Estimating Flood Damages Averted from NRCS Watershed Projects

Noel Gollehon, George Townsley, Ben Whitfield, William Merkel, and Sharon W. Waltman

Natural Resources Conservation Service, USDA

Soil and Water Conservation Society Annual meeting

July 24, 2012, Ft. Worth, Texas

1

Disclaimer

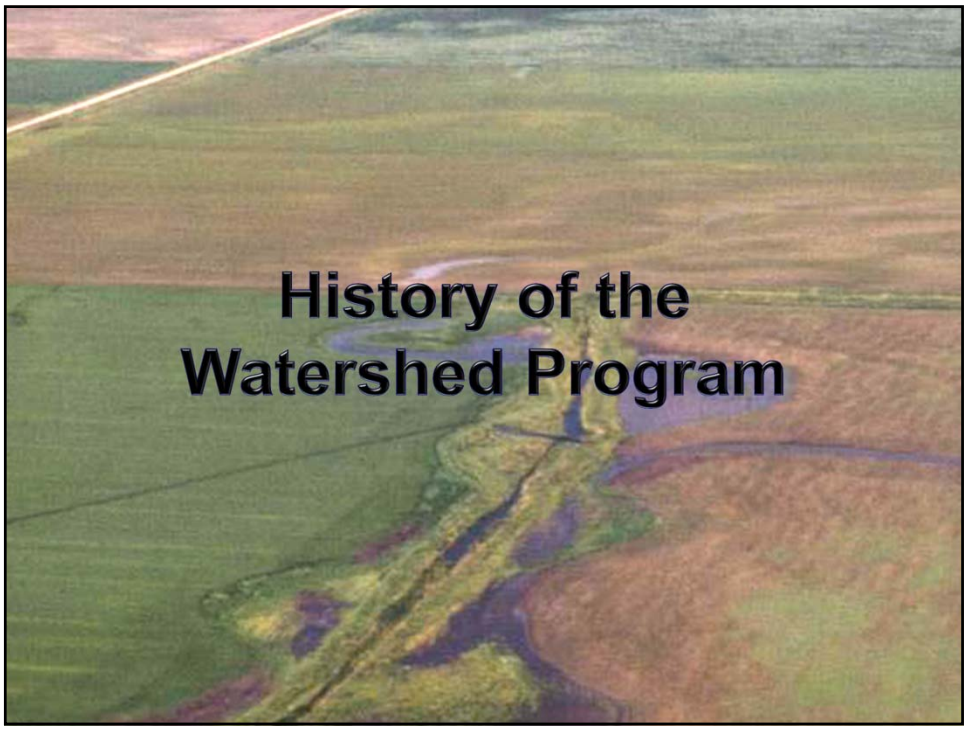
Thoughts and opinions presented today are those of the authors and do not represent those of USDA or the Natural Resources Conservation Service

2

Goals of presentation

1. Provide a historical description of NRCS's watershed dam program
2. Present preliminary monetary estimates of the flood damages averted as a result of the existing NRCS watershed projects during the 2011 storm events of Hurricane Irene (Irene) and Tropical Storm Lee (Lee)
3. To seek your help in improving the estimation process

3



History of the Watershed Program

- USDA became a Federal participant in the nation's flood control work via:
  - Flood Control Act of 1936
  - Flood Control Act of 1944
  - Flood Prevention Act of 1954
- USDA's work is limited to upstream tributary watersheds of less than 250,000 acres (<400 sq. miles)
- Flood prevention—engineering works
- Watershed protection—conservation practices on lands above the structures
- Many projects are multipurpose

