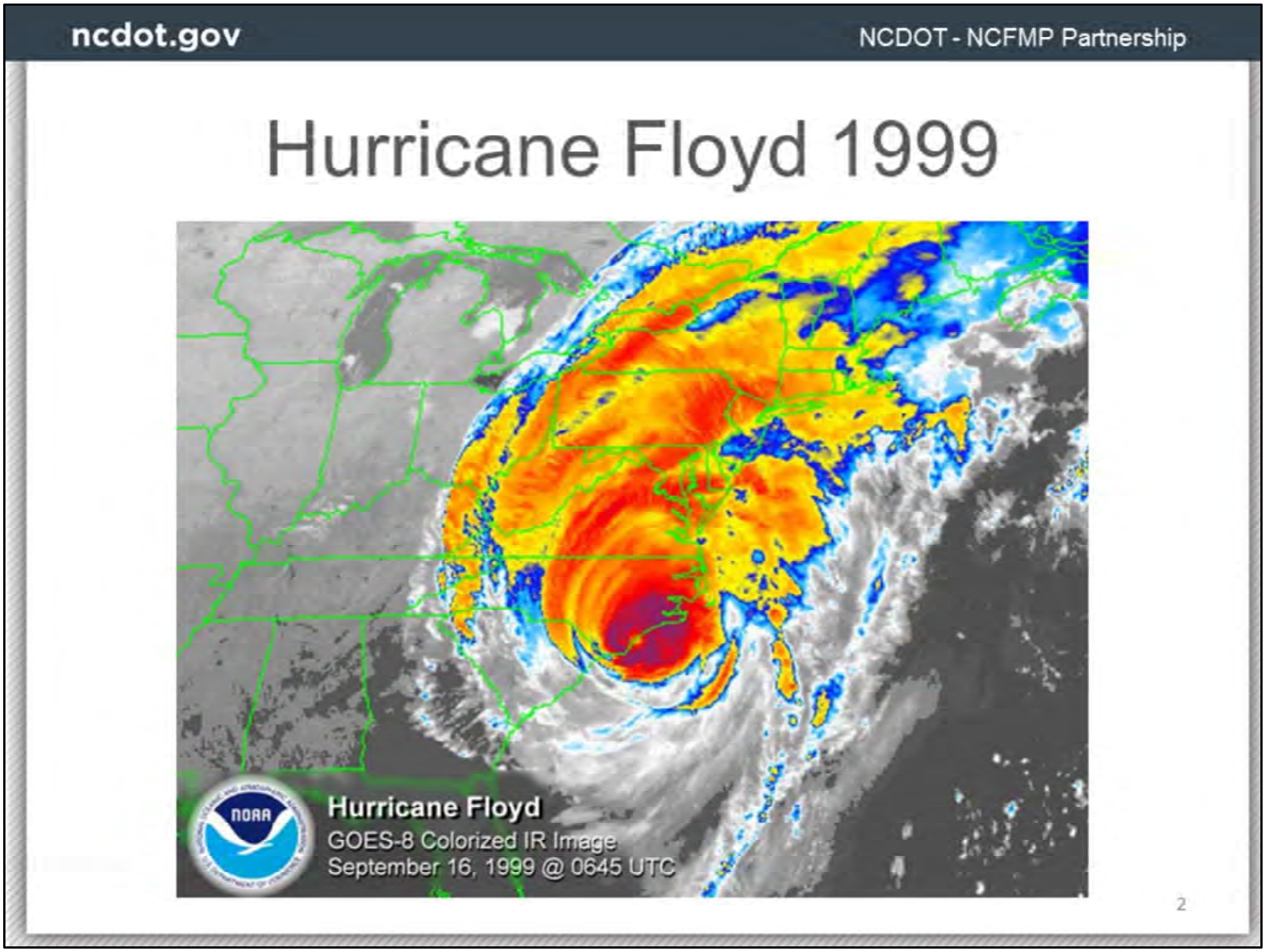
NORTH CAROLINA
Department of Transportation

NCDOT's Partnership with NC Floodplain Mapping Program

Streamlining NFIP Compliance

Jerry Snead, PE, CFM – NCDOT

NCAFPM Webinar Series, October 5, 2018



In 1999, Hurricane Floyd flooded thousands of square miles of eastern North Carolina and left thousands of people homeless. This disaster highlighted our vulnerability to natural disasters and the need for accurate, up-to-date floodplain maps.

NC FEMA CTP in 2000

FEMA

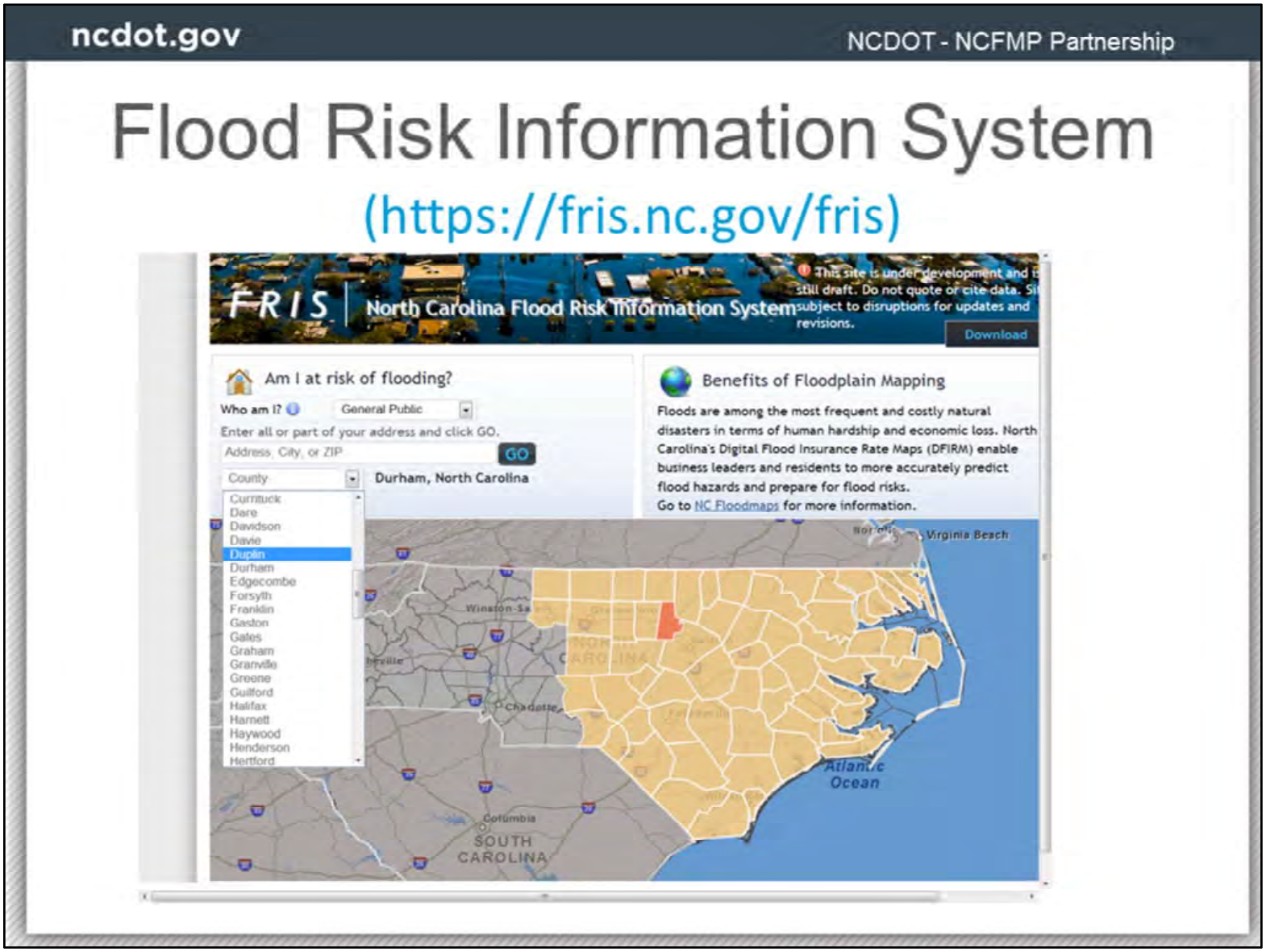
North Carolina Cooperating Technical Partner Agreement

Full Mitigation Best Practice Story

State-wide, North Carolina

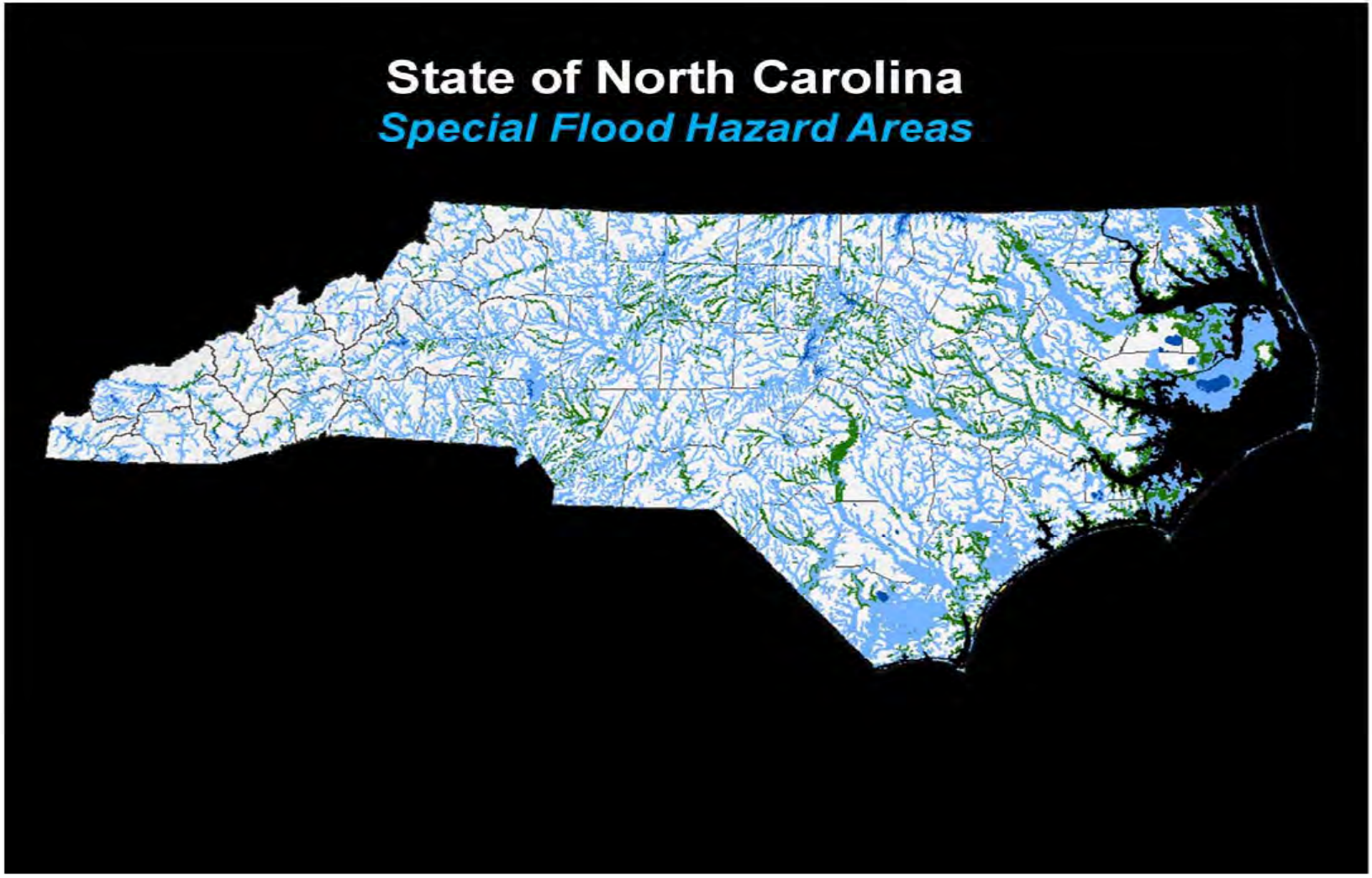
The State of North Carolina -- The State of North Carolina, FEMA, and numerous other Federal, State and local agencies entered a Cooperating Technical Partner (CTP) agreement September 15, 2000—the one-year anniversary of Hurricane Floyd. Under the agreement, the state will assume primary ownership of, and responsibility for, the National Flood Insurance Program (NFIP) Flood Insurance Rate Maps (FIRMs) for all North Carolina communities. The project includes conducting flood-hazard analyses and producing updated, digital FIRMs.

In 2000, the Federal Emergency Management Agency (FEMA) designated North Carolina a Cooperating Technical Partner State, formalizing an agreement between FEMA and the State to modernize flood maps. This partnership resulted in creation of the North Carolina Floodplain Mapping Program (NCFMP).



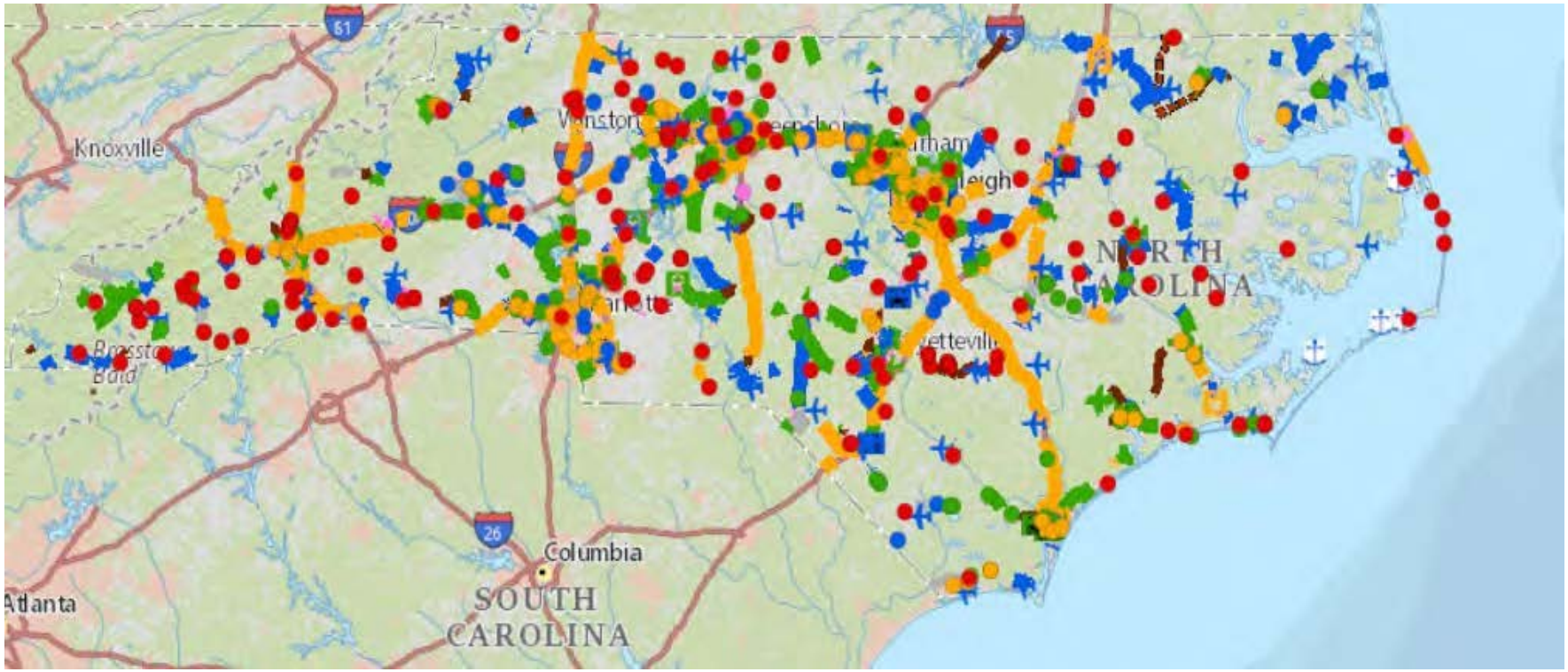
As a CTS, the State assumed primary ownership and responsibility of the Flood Insurance Rate Maps (FIRMs) for all North Carolina communities as part of the National Flood Insurance Program (NFIP). This project includes conducting flood hazard analyses and producing updated, Digital Flood Insurance Rate Maps (DFIRMs). These and much other flood risk information is publicly available on FRIS.

