River, and Raritan River, and their respective tributaries, that have been damaged by, or may be prone to incurring damage caused by storm-related flooding or that may buffer or protect lands from such damage.

County/Local Mitigation Strategy

Municipal Specific Flood Mitigation Goals and Action Plans

Through this Plan, Counties and municipalities developed individual mitigation action plans. The goal of this plan was to empower and enable local jurisdictions to evaluate their history of flooding, their future risk of flooding and to develop a mitigation action plan upon implementation, would reduce future flood loss.

Although municipalities are often affected by similar rainfall events, the effect of those events differs by municipality. Flood loss depends on many local factors including slope and elevation, amount of built environment in the floodplain, land use, location of essential facilities and population.

Taking this into consideration, each municipality was tasked to individually evaluate their risk and vulnerability to flooding. As a result, each municipality developed their own flood profile, set of individual flood mitigation goals and considered any unique flood risk to their municipality. Municipal specific flood profiles and individual mitigation action plans are presented in Section 6.

Mitigation Categories

Each municipality and county considered a range of flood mitigation actions to determine the most effective action for their community that had the best chance of being realized. Mitigation actions were discussed in county level meetings in terms of the following 6 categories. These include Prevention, Property Protection, Public Information and Awareness, Emergency Services, Natural Resource Protection and Structural Projects.

It was agreed that no one set of mitigation measures would stop flooding, instead a combination of actions would need to be considered and implemented to improve a community's resilience to flooding. The six mitigation categories were derived from FEMA Guidance, State and Local Mitigation how-to-guide: Developing the Mitigation Plan. More detail on each of the categories is provided below.

<u>Prevention</u>

Preventative activities are intended to keep hazard problems from getting worse. They are particularly effective in reducing a community's future vulnerability, especially in areas where development has not occurred or capital improvements have not been substantial. Examples of preventative activities include:

- Planning and zoning
- Building codes
- Hazard mapping
- Open space preservation
- Floodplain regulations
- Stormwater management

- Drainage system maintenance
- Capital improvements

Property Protection

Property protection measures enable structures to better withstand flood events, remove structures from hazardous locations, or provide insurance to cover potential losses. Examples include:

- Acquisition
- Building elevation
- Relocation
- Structural Retrofits (i.e., flood proofing, elevate utilities, etc.)
- Stormwater Retrofits (i.e., backflow preventers, culvert resizing, etc.)
- Critical facilities protection
- Insurance

Public Information and Awareness

Public Information and awareness activities are used to inform and educate residents, elected officials, business owners, potential property buyers, and visitors of the flood hazard and mitigation techniques they can use to protect themselves and their property. Examples of measures used to educate and inform the public include:

- Outreach and education
- Training
- Speaker series, demonstration events
- Real estate disclosure

Emergency Services

Although not typically considered a mitigation technique, emergency services minimize the impact of a hazard on people and property. Actions taken immediately prior to, during, or in response to a hazard event include:

- Warning systems; Reverse 9-1-1
- Search and rescue
- Evacuation planning and management

Natural Resource Protection

Natural resource protection activities reduce the impact of hazards by preserving or restoring the function of natural systems. Examples of such natural systems include floodplains and wetlands. Natural resource protection serves the dual purpose of protecting lives and property while enhancing environmental goals such as improved water quality or recreational opportunities. Examples include:

- Floodplain protection

- Riparian buffers
- Erosion and sediment control
- Stream corridor restoration
- Watershed management
- Wetland restoration
- Habitat preservation

Structural Projects

Due to a host of economic, environmental and political reasons, flood management has been historically moving away from large scale flood control projects. Although, in some cases, structural solutions such floodwalls, dams, engineered conveyances and control structures may be warranted after a careful analysis of the ecological, economic, long-term operation and maintenance, and social costs and benefits is performed. Structural projects are usually cost-shared between federal and local sponsors and managed or maintained by local public works staff. Examples include:

- Levees, dikes, or floodwalls
- Detention and retention basins
- Channel modification
- Stormwater Retrofits
- Maintenance of existing flood control structures

Prioritization Process

Each participating municipality independently identified and prioritized their mitigation actions contained in their specific action plan (contained in Section 6). Municipalities were provided with instructions and a copy of the STAPLEE matrix contained in FEMA's "How-to Guide #3: Developing the Mitigation Plan" FEMA 386-3. STAPLEE is an acronym for Social, Technical, Administrative, Political, Legal, Economic and Environmental criteria used in the evaluation process. Each of the seven STAPLEE evaluation criteria includes a number of sub-criteria for consideration. For example, included in the "Social" criteria are two considerations: "Community Acceptance" and "Effect on Segment of Population." See Appendix C for the STAPLEE Action Evaluation chart that contains the considerations used for all seven (7) STAPLEE criteria.

Each municipality scored each action with a plus (+) for favorable or minus (-) for less favorable, in every category. The considerations were first combined into a ranking for each STAPLEE criteria. Then, a priority ranking of High, Medium or Low was assigned to each action. These rankings are contained in each Municipal Flood Profile and Mitigation Action Plan, as well as, the following Tables 5-2 – 5-5.

Mitigation Action Tables

The following tables, Tables 5-2 – 5-5, present Municipal Mitigation Actions by County organized by Action Category. Over 160 mitigation actions are contained in these tables.

Table 5-2: Mercer County: Municipal Mitigation Actions by Action Category

1. Prevention (Policy/Ordinances/Studies/Enforcement)				
Municipality	**Mitigation Action**	**Responsible Party**	**Estimated Cost**	**Priority**
Hamilton Township	Flood Damage Prevention	Engineering, Planning, Inspections & Land Use	Staff time	High
Trenton City	Get into FEMA's Community Rating System	Trenton Department of Inspections	Staff time	High
Trenton City	Ongoing coordination and involvement with other agencies to maximize mitigation efforts and use of funds	Trenton Office of Emergency Management	Staff time	Medium
2. Property Protection (Acquisition, Elevation, Flood proofing)				
Municipality	**Mitigation Action**	**Responsible Party**	**Estimated Cost**	**Priority**
Hamilton Township	Property Acquisition	Engineering, Planning, and Inspections, administration	$500,000	High
Hopewell Township	Elevate utilities	Homeowners	$20,000 per home	Medium
Hopewell Township	Elevate properties	Homeowners	$100,000 per home	Medium
Trenton City	Selective acquisition and demolition of highly flood prone residential or commercial properties	Trenton Department of Housing and Economic Development	Dependant on funding	Medium
Trenton City	Acquire and demolish flood prone property on Taylor Street	Trenton Department of Housing and Economic Development or Inspections Department	Acquisition per structure: $700,000; demolition $800,000; remediation $600,000	High
Trenton City	Acquire and demolish flood prone property on Amtico Square	Trenton Department of Housing and Economic Development	Acquisition per structure: $700,000; demolition $800,000; remediation $600,000	High
Trenton City	Elevate mechanical and electrical equipment in flood prone residential structures	Trenton Department of Inspections	Estimated $5,000 to $10,000 per residential structure	High
Trenton City	Assess FEMA RLPs and SRLPs throughout the city to identify mitigation candidates	Trenton Department of Inspections	$25,000 - $50,000	High
Trenton City	Purchase and/or flood detention at the Freight Yards	Trenton Department of Housing and Economic Development	Acquisition remaining: $45,000; detention: $500,000-$1,000,000; demolition: $600,000; site remediation: $5M	High
3. Public Information and Awareness				
Municipality	**Mitigation Action**	**Responsible Party**	**Estimated Cost**	**Priority**
Hamilton Township	Public education and outreach	OEM, Engineering, Planning, and Inspections	$10,000	High

Table 5-2: Mercer County: Municipal Mitigation Actions by Action Category (continued)