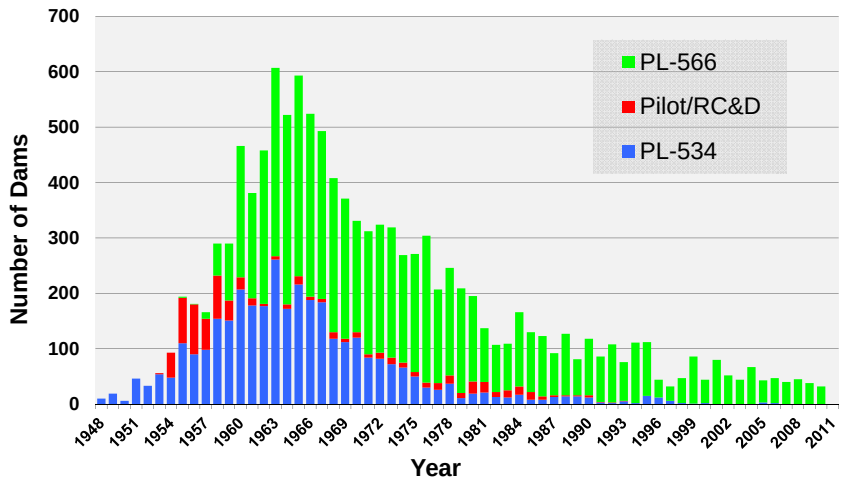
5

History of the Watershed Program

- Flood Control Act of 1944 (PL78-534): **3,444 dams in 12 states**
- Pilot Watershed Program (Ag Appropriation Act of 1954): **469 dams in 26 states**
- Watershed Protection and Flood Prevention Act (PL 83-566 enacted August 4,1954): **7,562 dams in 48 states**
- RC&D program through other Ag Appropriation Acts: **235 dams in 31 states**

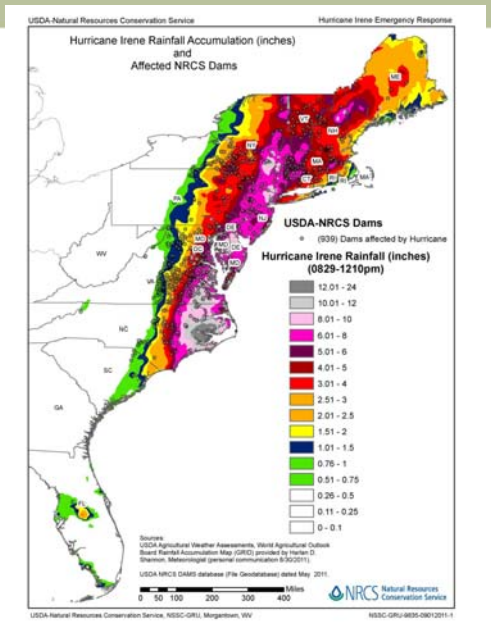
6

Watershed dam construction: By year and program



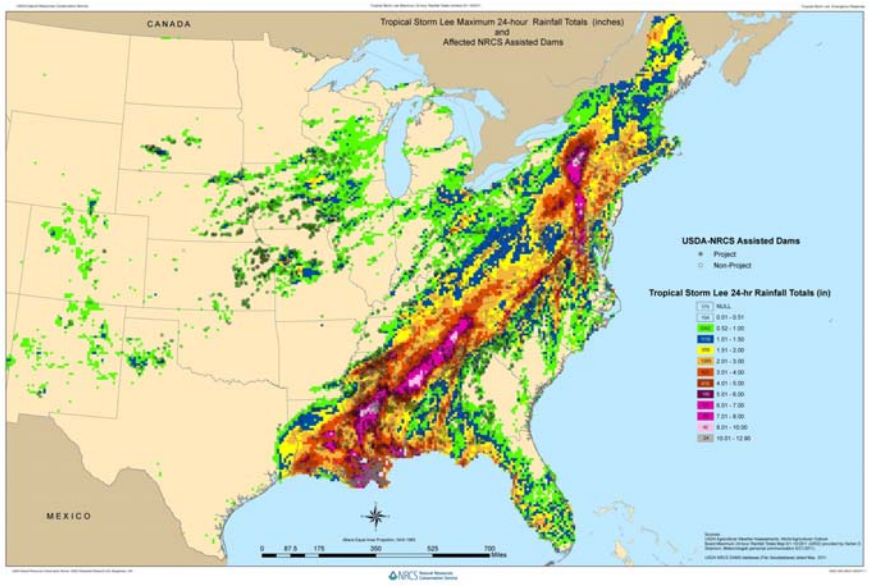
7

Hurricane Irene (August 27-29, 2011)



9

Tropical Storm Lee (September 2-10, 2011)