Nearly 85% NC streams in SFHAs



Now, nearly 85% of the streams in NC are in FEMA-regulated Special Flood Hazard Areas.

NC's largest developer is NCDOT



Given that NCDOT is the largest developer in the state, the burden of NFIP compliance is considerable.

Background

- FHWA / FEMA / NCDOT / NCFMP Meeting August 2006
- Federal Executive Order 11988 (1977)
- State Executive Order 123 (1979)
- FHWA "Procedures for Coordinating Highway Encroachments on Floodplains..." (1982) supplement to 23 CFR 650A
- Highway Administrator Bill Rosser Commitment to Compliance (2006)

Prior to 2006, NCDOT became aware of our need to significantly improve our floodplain management efforts. In August 2006 FHWA, FEMA, and NCFMP representatives met with NCDOT Hydraulics Unit staff to discuss floodplain management concerns. FHWA emphasized that Federal Aid Projects are required to be in compliance with FHWA regulations which are consistent with National Flood Insurance Program regulations, as outlined in a 1982 Memorandum of Understanding between FEMA and FHWA titled Procedures for Coordinating Highway Encroachments of Floodplains with FEMA (later codified in a supplement to the Federal Aid Policy Guide under 23 CFR 650A Location and Hydraulic Design of Encroachments on Flood Plains). Further, this policy is reinforced by both Federal and State Executive Orders and affirmed in the commitment by the Highway Administrator at that time (2006) to ensure NFIP compliance.

Federal Executive Order 11988

- Executive direction that all Federal agencies shall follow the NFIP guidelines and work with FEMA to do so
- Provides guidance for compliance
- Narrows agency statutory discretion
- Led to MOU Between FWHA and FEMA:
  - FHWA issued “Procedures for Coordinating Highway Encroachments on Floodplains...” (1982)

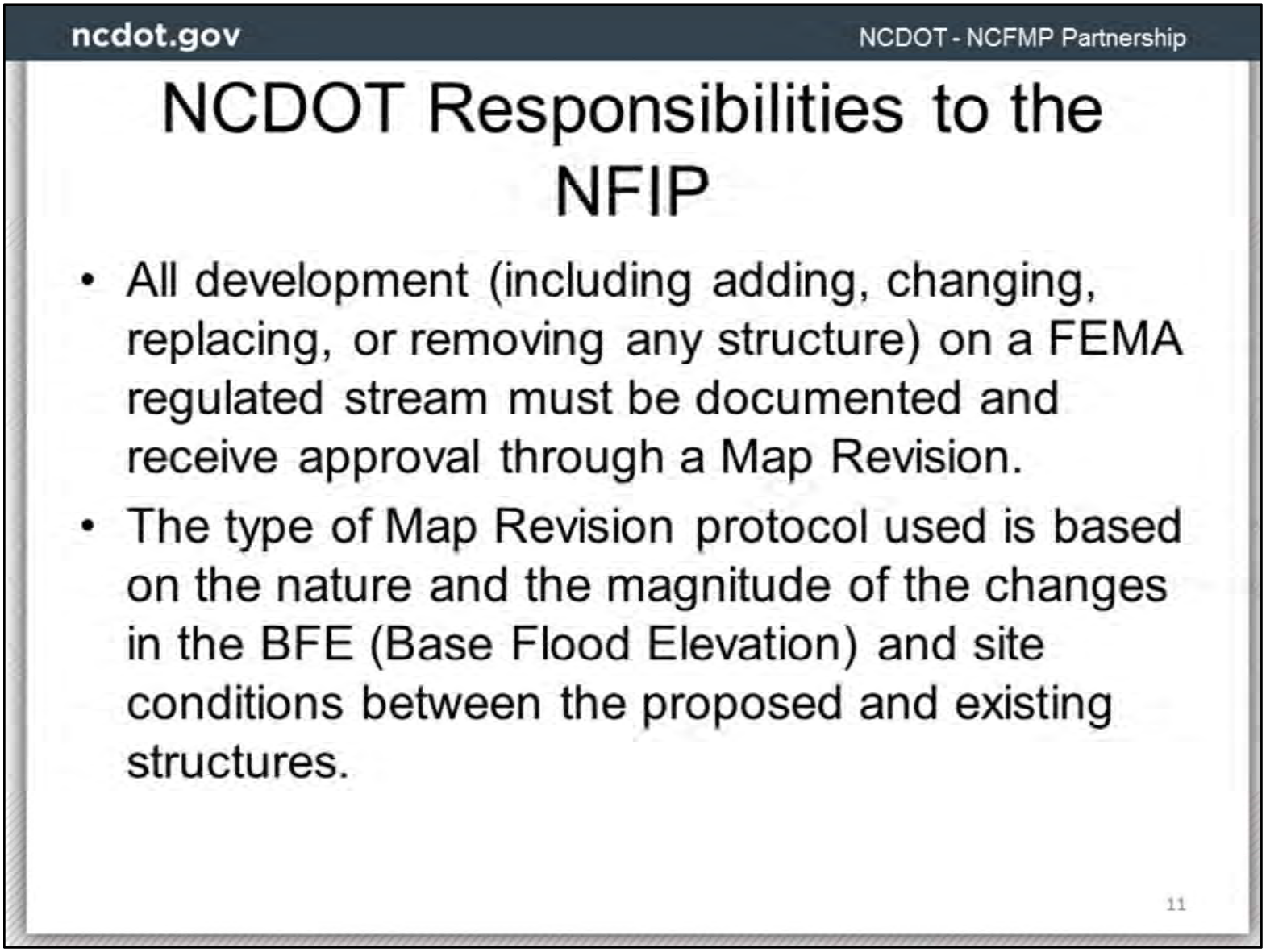
NC Executive Order 123

- State executive direction that requires all state agencies shall administer a unified floodplain management policy
- Provides guidance for compliance
- Mentions NC DOT specifically:
  - Section 3. The Department of Administration shall administer a Uniform Floodplain Management Policy for State Agencies. By agreement between the Department of Transportation and the Department of Administration, the **Department of Transportation shall work directly with the Federal Department of Transportation and the Federal Emergency Management Agency to apply appropriate standards and management to comply with the Floodplain Management Policy** relevant to highway construction within floodplains.

NFIP

- The goal of the National Flood Insurance Program (NFIP) is to reduce the impact of flooding on private and public structures..
- Any work within a designated Flood Hazard Area must be in compliance with the National Flood Insurance Program (NFIP) regulations (44 CFR 59-70).
- This includes road crossings or lateral encroachments inside of a regulated floodway or non-encroachment area.

Title 44 CFR parts 59, 60, 65 and 70
Contains the Code of Federal Regulations that define the NFIP.

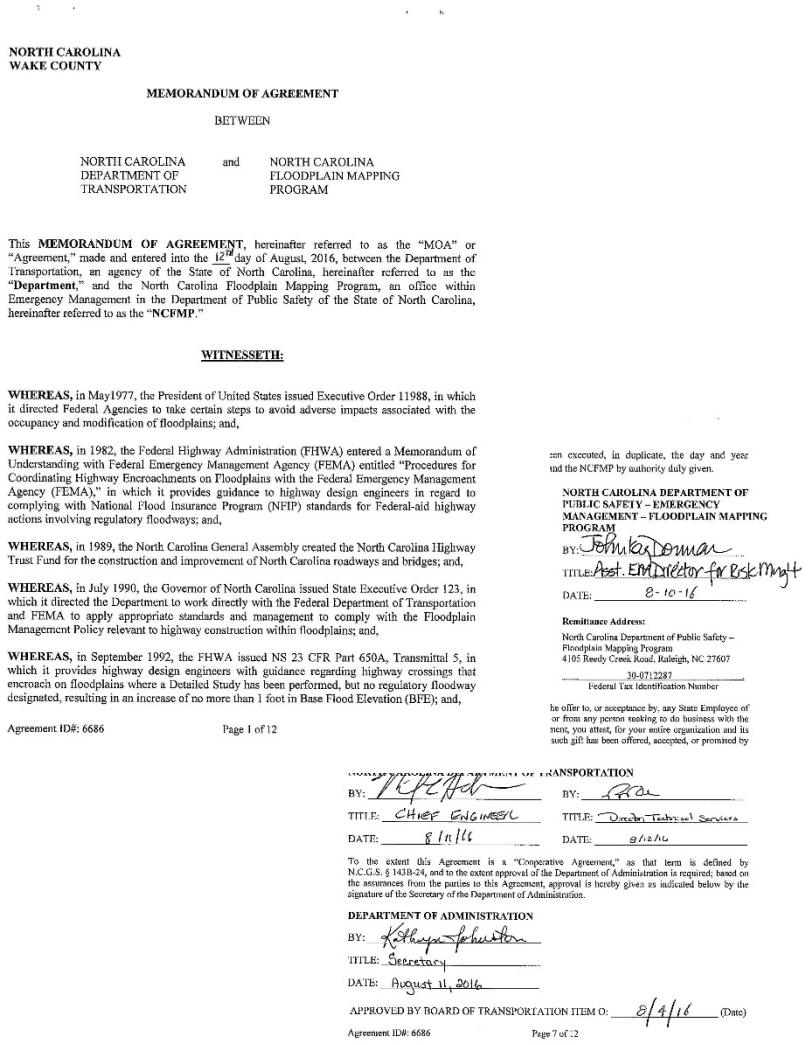


Revisions can include other encroachments (such as road widening, rest areas, BMPs, etc.) within FEMA Non-Encroachment Area.

NCDOT – NCFMP MOA

Agreement between NCDOT and NCFMP

- NCDOT and NCFMP are equal partners
- Ensures compliance with Federal and State Regulations
- Ensures Flood Hazard data is up-to-date
- Covers no-rise or decrease in Base Flood Elevation
- **Provides consistent project review statewide**



NORTH CAROLINA
WAKE COUNTY

MEMORANDUM OF AGREEMENT

BETWEEN

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION and NORTH CAROLINA FLOODPLAIN MAPPING PROGRAM

This **MEMORANDUM OF AGREEMENT**, hereinafter referred to as the "MOA" or "Agreement," made and entered into the 12th day of August, 2016, between the Department of Transportation, an agency of the State of North Carolina, hereinafter referred to as the "**Department**," and the North Carolina Floodplain Mapping Program, an office within Emergency Management in the Department of Public Safety of the State of North Carolina, hereinafter referred to as the "**NCFMP**."

WITNESSETH:

WHEREAS, in May1977, the President of United States issued Executive Order 11988, in which it directed Federal Agencies to take certain steps to avoid adverse impacts associated with the occupancy and modification of floodplains; and,

WHEREAS, in 1982, the Federal Highway Administration (FHWA) entered a Memorandum of Understanding with Federal Emergency Management Agency (FEMA) entitled "Procedures for Coordinating Highway Encroachments on Floodplains with the Federal Emergency Management Agency (FEMA)," in which it provides guidance to highway design engineers in regard to complying with National Flood Insurance Program (NFIP) standards for Federal-aid highway actions involving regulatory floodways; and,

WHEREAS, in 1989, the North Carolina General Assembly created the North Carolina Highway Trust Fund for the construction and improvement of North Carolina roadways and bridges; and,

WHEREAS, in July 1990, the Governor of North Carolina issued State Executive Order 123, in which it directed the Department to work directly with the Federal Department of Transportation and FEMA to apply appropriate standards and management to comply with the Floodplain Management Policy relevant to highway construction within floodplains; and,

WHEREAS, in September 1992, the FHWA issued NS 23 CFR Part 650A, Transmittal 5, in which it provides highway design engineers with guidance regarding highway crossings that encroach on floodplains where a Detailed Study has been performed, but no regulatory floodway designated, resulting in an increase of no more than 1 foot in Base Flood Elevation (BFE); and,

Agreement ID#: 6686 Page 1 of 12

…en executed, in duplicate, the day and year …nd the NCFMP by authority duly given.

NORTH CAROLINA DEPARTMENT OF PUBLIC SAFETY – EMERGENCY MANAGEMENT – FLOODPLAIN MAPPING PROGRAM

BY: John Ka Donnan

TITLE: Asst. EM Director for Risk Mgt

DATE: 8-10-16

Remittance Address:

North Carolina Department of Public Safety – Floodplain Mapping Program
4105 Reedy Creek Road, Raleigh, NC 27607

30-0712287
Federal Tax Identification Number

…he offer to, or acceptance by, any State Employee of …or from any person seeking to do business with the …ment, you attest, for your entire organization and its …such gift has been offered, accepted, or promised by

…RANSPORTATION

BY: [signature]

TITLE: CHIEF ENGINEER

DATE: 8/11/16

BY: [signature]

TITLE: Director, Technical Services

DATE: 8/12/16

To the extent this Agreement is a "Cooperative Agreement," as that term is defined by N.C.G.S. § 143B-24, and to the extent approval of the Department of Administration is required; based on the assurances from the parties to this Agreement, approval is hereby given as indicated below by the signature of the Secretary of the Department of Administration.

DEPARTMENT OF ADMINISTRATION

BY: Kathryn Johnston

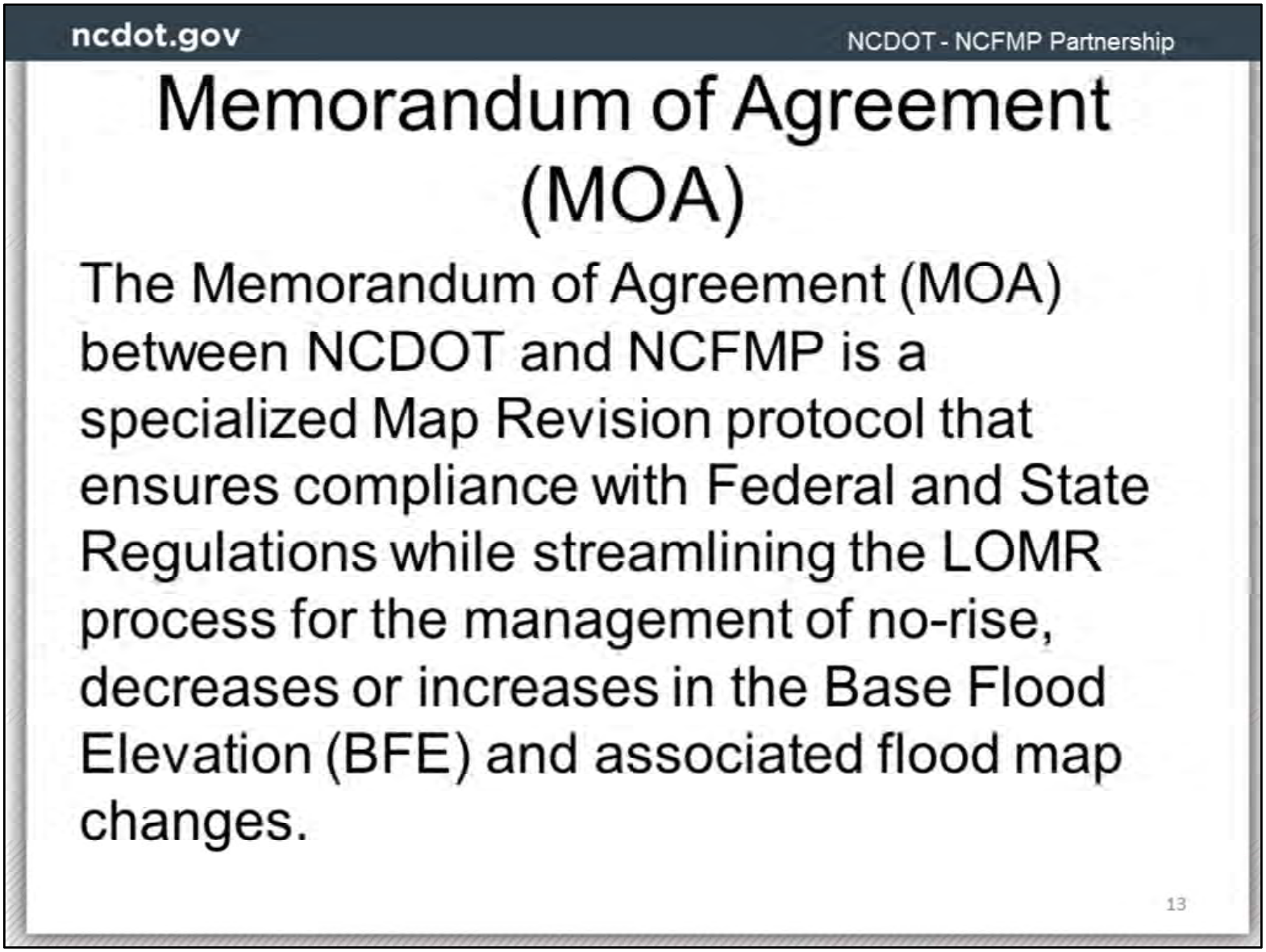
TITLE: Secretary

DATE: August 11, 2016

APPROVED BY BOARD OF TRANSPORTATION ITEM O: 8/4/16 (Date)

Agreement ID#: 6686 Page 7 of 12

In 2008, NCDOT entered into a Memorandum of Agreement with NCFMP to streamline FEMA compliance approvals for projects with no rise or minor decreases in BFE and to ensure Flood Hazard maps are updated statewide reflecting changes by NCDOT, the state's largest developer.