4. Emergency Services

Municipality	Mitigation Action	Responsible Party	Estimated Cost	Priority
Ewing Township	Power Grid Separation	PSE&G	$150,000	High
Ewing Township	Individual location shut off	PSE&G	N/A	High
Hamilton Township	Flood Threat Recognition System	NJOEM, Hamilton Township Dept. of Engineering, Planning & Inspections and Dept. of Public Works	$250,000	High
Hamilton Township	Advanced Flood Warning System	NJOEM, Hamilton Township Engineering and Dept. of Public Works	$400,000	HIgh

5. Natural Resource Protection (Floodplain protection, Stream Corridor Restoration, Open space)

Municipality	Mitigation Action	Responsible Party	Estimated Cost	Priority
Lawrence Township	Stream cleaning/clearing of Five Mile Run	Lawrence Township	$75,000	Medium
Lawrence Township	Stream stabilization behind Lawrence Shopping Center	Private property owner	Not known at this time	Medium
Pennington Borough	Land purchase	Borough Council	$300,000	High

6. Structural Projects

Municipality	Mitigation Action	Responsible Party	Estimated Cost	Priority
Ewing Township	Backflow prevention valves	NJDOT	unknown	High
Hamilton Township	Retrofit of Greenwood Avenue	NJDOT Region 3 Maintenance Office	$25,000	Medium
Hopewell Township	Inspection of canal banks	New Jersey Water Supply Authority	N/A	High
Hopewell Township	Raise canal bank	New Jersey Water Supply Authority, NJDEP, D&R Canal Commission	$250,000	High
Lawrence Township	Analysis of Route 206 at Notre Dame	NJDOT	$50,000	High
Lawrence Township	Analysis of Bakers Basin Road at Route 1	NJDOT	$50,000	High
Lawrence Township	Analysis of Princeton Pike culvert near Fairfield Avenue	NJDOT	$50,000	High
Trenton City	Daylighting the Assunpink from South Broad Street to Warren Street	Trenton Department of Housing and Economic Development/Department of Inspections	To be determined	Medium
Trenton City	Portable Flood Barrier Study and Implementation	Department of Inspections/Fire Department/Civic Associations	To be determined	Medium
Trenton City	Detailed flood vulnerability study of the Trenton Water Filtration Plant	City of Trenton Department of Public Works	$100,000-$150,000	Medium
Trenton City	Flood protection at Trenton Water Filtration Plant	City of Trenton Department of Public Works	To be determined, likely over $1M	Medium

Table 5-3: Hunterdon County: Municipal Mitigation Actions by Action Category

1. Prevention (Policy/Ordinances/Studies/Enforcement)

Municipality	Mitigation Action	Responsible Party	Estimated Cost	Priority
Delaware Township	Stream Corridor Ordinance	Township Committee	$3,000	High
Delaware Township	Update Stormwater Regulations	Waste Water Management Committee	$2,000	High
Delaware Township	Flood review of all new construction	Floodplain Coordinator	$500	High
Franklin Township	Maintain guidelines for steep slopes and flood prone areas	Planning Board and Building Dept.	N/A	Medium
Kingwood Township	Complete All Hazards Mitigation Plan	Kingwood Township	$1,000	High

2. Property Protection (Acquisition, Elevation, Flood proofing)

Municipality	Mitigation Action	Responsible Party	Estimated Cost	Priority
Frenchtown Borough	Relocation of electric panels at Public Works garage and sewer plant	Borough	$20,000	High
Frenchtown Borough	Relocation of Sewer Plant	Borough	$3-5M	High
Kingwood Township	Elevate Homes	Kingwood Township OEM	$5M	High
Kingwood Township	Property Acquisition	Kingwood Township OEM	$5M	High
Lambertville City	Assist residents and business owners with elevation applications	City Council	$250,000	High
Lambertville City	Analyze properties north of Cherry Street for structural elevation	City Council	To be determined	Medium
Raritan Township	Kuhl Road elevation	Township, county	$1.5 M	High
Raritan Township	Copper Hill Road elevation and bridge replacement	Township, county	$280,000	High
Raritan Township	Hampton Corner Road elevation and bridge replacement	Township, county	$330,000	High
Stockton Borough	Residential property acquisition	Floodplain Administrator	$1 M	High
Stockton Borough	Flood proof sewer pump station	Sewer Authority	$25,000	High
Stockton Borough	Relocate Fire Department	Planning Board	$750,000	Medium
Stockton Borough	Flood proof Borough Hall	Floodplain Administrator	$25,000	Low