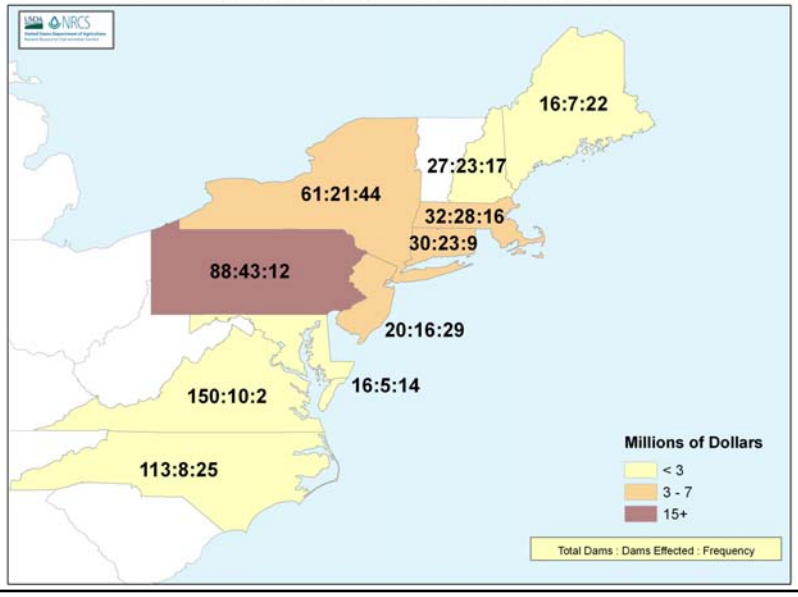
10

Motivation

- Was the watershed program a “good deal” for the taxpayer?
- Given the climate change projections of greater intensity storms, are the 2011 events scheduled to become more common?
- What does that mean for flood control policy?

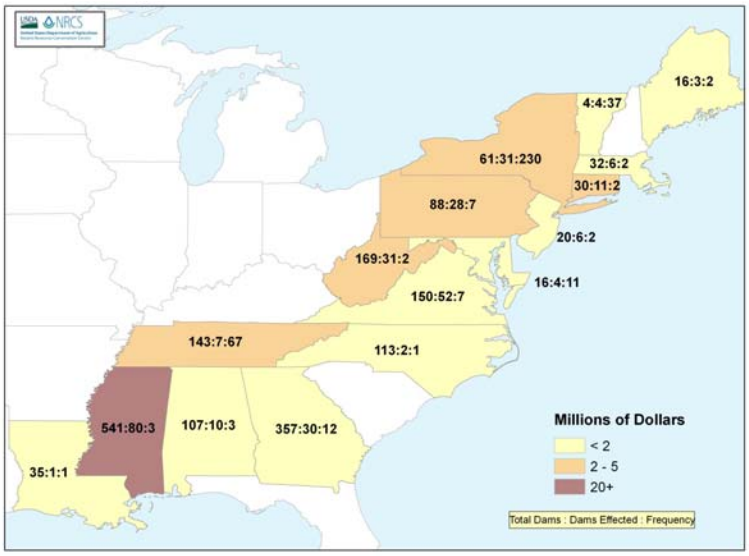
11

NRCS net damages avoided from flood prevention program—Irene



12

NRCS net damages avoided from flood prevention program—Lee



13

Method overview

- The precipitation amounts mapped against the location of dams in the impact area
- The flood year interval (e.g., 5-year, 10-year … 500-year) was assigned to each dam location
- The dams supported by NRCS watershed projects (project dams) were identified and assigned to watershed projects
- The dam flood-year intervals converted to watershed project average flood-year interval

14

Dams to watersheds: Numbers

	Irene	Lee
NRCS-sponsored dams in impact area	939	1,986
NRCS-sponsored "watershed" dams that potentially have flood control benefits *and* received more than a 1-year storm event	225	1,286
… *and* could be placed in a watershed project authorized under a program with flood control benefits (PL-566, PL-534 or Pilot programs)	211	283-377
NRCS watershed projects with the dams	68	76-104
… and reported average annual flood control benefits	59	59-79

15

Dams to watersheds: Process

	Process	Irene	Lee
NRCS-sponsored dams in impact area	GIS location	939	1,986
NRCS-sponsored "watershed" dams that potentially have flood control benefits *and* received more than a 1-year storm event	GIS location Storm Frequency Analysis	225	1,286
… *and* could be placed in a watershed project authorized under a program with flood control benefits (PL-566, PL-534 or Pilot Programs)	GIS location & **HAND MATCH**	211	283-377
NRCS Watershed Projects with the dams	GIS location & **HAND MATCH**	68	76-104
… *and* reported average annual flood control benefits	Internal data	59	59-79

16

Method overview (cont'd.)

