Delaware River
Flood Advisory Committee

A Partnership to Support Flood Mitigation

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Outline

- Background
  - Flood Damages
  - Mitigation
  - Flood Warning System

- Delaware River Flood Advisory Committee

- April 2005 Flood
Delaware River Basin

- Flooding has been recorded since 1839
  - Snowmelt
  - Severe Rainfall
  - Noreasters
  - Tropical Storms
  - Hurricanes
- Recent Events
  - Hurricane Floyd, January 1996, Tropical Storm Ivan, and the April 2005 floods produced major damage
  - Delaware main-stem first region wide floods since 1955
Mitigation

- Avoiding or reducing impact of hazards
- Federal Requirement
  - Essential to obtain post disaster assistance
  - Actions and plans need to be coordinated
  - Plan to avoid disaster is permitted by statute on a watershed basis
- Counties affected not eligible for HM because they do not have a “mitigation plan”
What is Mitigation Plan

- What are our hazards? – Flood, Drought
- What is at stake? – People, resources, animals
- What can we do about it?
- Selecting and prioritizing actions

Make ourselves safer and more sustainable
The importance of Flood Warnings in Flood Loss Reductions

- Flood Warning is a necessary piece of flood loss reduction
- NWS estimates flood warning can reduce flood damage by up to 10%
- B/C ratio for the flood warning system in the neighboring Susquehanna River basin is 12:1 (NWS, 1985)
- Effective flood warnings provides lead time
- EMAs and occupants must have lead time
- Flood Warnings are not a substitute for flood loss mitigation:
  - Flood proofing
  - Flood plain property acquisition
  - Flood plain regulations
  - Structural measures
Delaware River Basin Flood Advisory Committee

- DRBC established the Flood Advisory Committee in 1999
- Recommends flood loss reductions strategies
- Basin wide, interstate focus
- Assess, evaluate, and recommend improvements in the basin's flood warning system
- Increase local participation in flood loss reduction and mitigation opportunities.
- Improve distribution of flood loss reduction and mitigation program information.
Flood Advisory Committee

**Members:**

- Delaware Department of Natural Resources and Environmental Control
- New Jersey Department of Environmental Protection
- New York Department of Environmental Conservation
- Pennsylvania Department of Environmental Protection
- New York City Department of Environmental Protection
- Delaware Emergency Management Agency
- New Jersey Office of Emergency Management
- New York Office of Emergency Management
- Pennsylvania Emergency Management Agency
- Federal Emergency Management Agency
- U.S. Department of Agriculture Natural Resources Conservation Service
- U.S. Geological Survey
- National Weather Service
- U.S. Army Corps of Engineers
- National Park Service
- Delaware River Joint Toll Bridge Commission
- Hydroelectric Industry
- Local Water Resources Agency
- University of Delaware
NEW RAIN GAGES TO BE ADDED
NYC RAIN GAGES TO BE UPGRADED
PROPOSED TELEMETRY UPGRADES
PROPOSED STREAM GAGE TELEMETRY UPGRADES
POTENTIAL Prototype AHPS Flash Flood Graphics Application Using GIS and Doppler Radar
POTENTIAL FLOOD STAGE MAP PROTOTYPE
AHPS APPLICATION BASIN WIDE
POTENTIAL FLOOD STAGE MAP PROTOTYPE
POTENTIAL FLOOD STAGE MAP PROTOTYPE
FLOOD WARNING IMPROVEMENTS
Flood Forecasting in the Delaware River Basin

- Precipitation Estimates
- Radar Data
- Satellite Data
- River Gauge Data
- Weather Observations
- Snow Cover/Melt Data
- Reservoir Releases
- Climate Predictions
- Precipitation Forecasts
Basin Wide River Flood Warning Network

- Data collected from federal and state cooperators
- Middle Atlantic RFC models river systems to forecast river stages and flows
- NWS forecast offices at Binghamton, NY and Mt Holly, NJ issue forecasts and warnings
- NWS river and flood forecasts disseminated via NOAA Weather Radio, media outlets, Internet
Stream Gages and Flood Forecast Points in the Delaware River Basin

- **Stream Gage Inventory**
  - 160 continuous record stream gages
  - 118 gages have satellite telemetry
  - 46 Flood Forecast Points
Successes from the FAC

- Improved stream gaging and gage telemetry
  - New stream gauge for the Schuylkill River at Norristown, Pa.
  - Re-installation and modernization of a stream gauge at Tocks Island, NJ, in the Delaware Water Gap National Recreation Area.
  - Stream gauge on the Brodhead Creek at Minisink Hills.