It provides an agency to agency agreement that is dynamic and flexible that ensures project milestones are not delayed.

Commitments

- NCDOT Committed to:
  - NCFMP review of all projects in SFHA
  - Fee for review and map maintenance to NCFMP
  - NFIP Compliance
- NCFMP Committed to:
  - Assuming responsibility for map updates
  - To conduct LOMRs for NCDOT
  - To work with NCDOT's existing processes, products and schedules

MOA Implementation

- Monthly MOA Coordination Meetings
  - First Thursday of each month
  - Projects presented, issues discussed
  - Over 1750 projects through MOA in 10 yrs

- Projects submitted to NCFMP digitally - Completely digital process for comments, responses and approvals

MOA Implementation

State Hydraulics Engineer
Stephen Morgan, PE
NCDOT

Director
John Dorman, CFM
NCFMP

The NCDOT State Hydraulics Engineer and NCFMP Director meet as needed for ongoing MOA oversight.

Benefits to the NCDOT

- One stop shop for review
  - Consistency
  - Instead of up to 650 different communities
- Little to no revision to DOT processes and products
- Approval time cut by approx. 75% for no-rise or decrease in BFE submittals.
- Agency to Agency agreement that is dynamic and flexible
- Ensures Let Dates are not in jeopardy of delay
- Advocate to FEMA and locals (increase issues, and alternatives issues)
- NFIP compliance

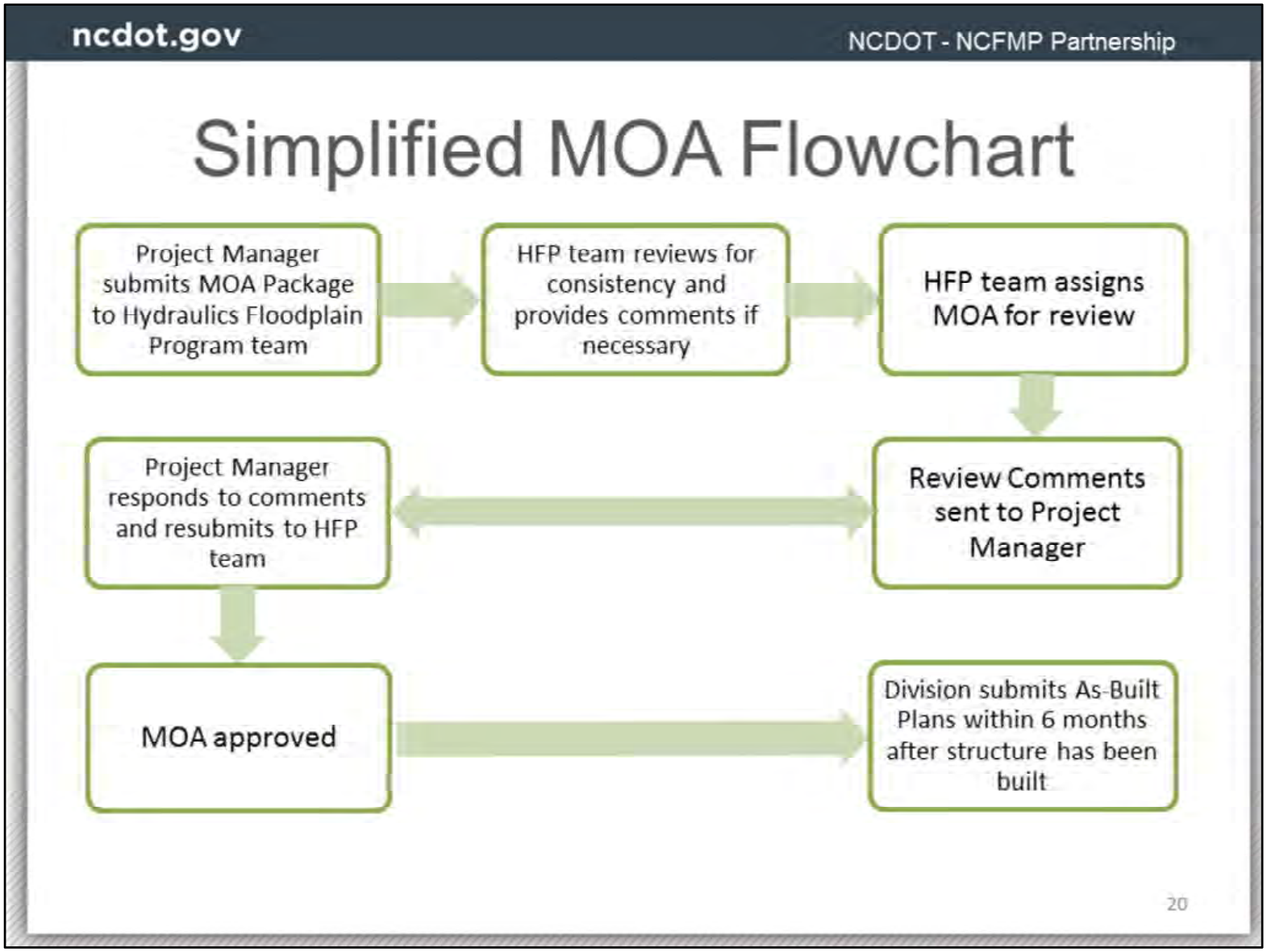
Read through slide. Note regarding approval time –CLOMRs typically take 1 year; MOA approvals generally under 3 months.

Benefits to the NCFMP

- Awareness of changes to the BFEs and SFHA for the largest floodplain developer in the State
- Fees support costs of map maintenance
- Current, accurate FIRMs and FIS reports
- True NCDOT NFIP compliance
- NCFMP models are used, avoiding rework
- Quality data
- Lessens load on communities

Additional Benefits

- Cross-training
  - 2-D modeling
  - HEC Center (HECRAS, etc)
- ESA Requirements (NEPA documents)
- Economy – private contractors
- Data Sharing
  - Effective hydraulic models, data
  - Terrain data (LiDAR), project surveys
  - Emergency response, early flood warning
  - Joint research opportunities
- PARTNERSHIP / COLLABORATION



This shows the basic MOA process from project submittal to approval and final submittal of as-built plans upon project completion.

Determination of MOA Type

MOA Type	Study Type	Change in Rounded BFE	Approval Authority	Additional Information
1	Any	Decrease ≤ 0.1'	SHE	Rounded BFE increases of 0.1 ft. and above are not permitted. Must confirm that there are no
2a†	Any	Decrease > 0.1' to < 0.5'	SHE	Must confirm that there are no structures impacted by a BFE increase in the hundreths.
2b	Any	Decrease ≥ 0.5'	NCFMP	Rounded BFE increases of 0.1 ft. and above are not permitted. Must confirm that there are no structures impacted by a BFE increase in the hundreths.
2c	Study with incomplete, erroneous or missing data	6 section analysis showing no BFE increase from existing to proposed conditions.	NCFMP	NCFMP Concurrence Required
2d†	Limited	Increase ≥ 0.1' to < 0.5'	SHE	The MOA narrative must confirm that there are no structures impacted by an increase greater than 0.00 ft.
2e	Limited	Increase ≥ 0.5' to ≤ 1.0	NCFMP	The MOA narrative must confirm that there are no structures impacted by an increase greater than 0.00 ft.

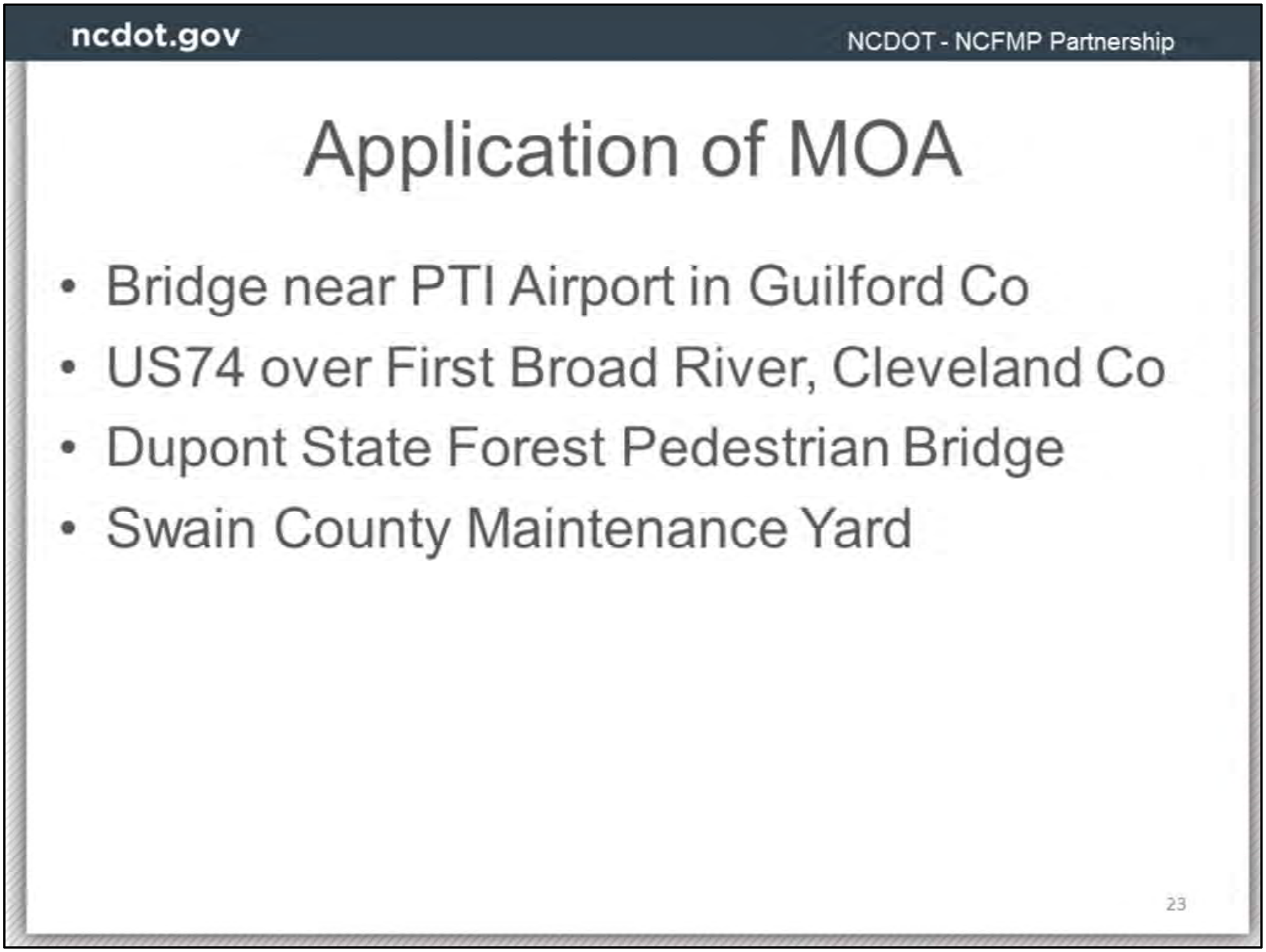
† If a project qualifies for both a 2a and a 2d, MOA type is determined by the maximum absolute change in BFE; if equal, submit as type 2d

The MOA specifies the criteria covered for BFE changes. Different review fees and protocols for approval are associated with each type.

Any BFE changes that fall outside these criteria must follow the normal FEMA CLOMR review process.

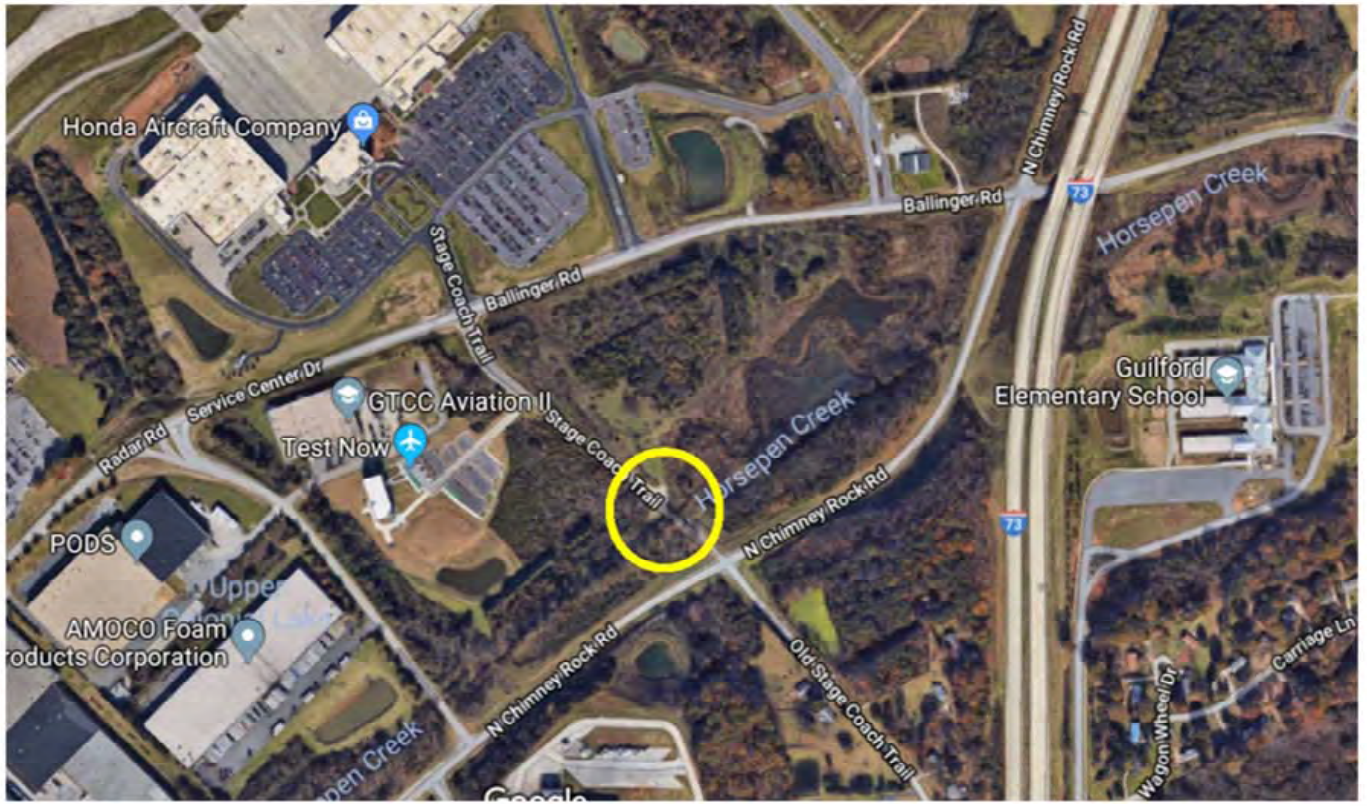
Determination of MOA Type

MOA Type	Study Type	Change in Rounded BFE	Approval Authority	Additional Information
2f	Limited	Increase > 1.0' & within ROW	NCFMP	Only applies if increase stays within ROW. FMP and SHE approval required.
2g	Detailed	Increase > 0.0 & within ROW	NCFMP	Only applies if increase stays within DOT ROW. FMP and SHE approval required.
3a	Approved CLOMR	n/a	NCFMP	Submit As-Built Plans for previously approved CLOMRs for which the DFIRM mapping is still current.
3b	Approved CLOMR	n/a	NCFMP	Submit As-Built Plans for previously approved CLOMRs for which the FIRM mapping has been modified since the issuance of the CLOMR approval.
3c	Any	Pre-application consultation when CLOMR is required or the published flood data are scientifically or technically incorrect	NCFMP	Engineer may initiate a pre-application consultation to discuss H&H design issues with a NCFMP representative.
4a	Approved MOA or CLOMR	n/a	NCFMP	Utilize when As-Built plans deviate from the design plans and flood models, which may results in a BFE and MOA type change and LOMR.