5. Watershed benefits from flood damages averted for each project were computed from:
   - Average annualized flood damages reduction benefits from the watershed project design
   - A function to convert annualized damages into storm event damages (the Oklahoma conversion)
6. Flood damages averted were summed for the watersheds that reported average annual benefits for the impact area

17

Method overview (cont'd.)

5. Watershed benefits from flood damages averted for each project were computed from:
   - **Average annualized flood damages reduction benefits from the watershed project design**
   - A function to convert annualized damages into storm event damages (the Oklahoma conversion)
6. Flood damages averted were summed for the watersheds that reported average annual benefits for the impact area

18

Storm-event damages to annualized project benefits

This is the process that watershed economists go through to determine flood control benefits

Storm Frequency (years)	1	2	5	10	25	50	100	500
Storm probability	1	0.5	0.2	0.1	0.04	0.02	0.01	0.002
Damage factor based on area	0.269	0.347	0.450	0.493	0.525	0.548	0.570	0.000

The damage factors are applied to the economic assets in the flood plain to develop an annual damage amount based on storm probability that is then “annualized”

NRCS internal data contains the present value of the annualized flood damage estimate

19

Method overview (cont’d.)

5. Watershed benefits from flood damages averted for each project were computed from:
   - Average annualized flood damages reduction benefits from the watershed project design
   - **A function to convert annualized damages into storm event damages (the Oklahoma conversion)**
6. Flood damages averted were summed for the watersheds that reported average annual benefits for the impact area

20

Annualized values to storm-event damages

An internal NRCS analysis conducted in Oklahoma examined the annualized damage estimates and linked the values to actual storm event flood damages and found storm event damage factors.

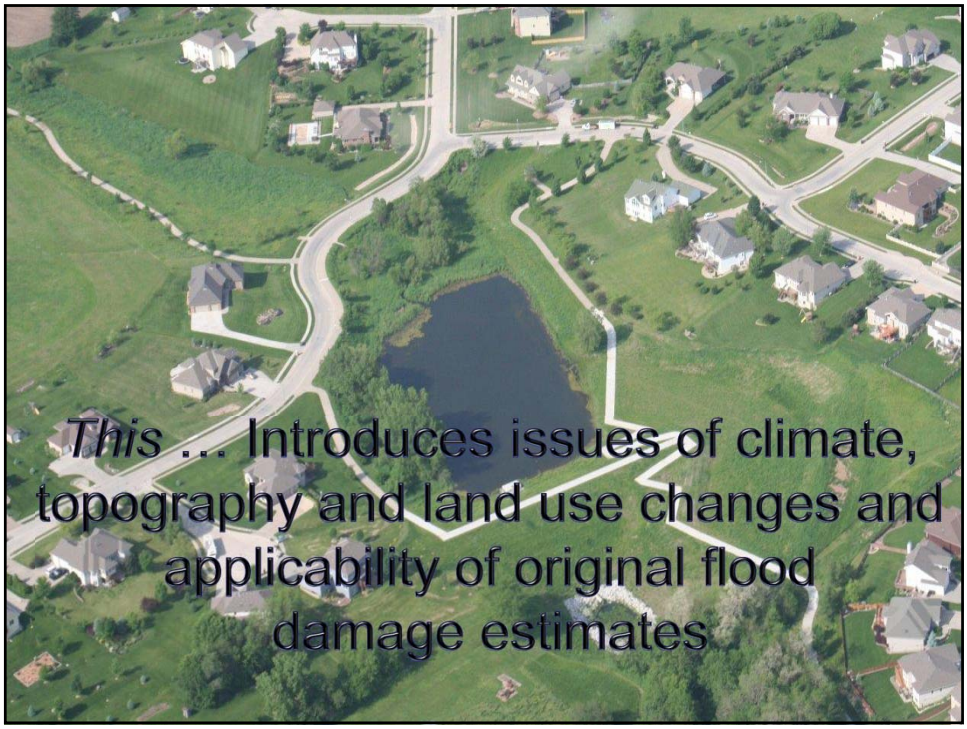
Storm Frequency (years)	1	2	5	10	25	50	100	500
Storm probability	1	0.5	0.2	0.1	0.04	0.02	0.01	0.002
Damage factor from Oklahoma study	**0.254**	**0.439**	**0.828**	**1.147**	**1.389**	**1.609**	**1.700**	**1.850**