- Improved hydrologic data for stream gauges at four locations:
  - Lehigh River at Lehighton, Pa
  - Schuylkill River at Berne, Pa
  - Brodhead Creek at Minisink Hills, Pa
  - Perkiomen Creek at Graterford, Pa
Successes from the FAC

- Expansion of NOAA All Hazards (weather) Radio (NWR) throughout the entire basin
  - Modernization of NWR system in Philadelphia to improve coverage.
  - Addition of two new NWR transmitters in Sussex County, N.J., and in Sudlersville, Md.
Successes from the FAC

- Improve Flash Flood Warnings for small watershed areas
- Flash Flood Monitoring and Prediction (FFMP) basin threat map and table.
Successes from the FAC

- AHPS Implementation in the Delaware River Basin
Advanced Hydrologic Prediction Service

**Unmet Customer Needs**
- More precise forecasts over all time scales
- Information to make risk based decisions
- Universal access
- Visually oriented products

**AHPS Provides**
- Flash-flood to seasonal forecasts
- Forecast certainty
- Improved product delivery (Internet, wireless)
- Flood-forecast mapping

*Water Predictions for Life Decisions*
Successes from the FAC

- Snowmelt forecasting enhancements
- Expanded annual snow surveys to improve estimates of snowmelt used for river forecast models.
Successes from the FAC

- Collaboration between NOAA’s NWS and NYC DEP
  - Semi-annual meetings since 2001 to discuss data sharing
  - Design and Implementation of NYC Reservoir Precipitation Network
    - Added 26 state-of-the-art rain gages with radio telemetry
    - Design based on NWS system specs for climate network
  - Improve quality data for DEP management of NYC Reservoir System
  - Provide timely data for issuance of NWS Flood Warnings
  - NHORSC improved snow water equivalent estimates
  - NWS sharing HAZMET information with DEP
Spring Flood of April 3-4, 2005

- Most extensive flooding along the main stem of the Delaware in nearly 50 years
- Capitalize on Flood Improvement recommendations from FAC
- Better advanced warnings on floods in PA, NJ, NY, and DE
- Improved flood response by county EMAs
- NWS AHPS/DRBC websites provided expanded information on flooding in the Delaware Basin
Spring Flood of April 3-4, 2005

Two early spring rainstorms - the first on March 28-29 and a second on April 2-3, 2005 - combined with snowmelt to cause major flooding in the Delaware River Basin. Along the main stem of the Delaware River, the flood crests exceeded those reached in Tropical Storm Ivan only six and a half months earlier, and again caused evacuations, bridge and road closures, and extensive damage.

Delaware Canal at Yardley, Pa. – one half mile upstream of Afton Avenue Bridge – 8:30 am, April 4, 2005
Prior to the first storm, some watersheds in the upper Delaware basin had in excess of three inches water equivalent in the snowpack.
Upper Basin
March 28-29, 2005

Doppler Rainfall Estimate

The first storm brought over two inches of rain to western and northern portions of the basin. Warm temperatures melted about half of the snowpack, which totaled over three inches water equivalent in some northern watersheds.
Lower Basin
March 28-29, 2005
Doppler Rainfall Estimate
The second storm produced three- to five-inches of rain in the middle half of the basin, over two inches in the Catskill headwaters, and melted most of the remaining snow.
Lower Basin
April 2-3, 2005
Doppler Rainfall Estimate
Snowpack Water Equivalent

April 3, 2005

By the end of the second storm, most of the snowpack had melted.
By April 3rd, flood stages were exceeded on rivers and streams throughout the Delaware River Basin. Flooding was the most severe along the main stem Delaware River and headwater tributaries.
Flood watches were posted two days in advance of the second storm by the National Weather Service. Advance flood crest forecasts also were made and adjusted upward along the main stem Delaware as rainfall totals and streamflow data from U.S. Geological Survey (USGS) stream gaging stations were received.
This is an example of the flood crest forecast hydrographs posted on-line by the National Weather Service prior to and during the flood event.

These forecast products are a result of the National Weather Service’s Advanced Hydrologic Prediction Services, combined with stream monitoring by the USGS. The forecasts are made for real time gaging stations maintained by the USGS. During this severe flooding, forecasts also were made at Delaware River bridges operated and monitored by the Delaware River Joint Toll Bridge Commission.
# FLOOD PEAK COMPARISON
## AT SELECT BRIDGES ON THE DELAWARE RIVER

<table>
<thead>
<tr>
<th>BRIDGE</th>
<th>AUG '55 PEAK</th>
<th>SEPT '04 PEAK</th>
<th>APR '05 PEAK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phillipsburg-Easton</td>
<td>43.70’</td>
<td>33.45’</td>
<td>E36.5’</td>
</tr>
<tr>
<td>Frenchtown</td>
<td>27.80’</td>
<td>20.70’</td>
<td>22.55’</td>
</tr>
<tr>
<td>Stockton</td>
<td>28.40’</td>
<td>22.50’</td>
<td>E26.75’</td>
</tr>
<tr>
<td>New Hope</td>
<td>24.30’</td>
<td>*</td>
<td>19.70’</td>
</tr>
<tr>
<td>Washington-Crossing</td>
<td>27.80’</td>
<td>20.20’</td>
<td>E26.7’</td>
</tr>
</tbody>
</table>

*gage was removed for construction during 2004.


Data is provisional and subject to change.

E=estimated
FAC Recommendations have provided

- Enhanced and improved data collection
- Excellent cooperation
- Longer lead times
- Accurate and timely flood forecast information dissemination