I want to discuss four projects which are few examples of how the MOA has been applied successfully on NCDOT projects.

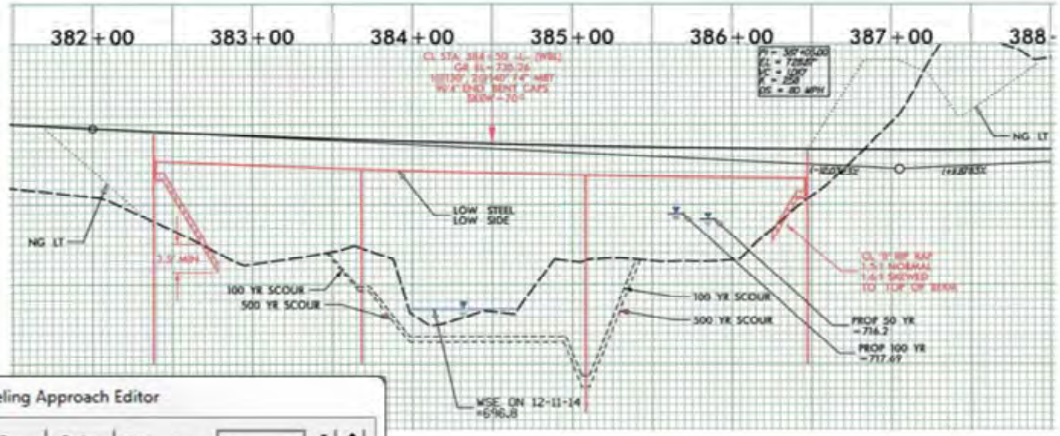
Culvert near PTI Airport, Guilford County



Reopening road to Honda Aircraft Company facility – fast track!
Proposed culvert caused rise in BFE – Horsepen Creek – CLOMR needed, but not enough time in schedule.

Under MOA, processed as Type 2g, rise contained in DOT right-of-way.
Approved in 1 month!

US74 over First Broad River - Cleveland Co



- Conventional modeling procedure is to select both Energy and Momentum methods.
- Engineer demonstrated momentum method not applicable here.

Conventional modeling caused increase in BFE which would have required a CLOMR.
Good communication/documentation allowed qualification for approval as MOA Type 2d.

Dupont State Forest Bridge

Transylvania County

In DuPont State Recreational Forest, traveling a very popular trail between Hooker Falls and Triple and High Falls required hikers to either ford the several foot deep, fast flowing Little River or to climb stairs and cross a very busy road — over guard rails on both sides — that served as the main access to a large portion of the park. Due to the volume of traffic on the roadway, this route was becoming increasingly unsafe for the hikers. Furthermore, horseback riders' only option was to ford the Little River, presenting a safety concern due to slick rocks and a swift current. As a solution, DSRF staff identified a location in the immediate vicinity of the existing ford that would be suitable for a bridge to serve both hikers and horseback riders.

Dupont State Forest Bridge

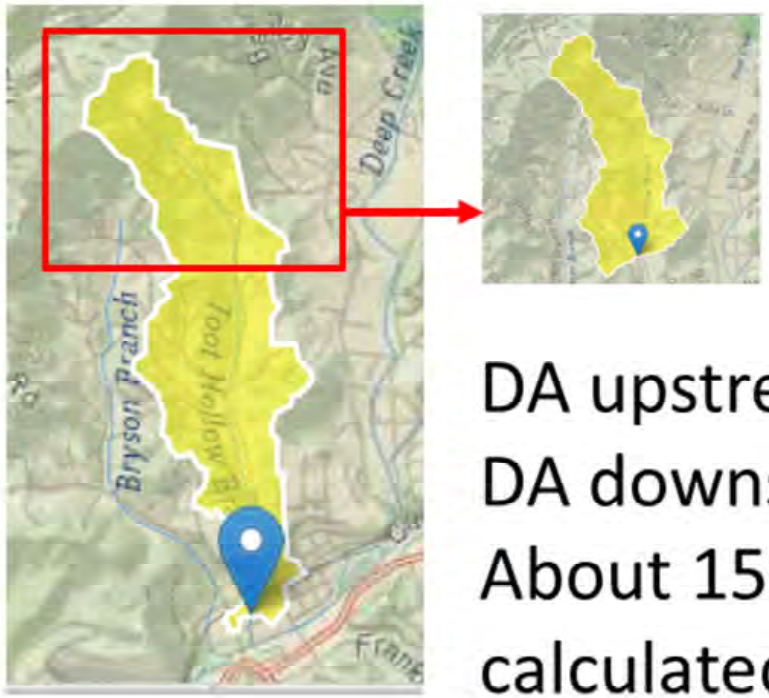
- High priority – design to completion in 6 months! Bridge created increase in BFE contained within State-owned property.
- Was able to use MOA (Type 2g) to get quick approval in about 1 month!

Swain County Maintenance Yard

- Toot Hollow Branch Special Flood Hazard Area very wide in project area.
- Limited detailed study – flow based on downstream drainage area.
- Good example of MOA coordination.

DOT needed to build a new building on the maintenance yard which would have been in a designated Special Flood Hazard area.

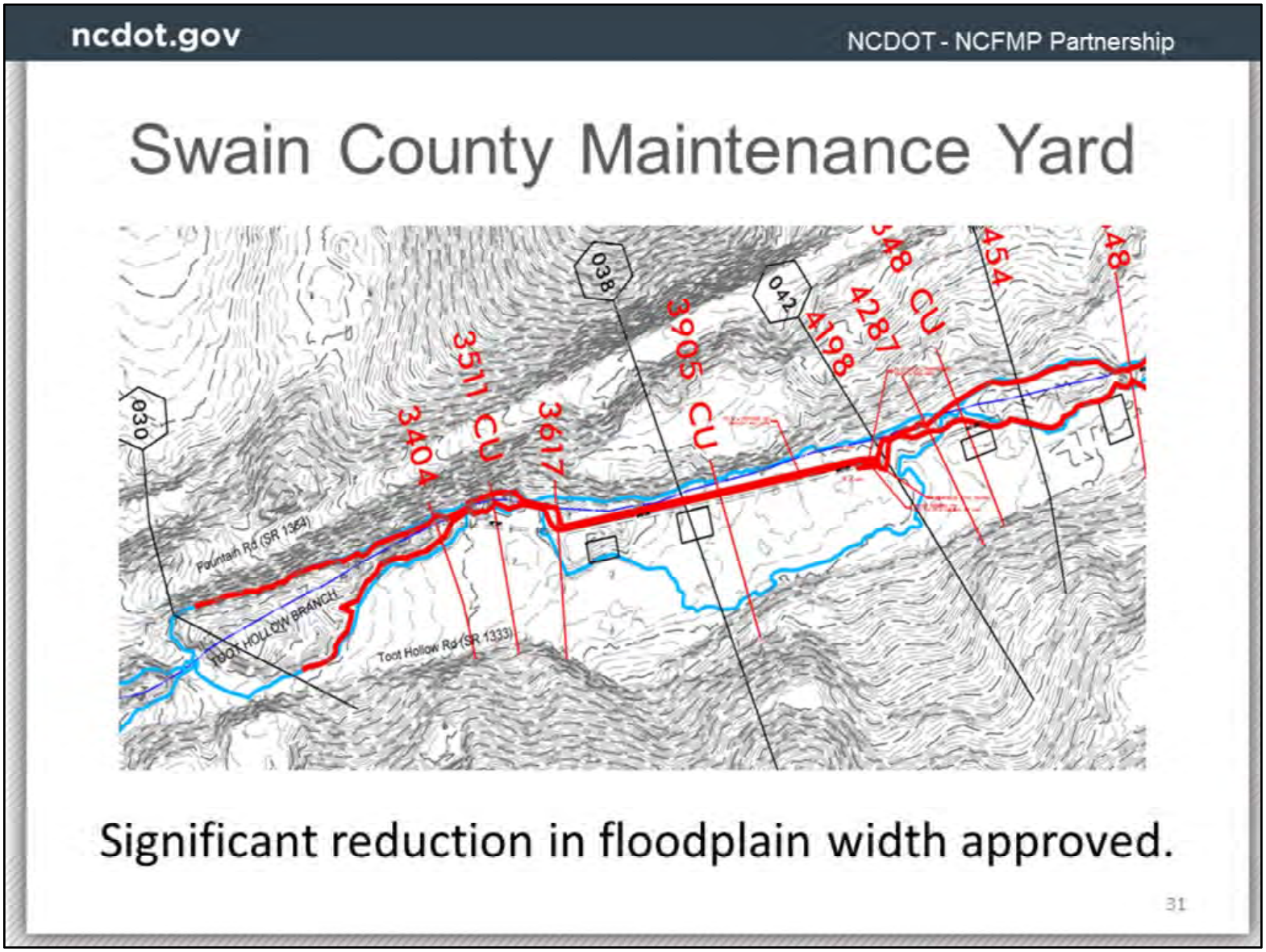
Swain County Maintenance Yard



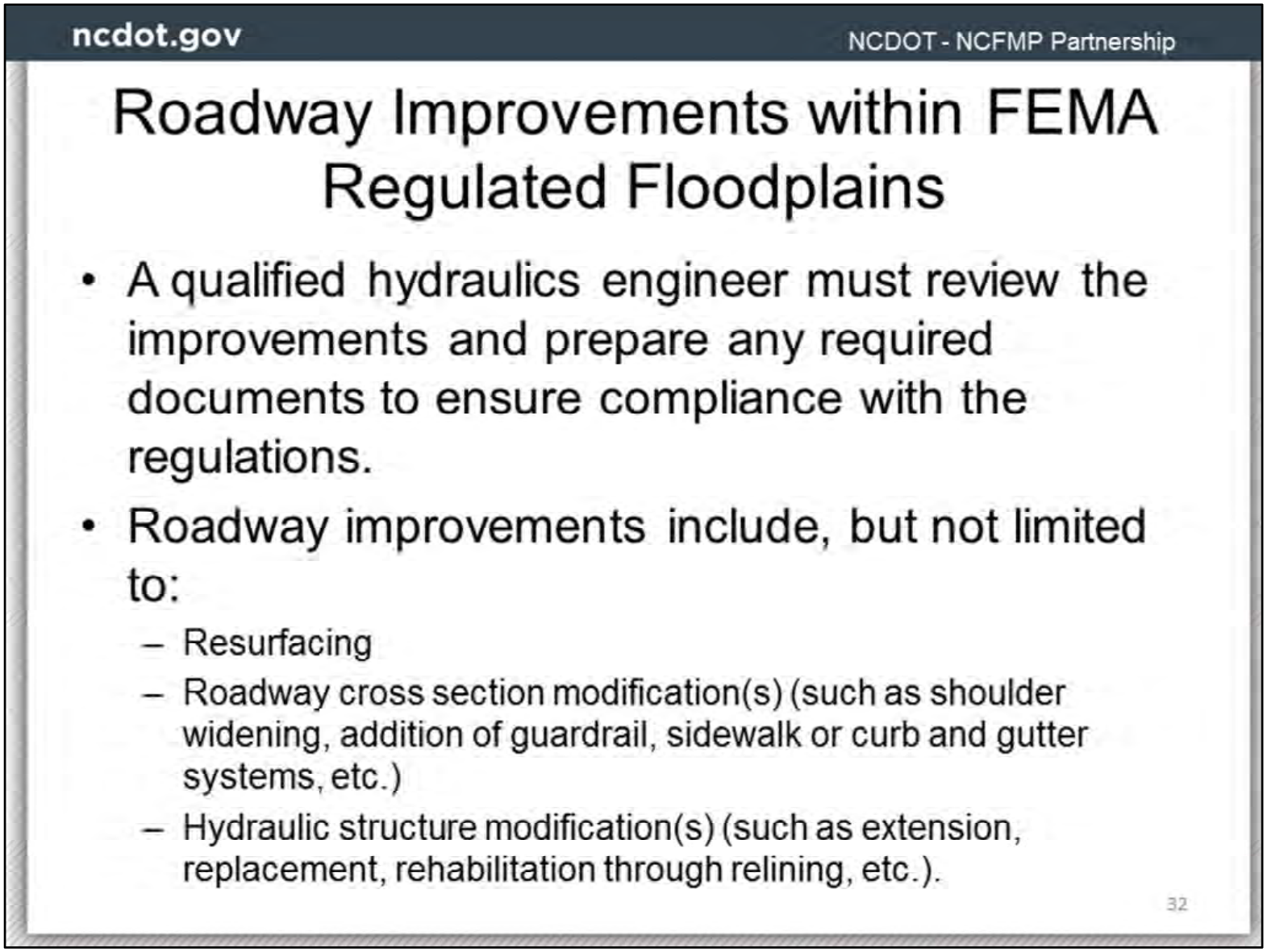
Added flow change location in model.

DA upstream: 340 acres
DA downstream: 435 acres
About 15% reduction in calculated 100 yr flow rate.

The effective hydraulic model used the downstream flow rate to calculate the 100 year water surface elevations upstream.
A new flow change location was added in the model near the proposed building site location to obtain a more accurate flow rate at that location.



Additionally, the 100 year flow was able to be contained in a closed pipe system through the proposed building site significantly reducing the floodplain width, so the proposed building could be built outside the SFHA. Approved as a Type 2b MOA (Limited Detailed Study stream).