This function from Oklahoma became a key element in our methodology

Need to examine the properties of this function …

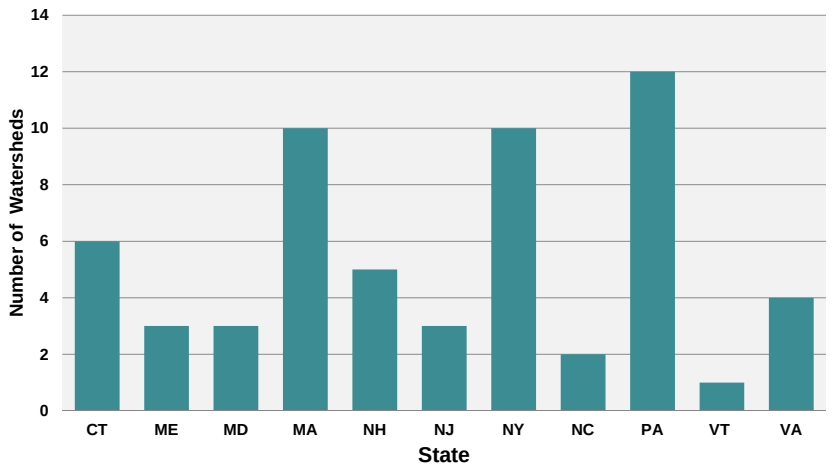
- Transferability across climate, topography, land use changes
- Applicability given that the original flood damage estimates were done before construction

21


This … Introduces issues of climate, topography and land use changes and applicability of original flood damage estimates