3. Public Information and Awareness

Municipality	Mitigation Action	Responsible Party	Estimated Cost	Priority
East Amwell Township	Community education for flood preparedness	East Amwell Township	To be determined	High
Lebanon Township	Public education	Lebanon Township	Minimal direct cost	Medium
Stockton Borough	Public awareness program	Stockton OEM	$500	Medium

Table 5-3: Hunterdon County: Municipal Mitigation Actions by Action Category (cont'd)

4. Emergency Services

Municipality	Mitigation Action	Responsible Party	Estimated Cost	Priority
East Amwell Township	Upgrade community notification system and township web site	East Amwell Township	To be determined	Medium

5. Natural Resource Protection (Floodplain protection, Stream Corridor Restoration, Open space)

Municipality	Mitigation Action	Responsible Party	Estimated Cost	Priority
Alexandria Township	Open space along the Delaware	To be determined	To be determined	High
Delaware Township	Analysis of local watersheds	Princeton Hydro	$8,000	High
Franklin Township	Place rip-rap at face of stream adjacent to roadway	Franklin DPW	$2,000	High
Franklin Township	Remove sediment and vegetation from roadside culverts	Franklin DPW and/or sub-division developer	Depends on extent, $10,000 estimate	Medium
Franklin Township	Check for waterway obstructions (ie fallen trees, large debris, etc.)	Franklin DPW/landowners	Varies, $1,000 per obstruction estimate	Medium
Hampton Borough	Storm Creek bed clean-up	Franklin DPW	Free	High
West Amwell Township	Preserve open space and farmland	To be determined	To be determined	Medium

6. Structural Projects

Municipality	Mitigation Action	Responsible Party	Estimated Cost	Priority
Frenchtown Borough	Install backflow prevention plugs on drainage pipes under towpath and at sewer plant	Frenchtown Borough	$25,000	High
Frenchtown Borough	Raise level of the D&R towpath to prevent backflow of Delaware River over towpath	NJ State (DEP, D&R Canal Commission)	To be determined	Medium/ Low
Hampton Borough	Route 31 Retention Pond	NJDOT	To be determined	Medium
Lambertville City	Install a backflow prevention device storm sewer behind CVS Pharmacy that surcharges adjacent to the Canal Studios building	City Council	$75,000.00	High
Lambertville City	Install backflow prevention device within Niece Lumberyard to mitigate backflow of Ely Creek	City Council	$120,000	High
Lambertville City	Install flood gate and lift station at Swan Creek	City Council	$8 million	High
Lambertville City	Study of sanitary sewerage backflow during flooding events	Lambertville Sewer Authority	$500,000	High
Milford Borough	Wet well	Borough of Milford	To be determined	Medium
Stockton Borough	Levee (river wall) improvement plan	Governing body	$5 M	High
Stockton Borough	Backflow prevention on storm drain outlets	Storm Water Management Coordinator	$50,000	Medium