In addition to NCDOT bridge replacement and major roadway projects, the MOA also provides a mechanism for NFIP compliance with respect to routine maintenance and operations activities as well as emergency response… (next slide)

Emergency Response

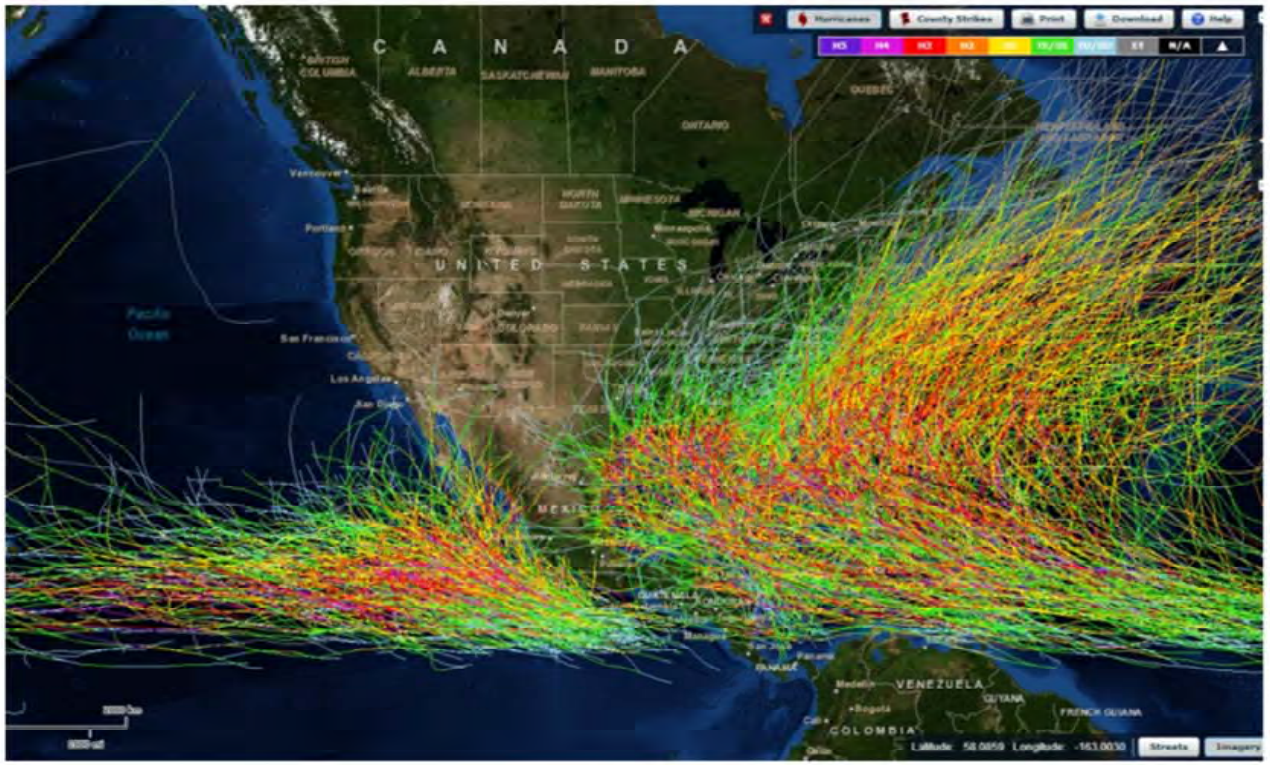
- The MOA allows us to follow our 2016 *Guidelines for Drainage Studies and Hydraulic Design*, Chapter 15, Section 15.8 Replacement of Emergency Flood-Damaged Structures.
- This protocol only applies to emergency replacements.

As we've been reminded lately with Hurricane Florence, Emergency Response is a very important aspect of our collaboration with NCFMP. The next several slides will highlight this, followed by some information provided by NCFMP on their Flood Inundation Mapping and Alert Network (FIMAN) application, which has proved very beneficial to us both during and after Hurricane Florence.

The MOA allows for NCDOT to follow its published emergency response guidelines in the event of flood damage from extreme storm events with appropriate follow-up afterward to provide NCFMP with supporting data for flood map and study updates as needed. However, routine maintenance tasks involving regulated SFHAs must follow the MOA process to ensure NFIP compliance.

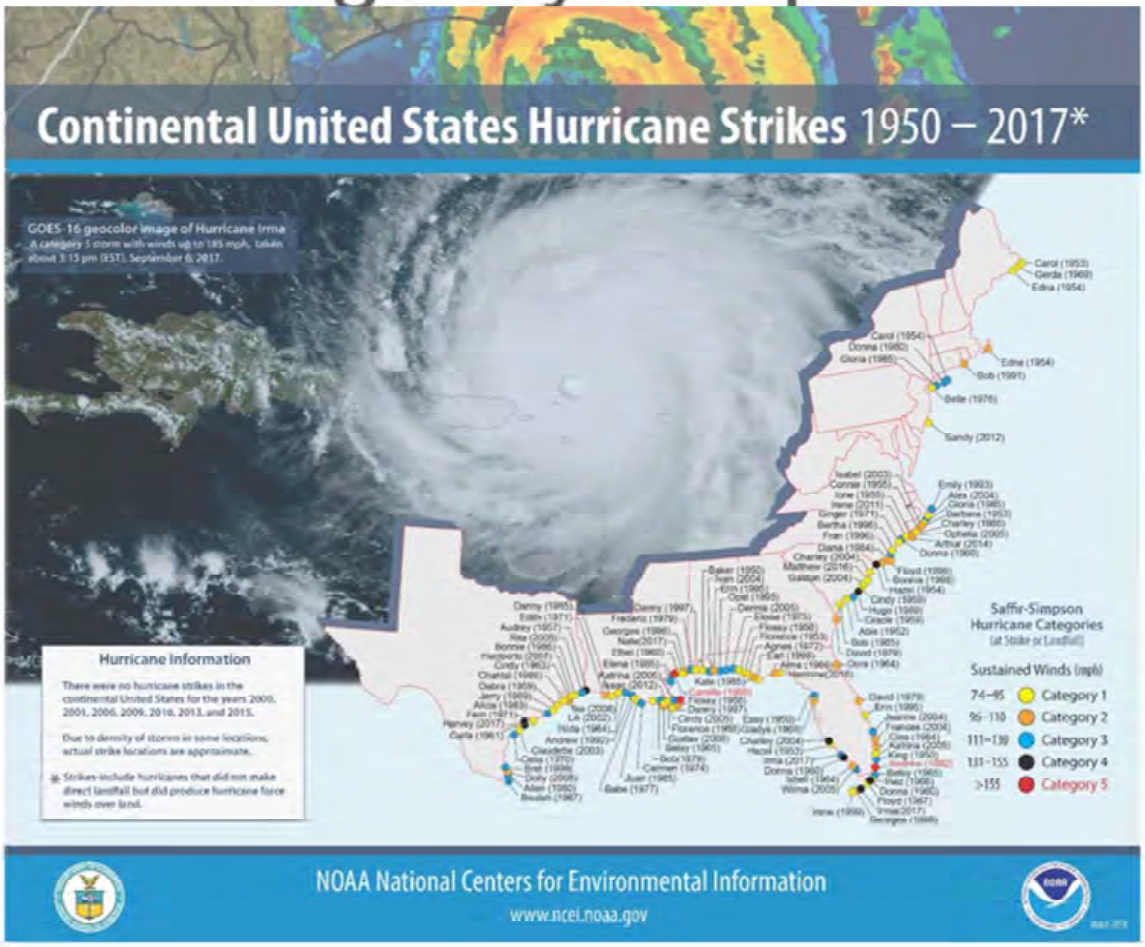
Following the emergency protocol outlined in our Guidelines, the Hydraulics Unit's Highway Floodplain Program staff and the State Hydraulics Engineer work to ensure that the necessary documentation, correspondence and review of any hydraulic structure replacements or repairs are submitted to NCFMP to maintain compliance with NFIP regulations.

Emergency Response

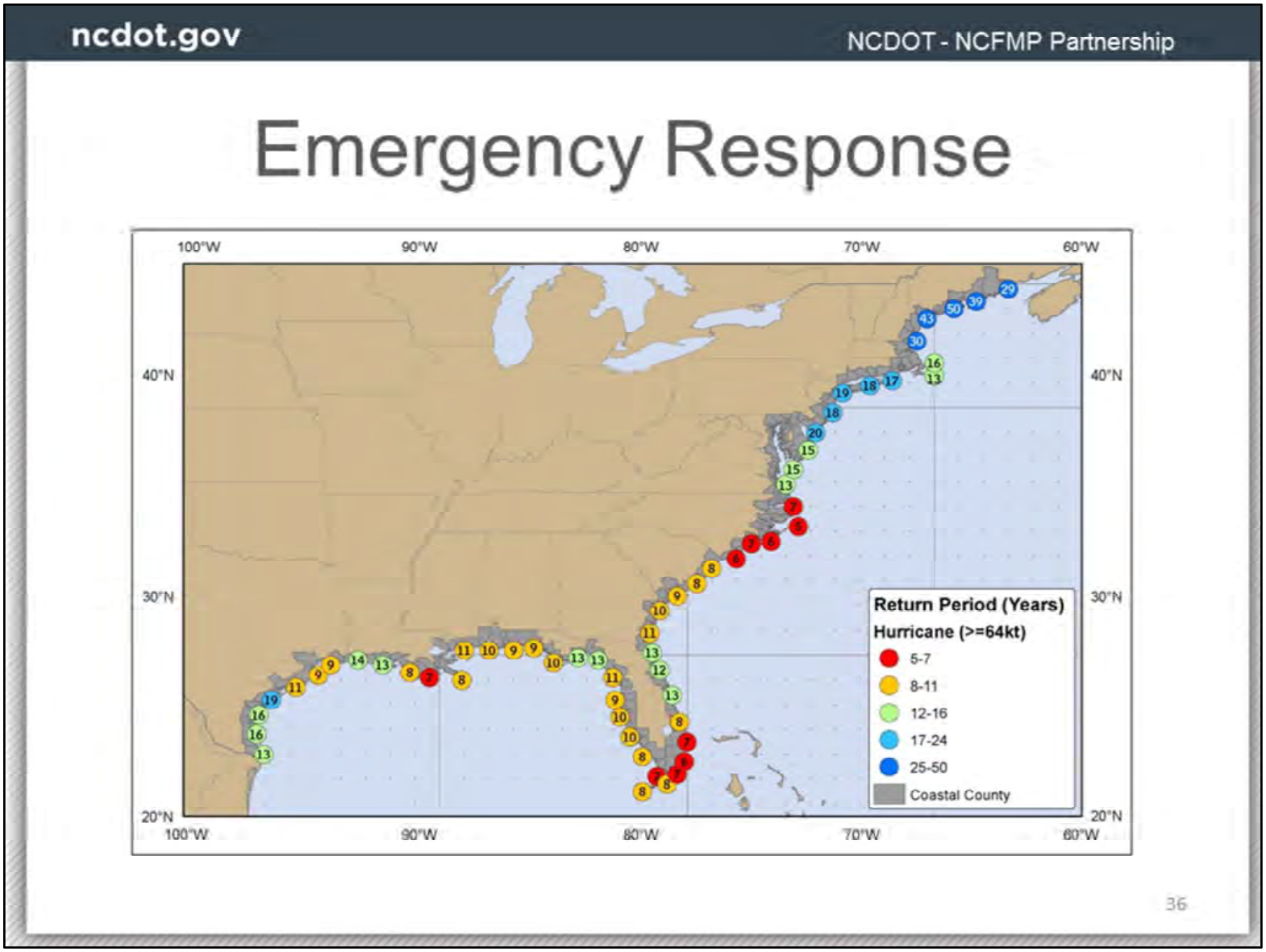


This impressive image from NOAA depicts the paths of all major hurricanes and tropical storms affecting the US over the last 170 years, highlighting the importance of our interagency collaboration with respect to Emergency Response efforts.

Emergency Response



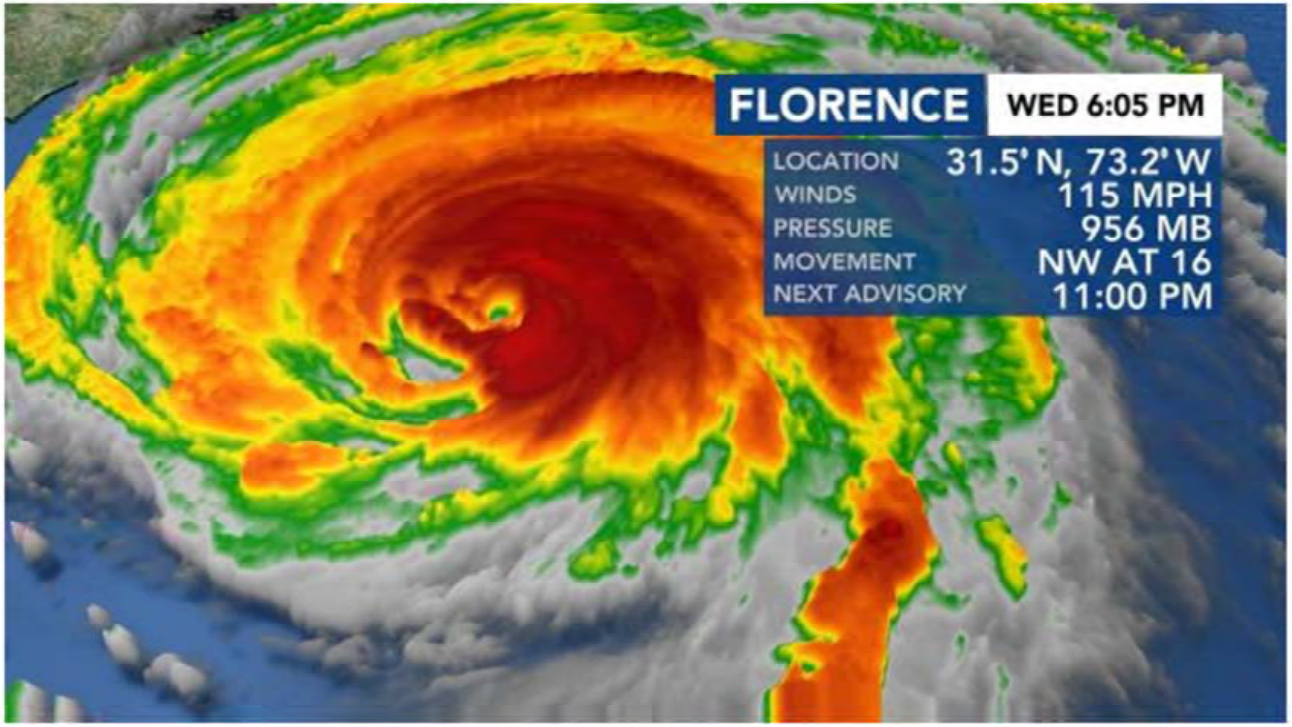
This shows all of the named hurricanes that have hit the US east and gulf coasts in the past 67 years. Over 20 hit NC coastline.