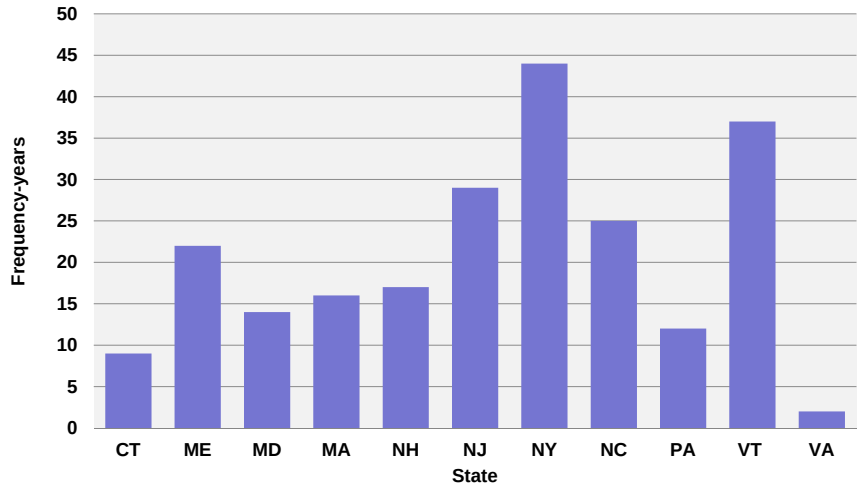
Damages-averted estimates

Number of watersheds with NRCS projects in Irene impact area



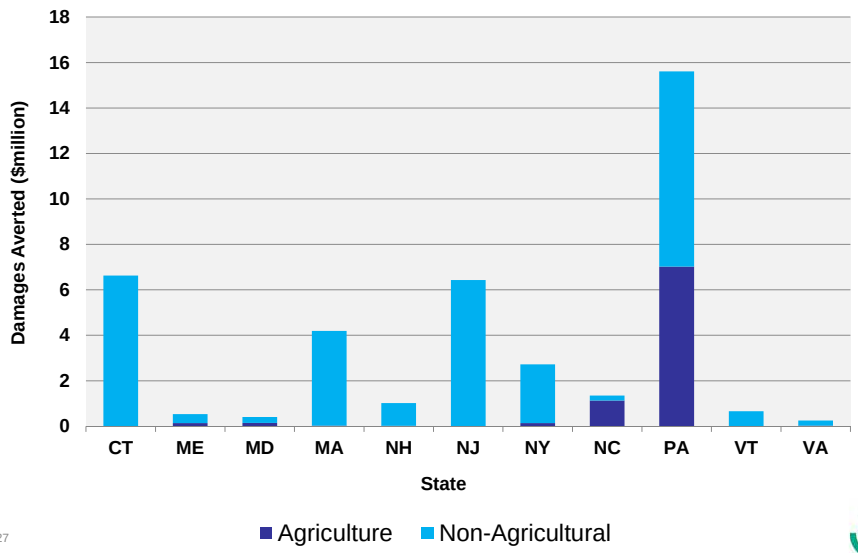
25

Storm frequency in NRCS watersheds—Irene



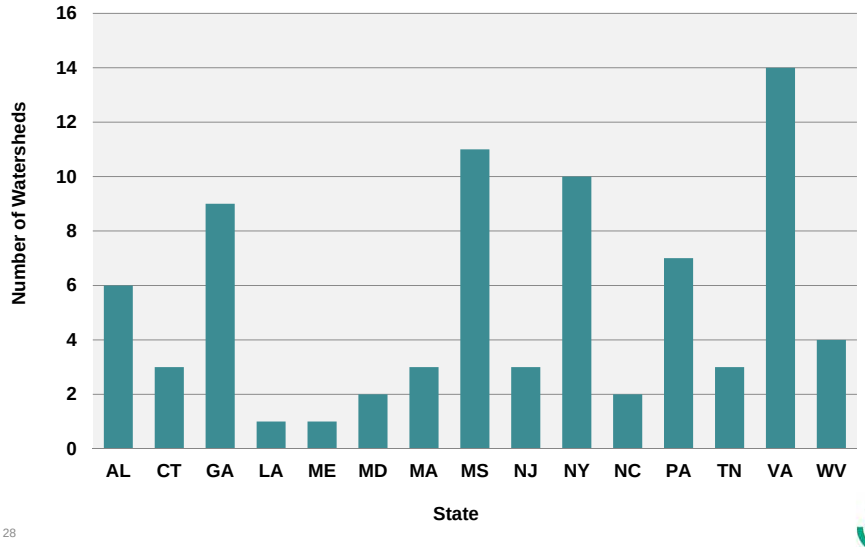
26

Estimate of flood damages averted in NRCS watersheds—Irene



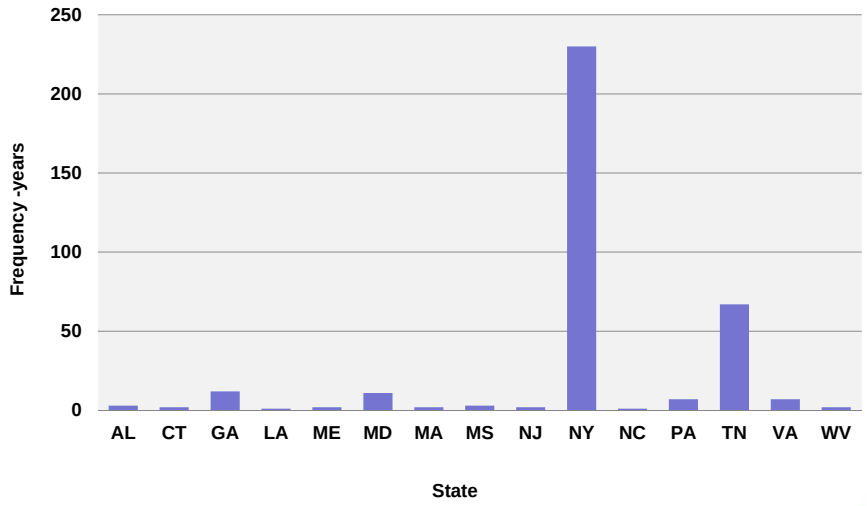
27

Number of watersheds with NRCS projects in Lee impact area



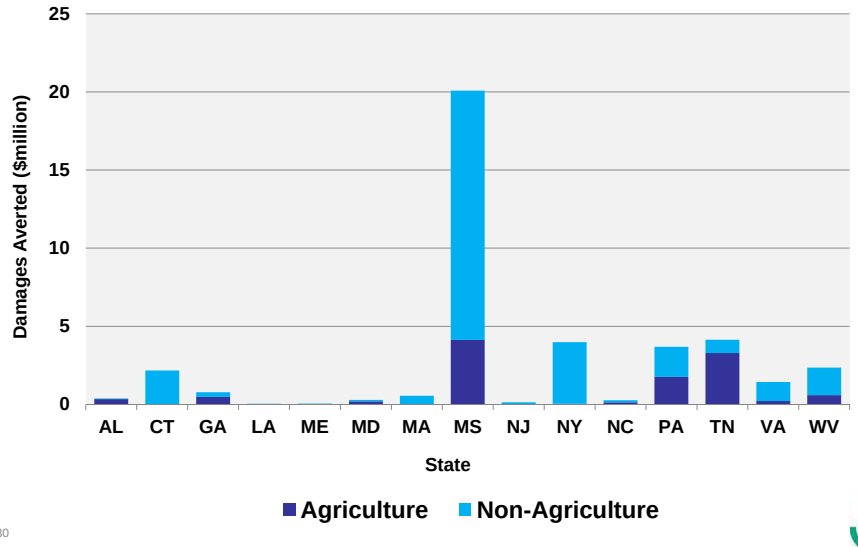
28

Storm frequency in NRCS watersheds—Lee



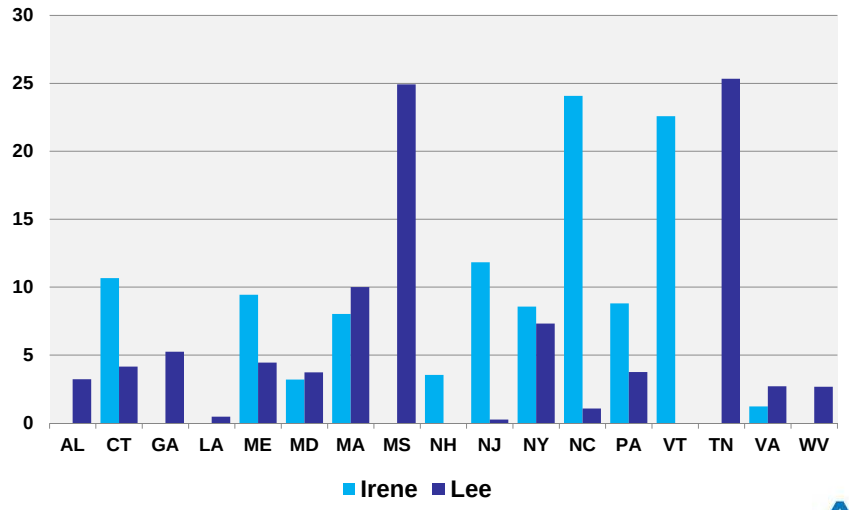
29

Estimate of flood damages averted in NRCS watersheds—Lee



30

Flood damages averted from single storm compared to project costs



31

Summary of damages averted analysis for 2011 floods from Irene and Lee

- Rainfall intensity reached levels of a 350-year storm for Irene and 700-year storm for Lee
- Over 400 NRCS flood control structures in more than 120 watershed projects performed ***as planned***
- Estimated damages averted from these projects is almost $80 million
- For agriculture—about $20 million estimated damages were averted

32

Watershed rehabilitation program

- Flood control efforts have been ZERO funded
  - Not terminated, but loss of staff resources will limit restart options
- Watershed rehabilitation program is ongoing
  - FY2012 at $15 million but Senate appropriation at zero
  - Rehab program is focused on dam safety for dams reaching their design life, especially in “high hazard” areas
    - Over 1,800 dams exceeded design life in 2010
    - Over 4,300 dams will exceeded design life by 2015
  - Rehab program activities
    - 27 states participating
    - 86 projects completed, over 100 in design or planning

34

How can we improve this process?

- Seek your help in improving the estimation of damages averted
- If you have ideas or suggestions or proposals please contact me

35

Thank you!

Noel Gollehon

301-504-1763

Noel.Gollehon@wdc.usda.gov

36