Table 5-4: Warren County: Municipal Mitigation Actions by Action Category

1. Prevention (Policy/Ordinances/Studies/Enforcement)				
Municipality	**Mitigation Action**	**Responsible Party**	**Estimated Cost**	**Priority**
Belvidere Township	Decommission lower dam	TBD	To be determined	Medium
Blairstown Township	Change ordinance to request BFE of at least one foot above	Blairstown Township	$100	High
Frelinghuysen Township	Maintenance of stormwater facilities (non-functioning retention pond)	To be determined	To be determined	TBD
Warren County	Decommission the Lower Dam of the Pequest River	NJDEP/USACE	Unknown	High
Pohatcong Township	Adopt new flood damage prevention ordinance	Township Council	$5,000.00	High
Pohatcong Township	Review development ordinances including density of development and stormwater management requirements	Land Use Board and Township Council	$5,000.00	Medium
2. Property Protection (Acquisition, Elevation or Flood proofing)				
Municipality	**Mitigation Action**	**Responsible Party**	**Estimated Cost**	**Priority**
Belvidere Township	Elevation	TBD	To be determined	High
Blairstown Township	Elevate utilities in homes in flood prone areas	Homeowners	5,000 to 10,000 per home	High
Frelinghuysen Township	Analyze the properties in a portion of town for structural elevation	TBD	To be determined	TBD
Frelinghuysen Township	Elevation of flood-prone structures	TBD	To be determined	TBD
Harmony Township	Acquire 10 properties on Goat Farm Road	Township Committee	$2,500,000	High
Knowlton Township	Mitigation of Severe Repetitive Loss Properties	Knowlton Township	To be determined	High
Knowlton Township	Elevate utilities and secure oil tanks	Property owners	To be determined	High
Independence Township	Assess elevations of critical facilities identified as being within the 100 year floodplain of the Pequest River	Township Committee	$10,000	Medium
Oxford Township	Assess elevations of critical equipment in the wastewater treatment plant and plan corrective action	PRMUA	$10,000 (assessment)	Medium
Pohatcong Township	Elevation of flood-prone residences	Property owners	$50,000 - $100,000 per structure	High
3. Public Information and Awareness				
Municipality	**Mitigation Action**	**Responsible Party**	**Estimated Cost**	**Priority**
Hardwick Township	Education through seminars and discussions	TBD	To be determined	Medium

Table 5-4: Warren County: Municipal Mitigation Actions by Action Category (cont'd)

4. Emergency Services

Municipality	Mitigation Action	Responsible Party	Estimated Cost	Priority
Allamuchy Township	Create an emergency plan in case of dam failure or an uncontrolled release of stored water	TBD	To be determined	High
Hardwick Township	Continue Early Warning by use of Emergency Operation Plan	OEM	To be determined	High
White Township	Early Warning	Township	$15,000	High

5. Natural Resource Protection (Floodplain protection, Stream Corridor Restoration, Open space)

Municipality	Mitigation Action	Responsible Party	Estimated Cost	Priority
Belvidere Township	Reroute creek banks to channel water away from residential areas	TBD	To be determined	TBD
Belvidere Township	River and creek bank replacement	TBD	To be determined	TBD
Belvidere Township	Dredging	TBD	To be determined	TBD
Blairstown Township	Removing debris along Paulinskill River	DPW and DEP	$100,000.00	High
Franklin Township	Remove debris from the Musconetcong and other waterways	NJDEP	$100,000	Medium
Hackettstown	Remove downed trees and debris from Musconetcong and small streams.	Hackettstown OEM	To be determined	Low/ Medium
Independence Township	Remove debris from sections of the Pequest	NJDEP	$100,000	High
Mansfield Township	Remove or thin out debris on Musconetcong River	TBD	To be determined	TBD
Pohatcong Township	Landscape Block 97, Lots 53 & 54 which are in the riparian zone of the Delaware River	Rutgers Forest Restoration Program	$20,000	Low
Warren County	Dredge lower portion of the Pequest River	NJDEP/USACE	Unknown	Medium
Warren County	Desnag the Pequest, Paulinskill, and Delaware River	NJDEP	Unknown	Medium
White Township	Remove debris from tributaries	DEP, DPW	$100,000	High
White Township	Keep entrance from tributaries to the Delaware River clear to prevent backup	DEP, federal	$100,000	High

Table 5-4: Warren County: Municipal Mitigation Actions by Action Category (cont'd)