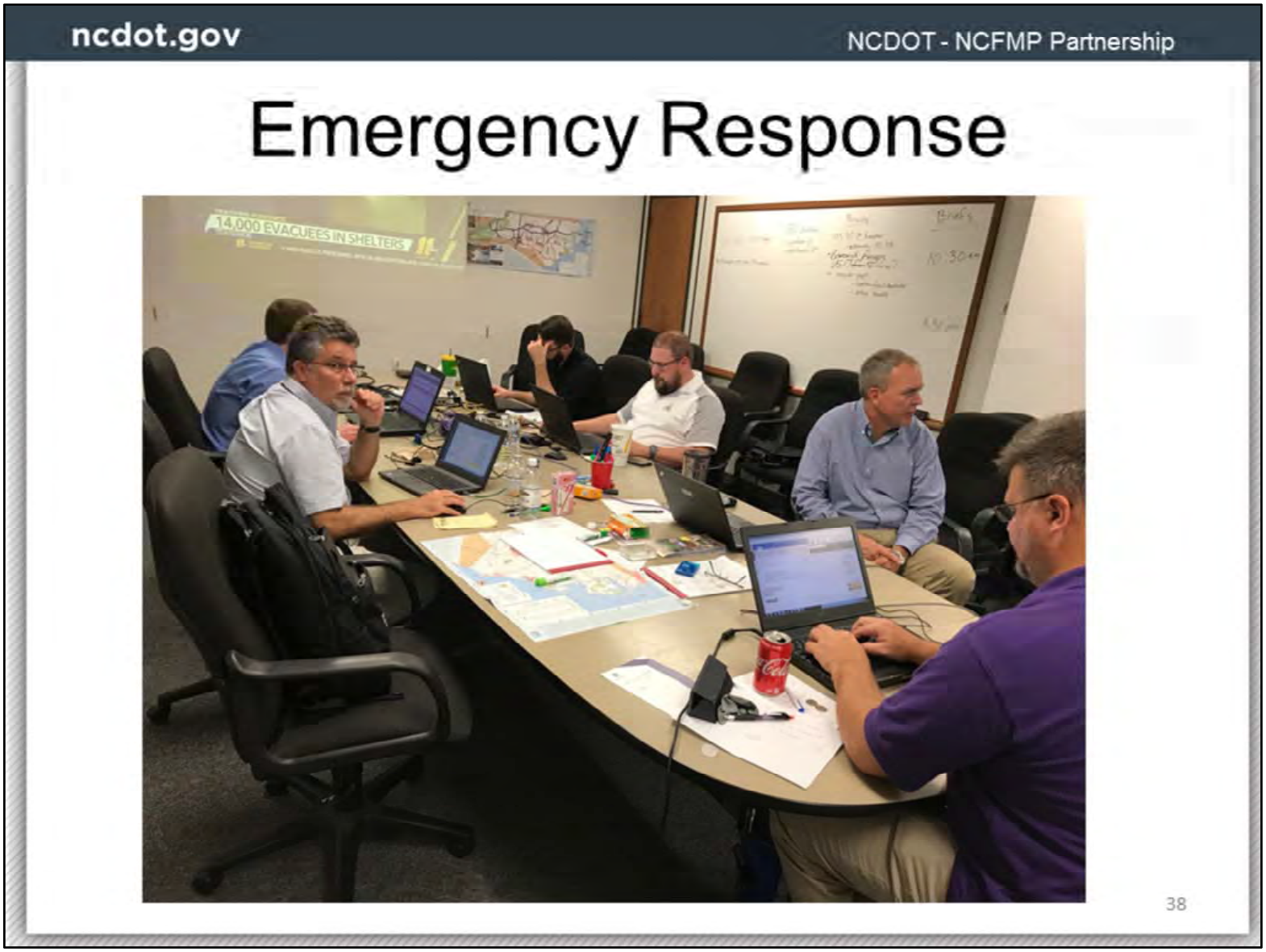
From this graphic, we can see that North Carolina experiences major hurricane events at about a 5-7 year return interval, similar to the southern tip of Florida.

On average (statistically) over previous 100 years a Category 3 or greater storm passed within 50 nm of NC about 20 times.

Emergency Response

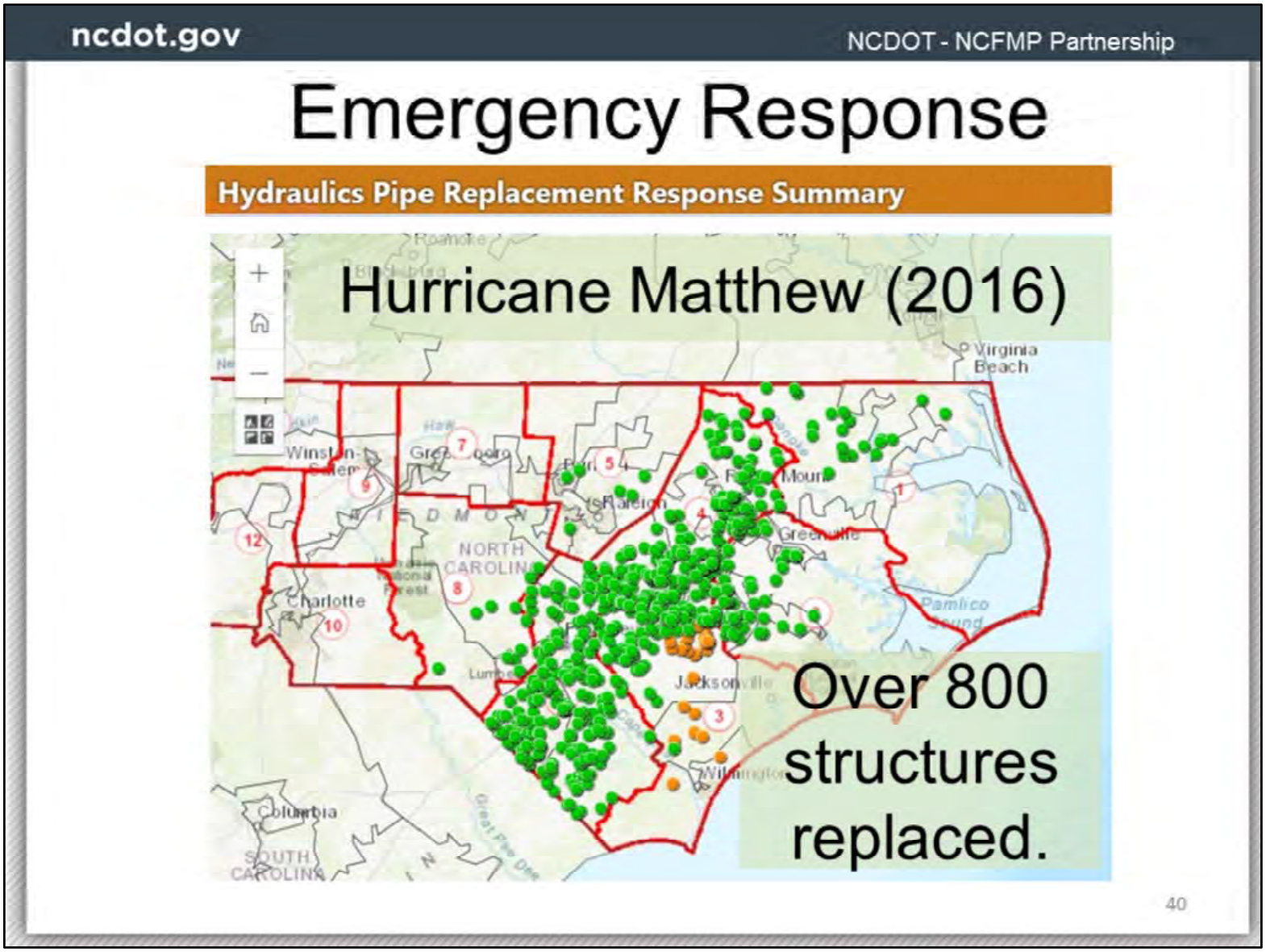


Hurricane Florence made landfall September 14th near Wrightsville beach (thankfully downgraded to a Category I storm), but moved very slowly across the Carolinas causing extensive flooding and destruction.

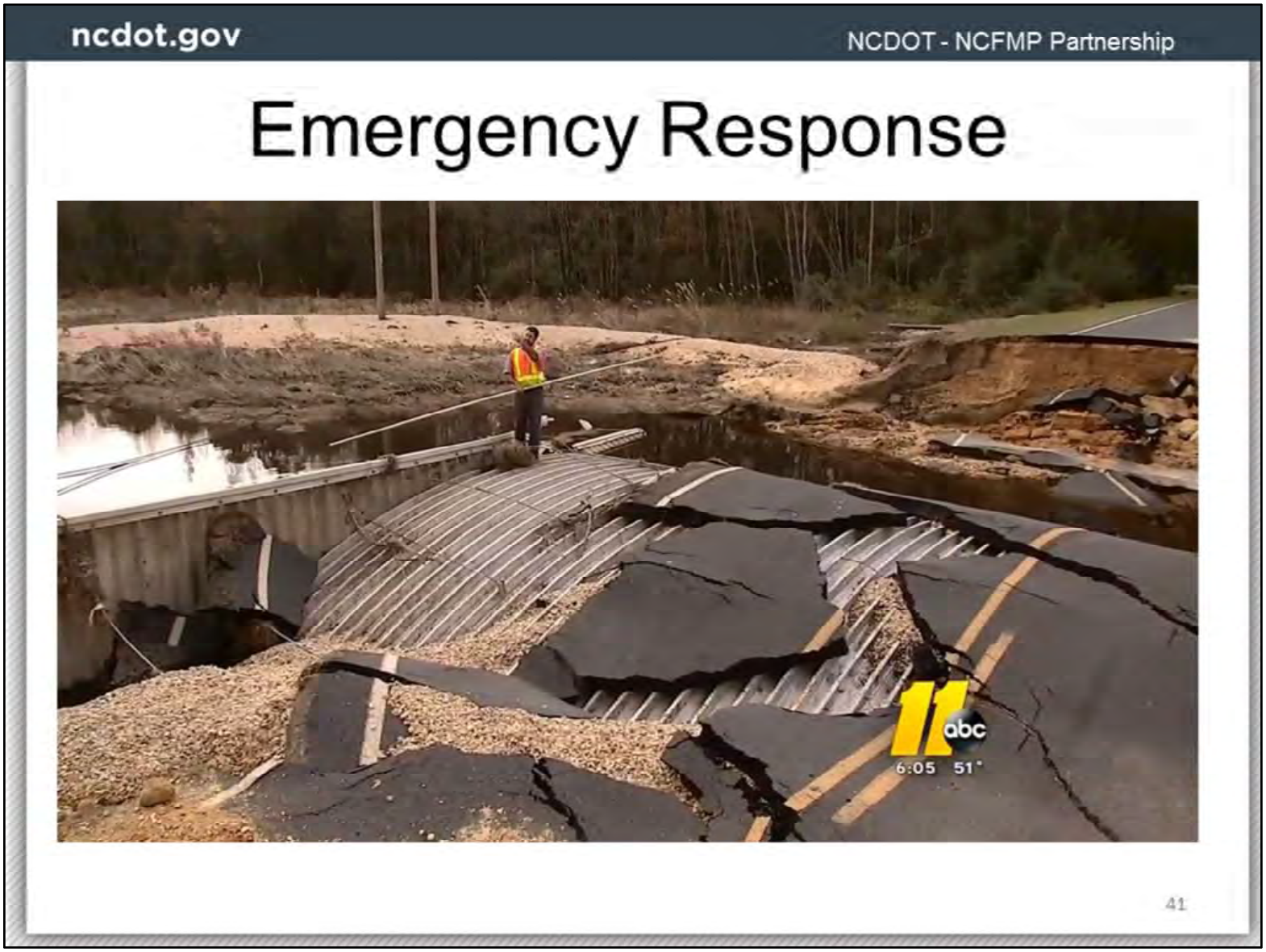


Following the storm, Hydraulics Unit maintained close contact with the State EOC, receiving regular briefings on flood conditions, provided by NC Floodplain Mapping staff. We closely monitored USGS and FIMAN stream gage data (more on that later) to provide needed input to the NCDOT Secretary regarding predictions of where roads were likely to be flooded and when already flooded roads could be expected to no longer be inundated.

When Governor Cooper gave televised updates from the State EOC, our team was providing critical and timely information to the NCDOT Secretary for his briefings to the public. Our multidisciplinary team was comprised of both in-house personnel and private consultants which applied a high level of engagement of expertise and technological tools in this effort.



Prior to Florence, Hurricane Matthew was the most recent major emergency response effort engaged in by NCDOT and NCFMP.

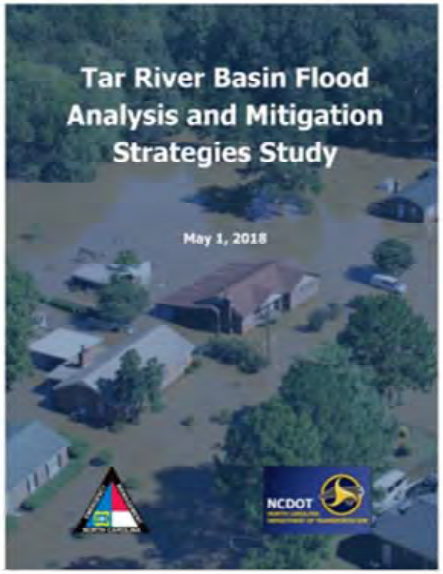


Following Hurricane Matthew, the majority of emergency structure replacements were assessed and recommendations made over a period of about two to three months. This image is from a News 11 ABC report about a month after Hurricane Matthew.

Emergency Response

These are two of our in-house hydraulic engineers who were doing emergency assessments at that time. In 2016, most of this effort (about 95%) was performed by our in-house staff, with only about 5% done by private consultants. Since that time, NCDOT has significantly restructured, and following Hurricane Florence, our Division offices will be contracting more of this type of work to private consulting engineers; although, our in-house Hydraulics Unit Operations staff will still be heavily relied upon by our Division Offices for technical expertise and guidance in support of this effort as well.

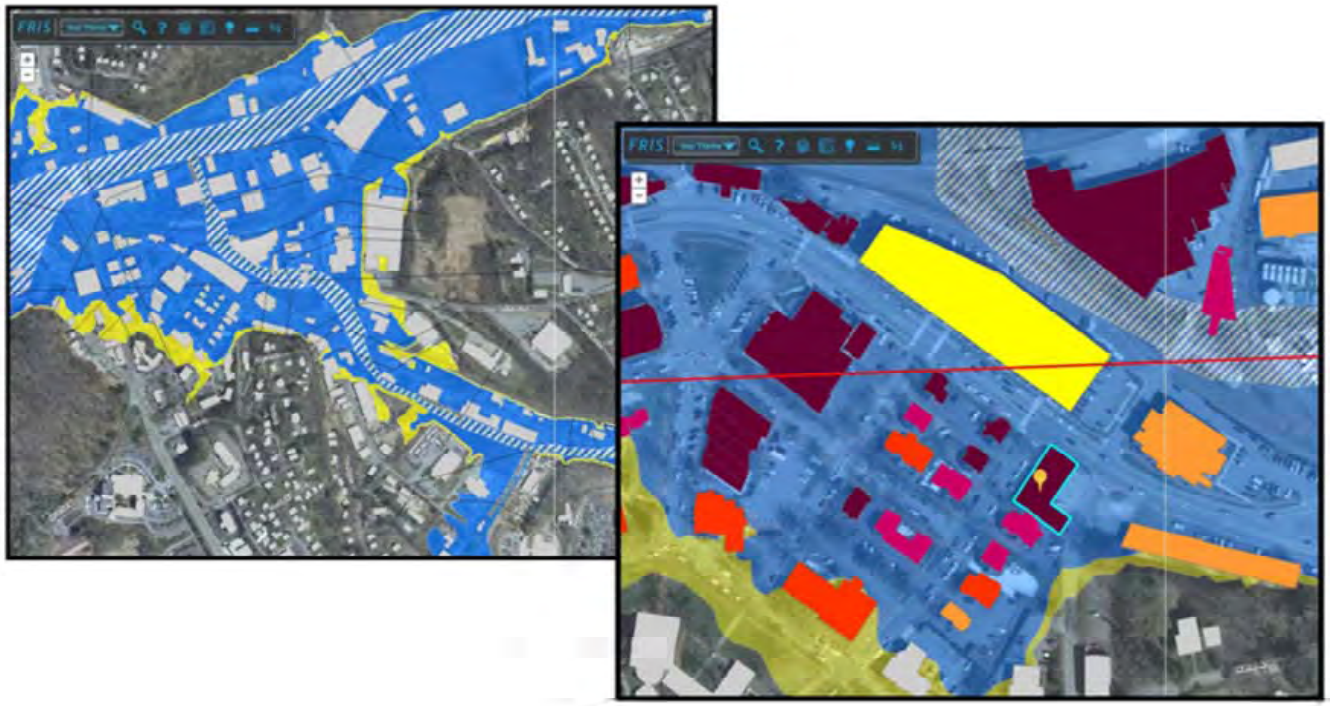
Mitigation Strategies Flood Studies



NCDOT has also participated with NCFMP in developing mitigation strategies flood studies in areas devastated by Hurricane Matthew as part of the Governor's Rebuild NC program.