6. Structural Projects

Municipality	Mitigation Action	Responsible Party	Estimated Cost	Priority
Belvidere Township	One-way valve	To be determined	To be determined	TBD
Belvidere Township	Reroute creek banks	To be determined	To be determined	TBD
Blairstown Township	Install backflow suppressors	DPW	$20,000	Medium
Blairstown Township	Levy along Paulinskill River at Paulinskill Fields	Contractor and DEP	$30,000	Medium
Blairstown Township	Channeling or walls built along Blair Creek	Contractor and DEP	TBD	Medium
Franklin Township	Attenuate Stormwater with a section of the Morris Canal	Township Committee	$270,000	High
Frelinghuysen Township	Construction of barriers to protect flood-prone	To be determined	To be determined	TBD
Hackettstown	Install storm drain basins and larger storm pipes in area of East Prospect Street	Hackettstown Department of Public Work	$51,000	Medium
Lopatcong Township	Sewer Line Modification	Lopatcong/Phillipsburg	$625,000	High
Oxford Township	Use Furnace Lake and dam as a detention basin to attenuate stormwater	NJDEP	$30,000	High
Phillipsburg Town	Modifications to Lift Station on Riverside Way	Town of Phillipsburg	$500,000	High
Phillipsburg Town	Modifications to WWTP on S. Main Street	Town of Phillipsburg	$500,000	High
Phillipsburg Town	Modifications to Street and Retaining Wall on Riverside Way	Town of Phillipsburg	$400,000	High
Phillipsburg Town	Provide for an Engineering Feasibility Study of the Lopatcong Creek to determine Mitigation Actions to Prevent Backflow of Creek when the Delaware River is at Flood Stage	Town of Phillipsburg	$200,000	High
Phillipsburg Town	Install Backflow Prevention on Stormwater Discharges to the Delaware River and Lopatcong Creek	Town of Phillipsburg	$500,000 - $1,000,000	High
Pohatcong Township	Install a pipe with backflow prevention device under railroad from River Road to the Delaware River	Township Council	$150,000	Medium
Pohatcong Township	Install backflow prevention device on several existing pipes/culverts that discharge to the Delaware River	Township Council	$300,000	Medium
Pohatcong Township	Construct a stormwater detention basin along to Mountain Road to control runoff from the mountain	Dept. of Agriculture, Soil Conservation Service	$250,000 - $350,000	Medium
Pohatcong Township	Study the impact of the removal of the Musconetcong River dams on flooding	Musconetcong Watershed Assoc., USACE	$300,000	Medium

Table 5-5: Sussex County: Municipal Mitigation Actions by Action Category

1. Prevention (Policy/Ordinances/Studies/Enforcement)

Municipality	Mitigation Action	Responsible Party	Estimated Cost	Priority
Fredon Township	Support new Master Plan with ordinances as detailed therein	Fredon Township	$20,000	Low
Frankford Township	Mountain Snowmelt and Rain Runoff Analysis	State, County, Local	$1M +	Medium to High
Fredon Township	Dam Analysis	Fredon Township	Staff time	Medium
Town of Newton	Dam Analysis	Town of Newton/ Private Property Owners	To be determined	High
Town of Newton	Enforce Municipal Ordinances and Town Master Plan	Town of Newton	N/A	Medium
Stillwater Township	Create County GIS Coverage for Dams and Inundation Areas	To be determined	To be determined	High
Sparta Township	Dam Analysis	Private Dam Owners	To be determined	High

2. Property Protection (Acquisition, Elevation or Flood proofing)

None Identified

3. Public Information and Awareness

Municipality	Mitigation Action	Responsible Party	Estimated Cost	Priority
Montague Township	Public Awareness	County OEM, township	$1,000	Medium
Sandyston Township	Public awareness	County	To be determined	Medium

4. Emergency Services

Municipality	Mitigation Action	Responsible Party	Estimated Cost	Priority
Fredon Township	Provide power to shelter at Civic Center	Fredon Township	$65,000	Low
Montague Township	Warning system installation along flood areas on River Road	Municipality	$50,000	Low to Medium

5. Natural Resource Protection (Floodplain protection, Stream Corridor Restoration, Open space)

Municipality	Mitigation Action	Responsible Party	Estimated Cost	Priority
Andover Borough	Klymers Brook Mitigation	John Risko, Robert Smith, chair	$10,000	Low
Branchville Borough	Cleanout brooks	Branchville Borough	$50,000	High
Branchville Borough	Removal of old railroad culvert in brook	Branchville Borough	To be determined	High
Fredon Township	Protect Whittemore Pond from new development	Fredon Township	$100,000	High

Table 5-5: Sussex County: Municipal Mitigation Actions by Action Category (cont'd)

5. Natural Resource Protection (Floodplain protection, Stream Corridor Restoration, Open space) continued

Municipality	Mitigation Action	Responsible Party	Estimated Cost	Priority
Montague Township	Clean up existing debris in the Benekill River	Flood Mitigation Committee and USACE	$500,000 - $700,000	High
Town of Newton	Moore's Brook Stream Cleaning and Desnagging	Town of Newton	To be determined	High
Sparta Township	Stream Restoration - Sparta Glen Brook	County, township	To be determined	High
Sparta Township	Stream Restoration - Wallkill River @ Station Park	Sparta Township	To be determined	Medium
Stillwater Township	Bank and Slope Stabilization - Paulinskill River @ Kohlbocker Road	To be determined	To be determined	High
Stillwater Township	Channel Modification and Bank stabilization - Neldon's Brook Stream Cleaning	To be determined	To be determined	High
Town of Newton	Moore's Brook Stream Cleaning and Desnagging	Town of Newton	To be determined	High
Sparta Township	Stream Restoration - Sparta Glen Brook	County, township	To be determined	High
Sparta Township	Stream Restoration - Wallkill River @ Station Park	Sparta Township	To be determined	Medium
Stillwater Township	Bank and Slope Stabilization - Paulinskill River @ Kohlbocker Road	To be determined	To be determined	High
Stillwater Township	Neldon's Brook Stream Cleaning, Channel Modification and Bank Stabilization	To be determined	To be determined	High

6. Structural Projects

Municipality	Mitigation Action	Responsible Party	Estimated Cost	Priority
Andover Borough	Install catch basin on Washer Farm	Andover Borough Building and Grounds Department	$65,000 (2006 dollars)	Medium
Andover Borough	Re-direct runoff from Route 206 near Whitehall Road to a catch basin	Andover Borough Streets and Roads Department	$13,000	High
Branchville Borough	Repair Small Pond Dam	Branchville Borough	To be determined	High
Byram Township	Little Paint Drainage Improvements	Byram Township	$75,000	High
Byram Township	Lackawanna Dam improvements	Byram Township, Lake Lackawanna Investment Corp.	To be determined	High
Fredon Township	Upgrade drain at intersection of Pond Place and Slate Ridge	Fredon Township	$10,000	High
Fredon Township	Mitigate Runoff from Newton Memorial Hospital	Newton Township	Unknown	Medium
Montague Township	Ice Flow Channel correction in the Benekill River	USACE	$500,000 - $1,000,000	High
Montague Township	Elevate River Banks along the Delaware and Benekill Rivers	Flood Mitigation Committee	To be determined	Low

Table 5-5: Sussex County: Municipal Mitigation Actions by Action Category (cont'd)

6. Structural Projects - continued

Municipality	Mitigation Action	Responsible Party	Estimated Cost	Priority
Town of Newton	Upgrade of Merriam Avenue School Stormwater Pump Facility	Town of Newton/ Board of Education	To be determined	High
Town of Newton	Stormwater Drainage Improvements in west end section of town	Town of Newton/ County of Sussex	To be determined	High
Town of Newton	Stormwater Drainage Improvements - Route 206 in the area of the Merriam Avenue Intersection	NJDOT	To be determined	High
Sparta Township	Re-direct stormwater in the area of Hopkins Corner Road and Valley Manor Drive	Sparta Township	To be determined	High

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