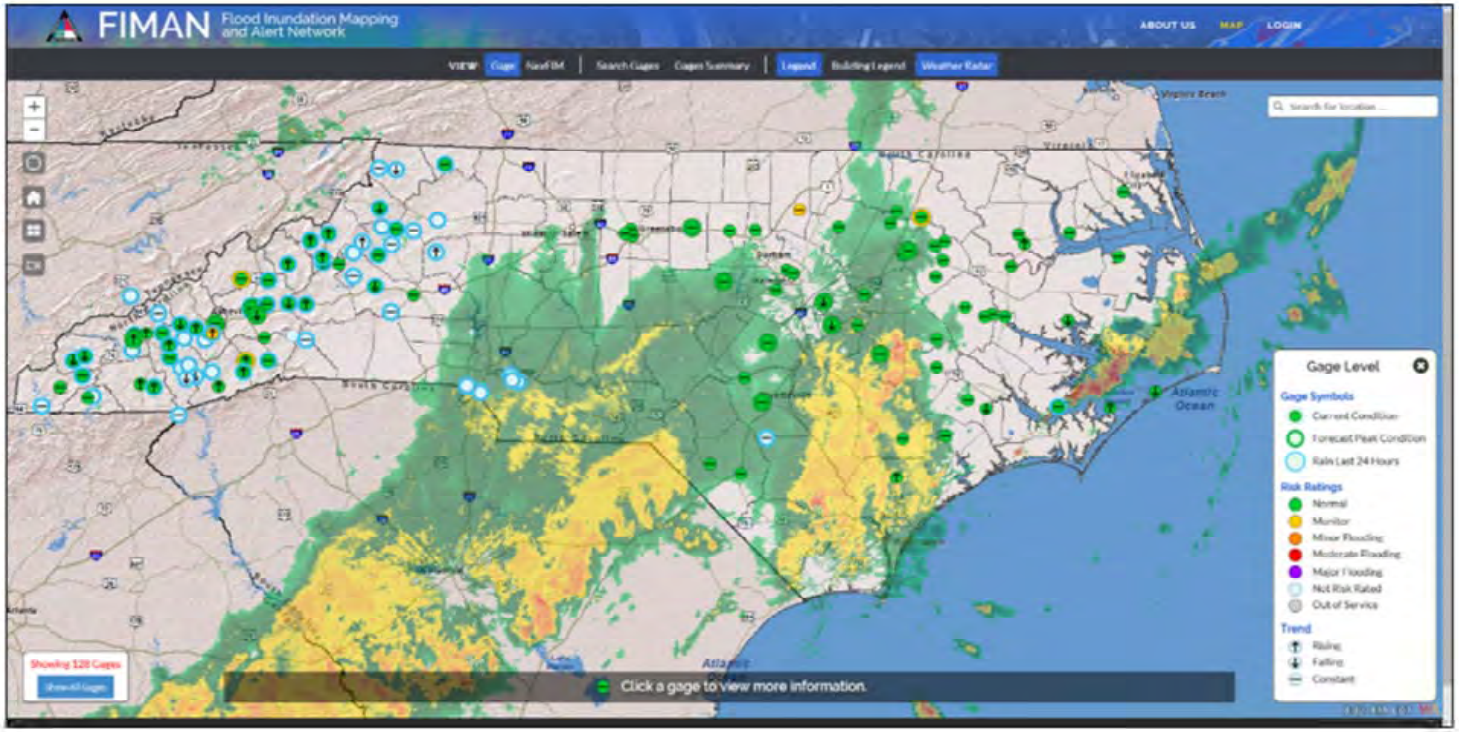
Additional information provided by NCFMP

(Tom Langan, PE, CFM - Engineering Supervisor for NCFMP)



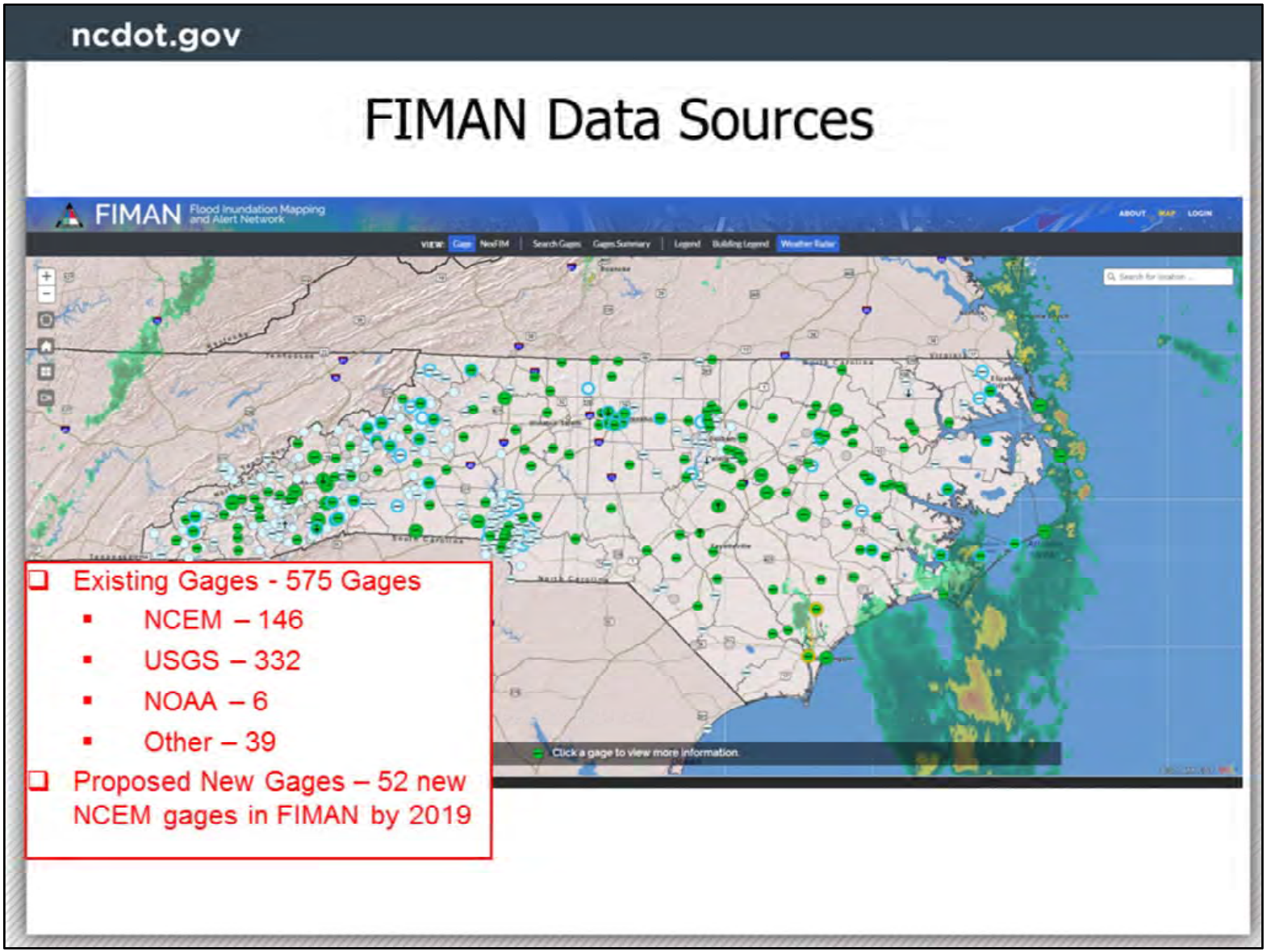
Flood Inundation Mapping Alert Network (FIMAN)

https://fiman.nc.gov/fiman

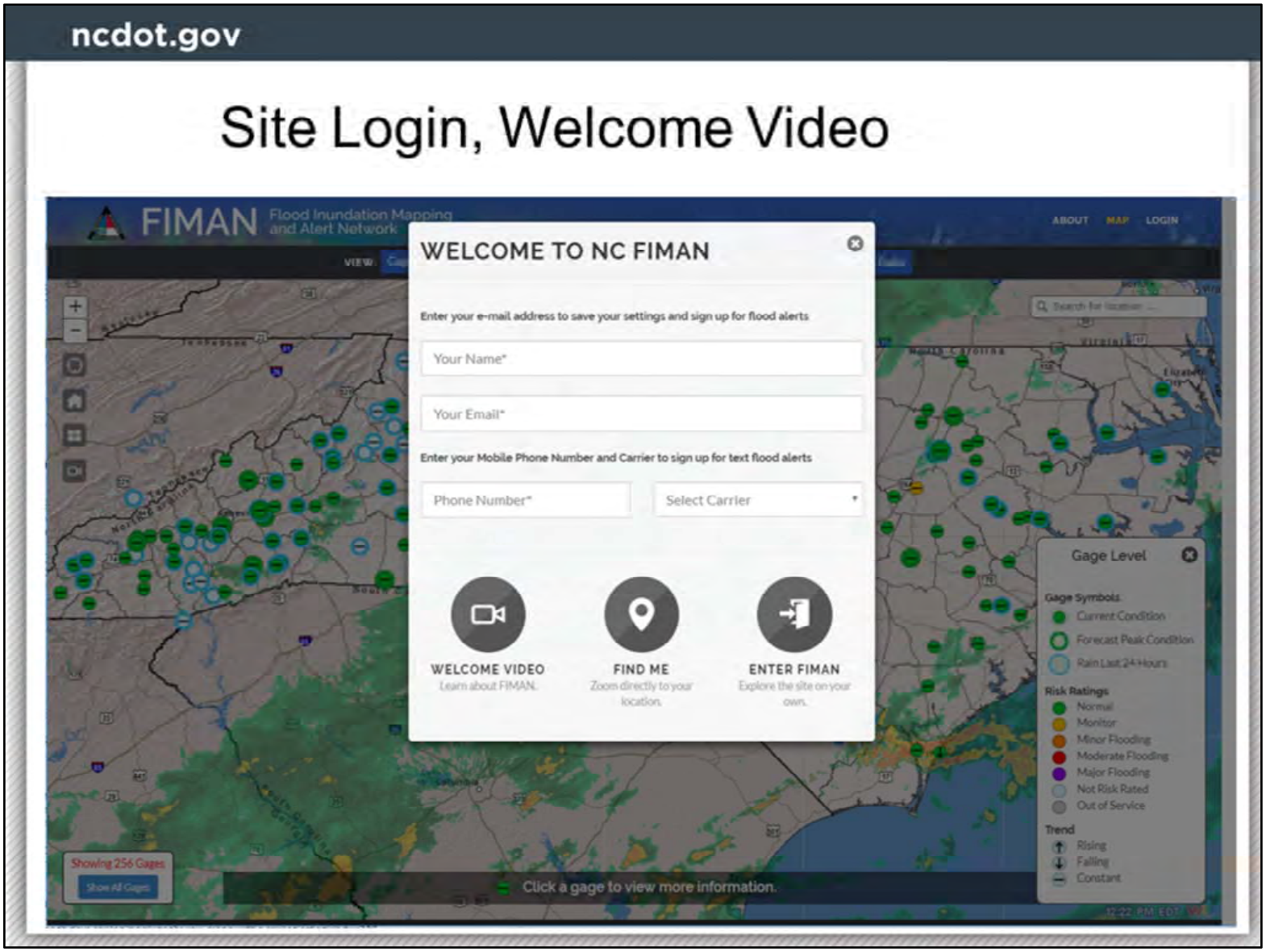


N.C. Flood Warning Program Goals

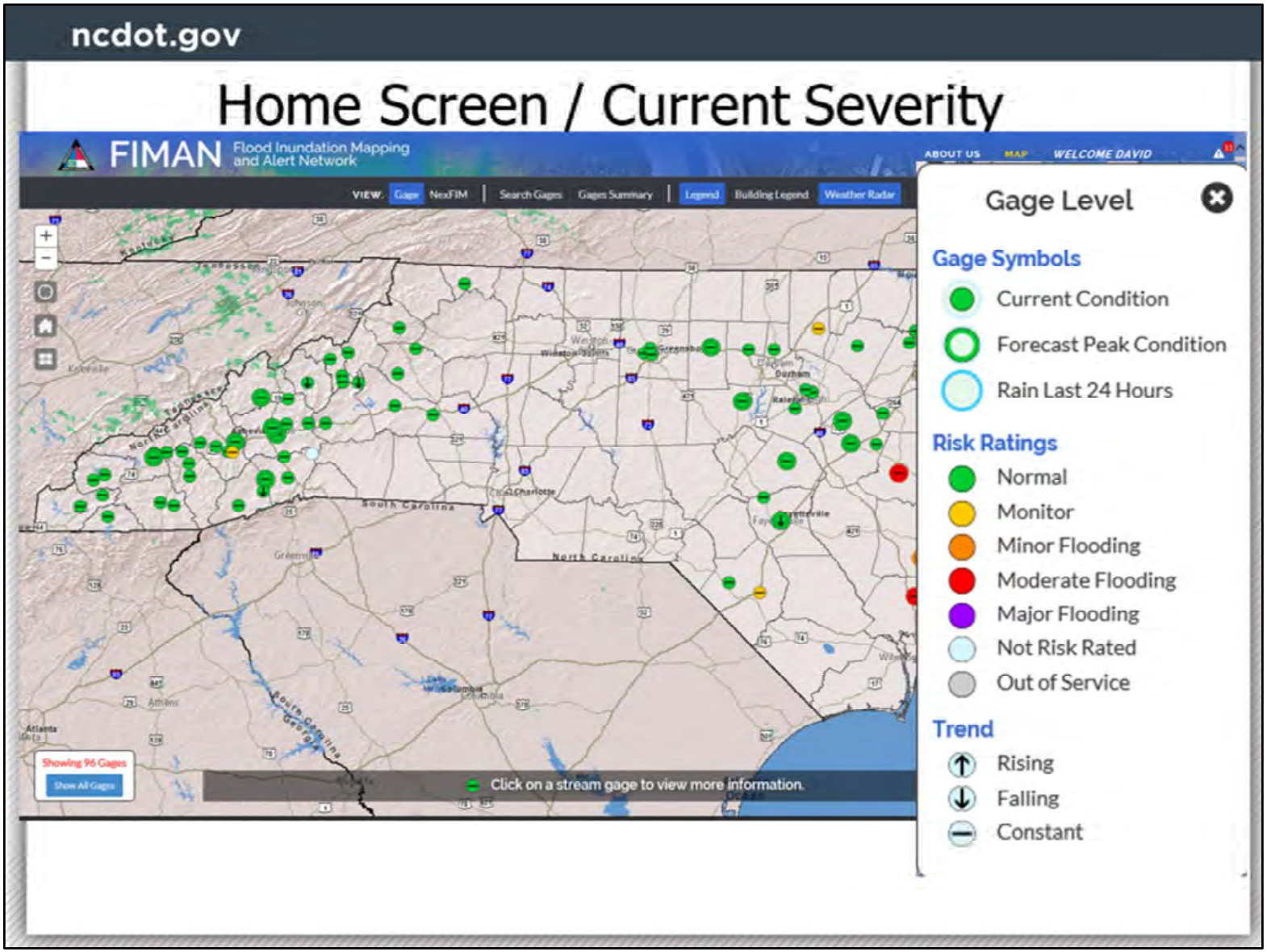
- Real-time flood inundation mapping (current and forecast)
- Gage Alerts
- Leverage vast investment in flood mapping and building level risk data
- Assist in risk-based decisions during and before disaster
- Prevent and reduce the loss of lives and property



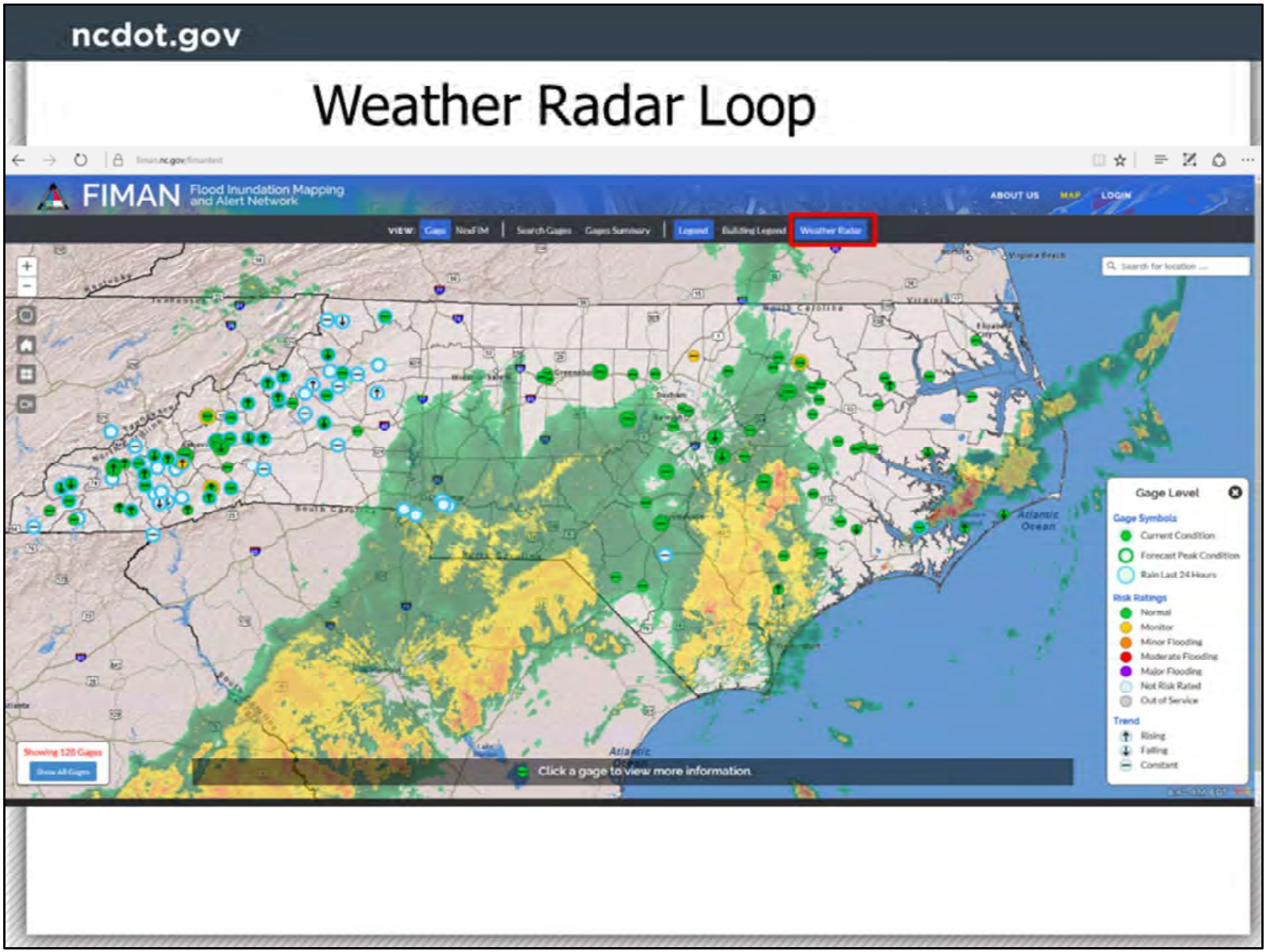
Approximately 600 gages are in the system including stream and precipitation gages. NCEM has over 150 gages



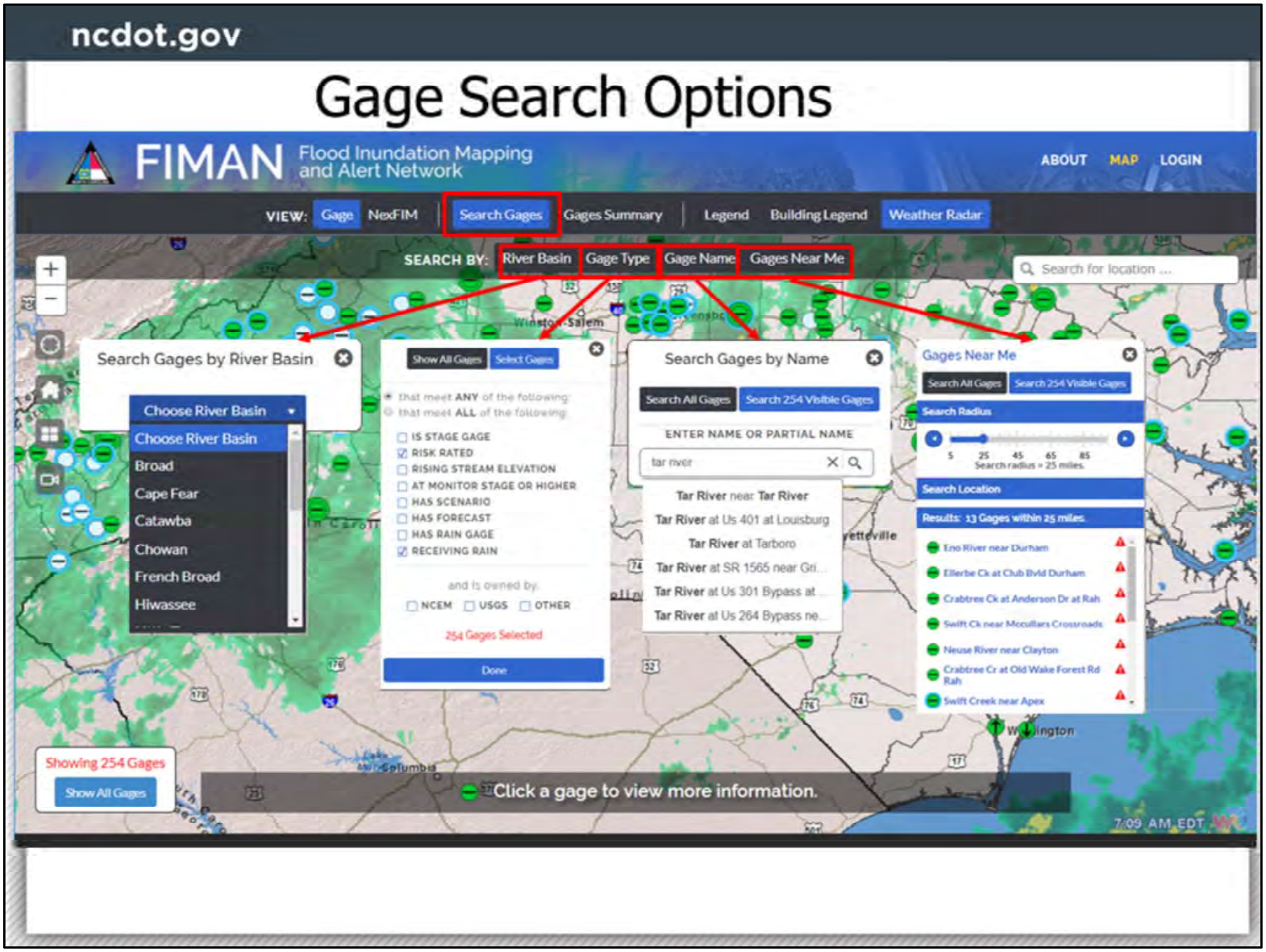
When you come into the site you will see a welcome video. The welcome screen will then appear where you can provide your contact information, which will allow you to sign up for real-time gage alerts.



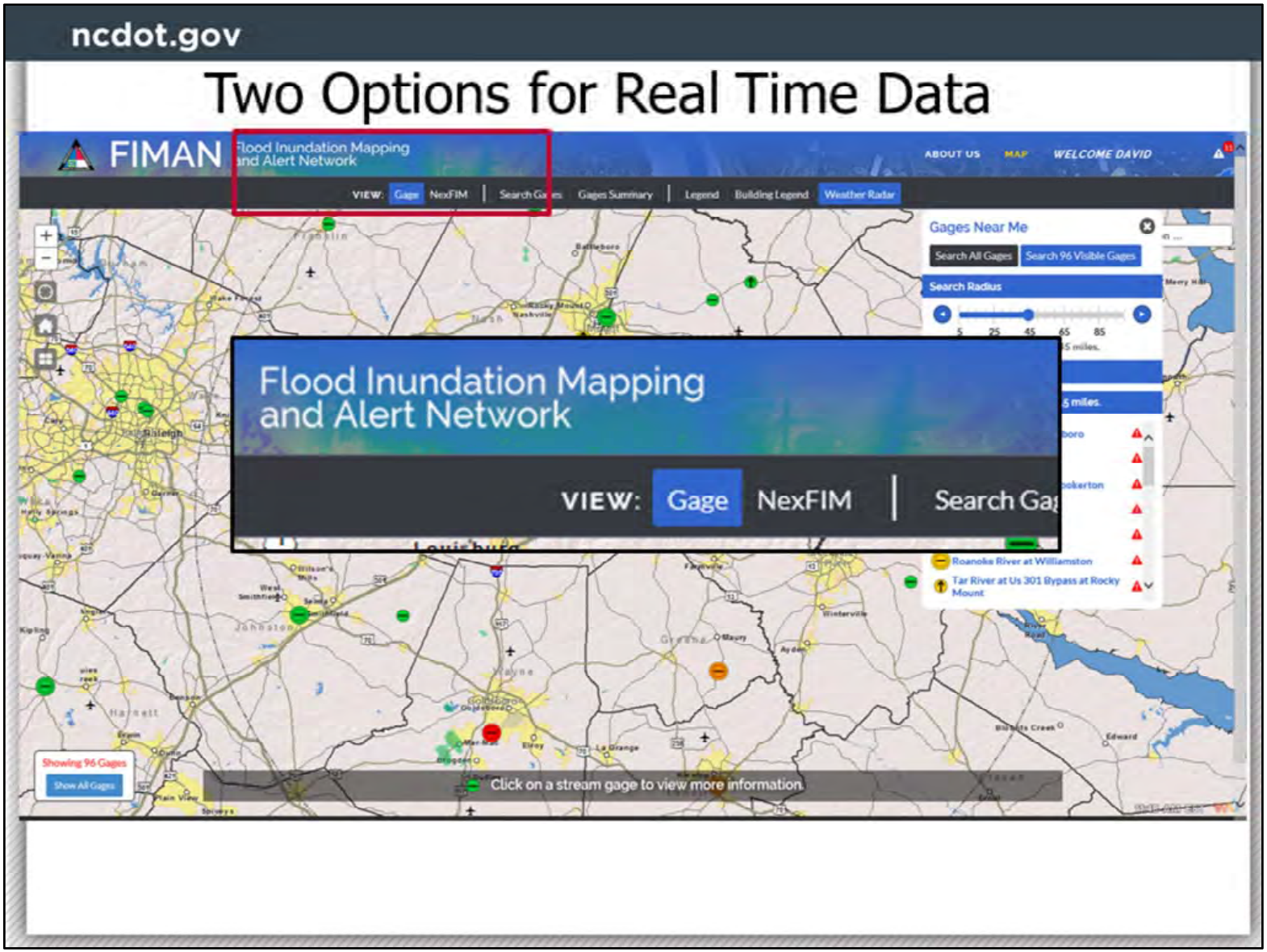
After you login the home screen will appear which includes gages color coded by flood risk severity. The inter ring color indicates current conditions and the center ring indicates forecast conditions. An outer halo indicates gages that have had rainfall in the last 24 hours. The flood stage trend of rising falling or constant are indicated by the arrows and hash mark in the center of the symbol.



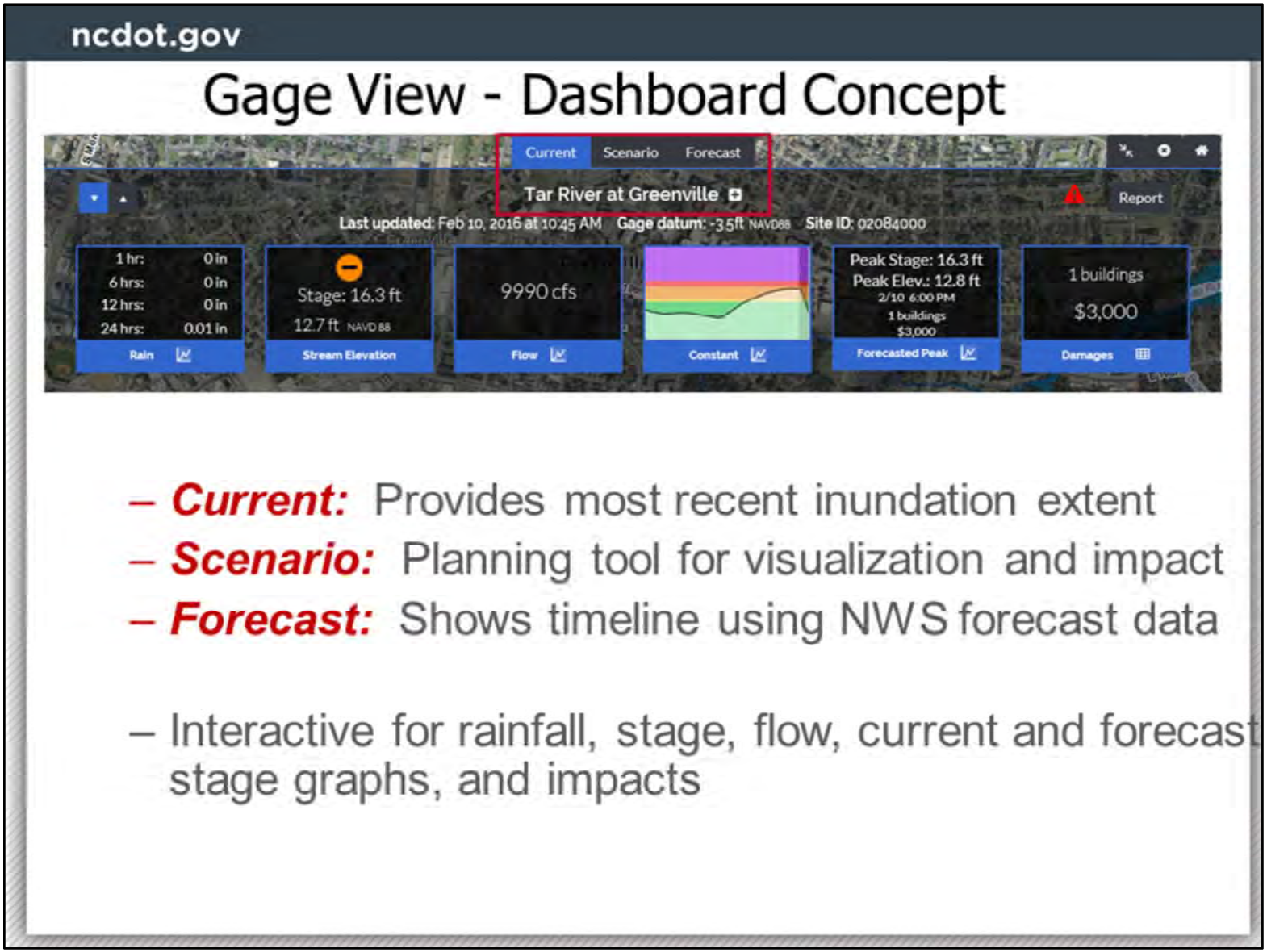
In the upper right corner is the precipitation radar data, which is turned on by default.



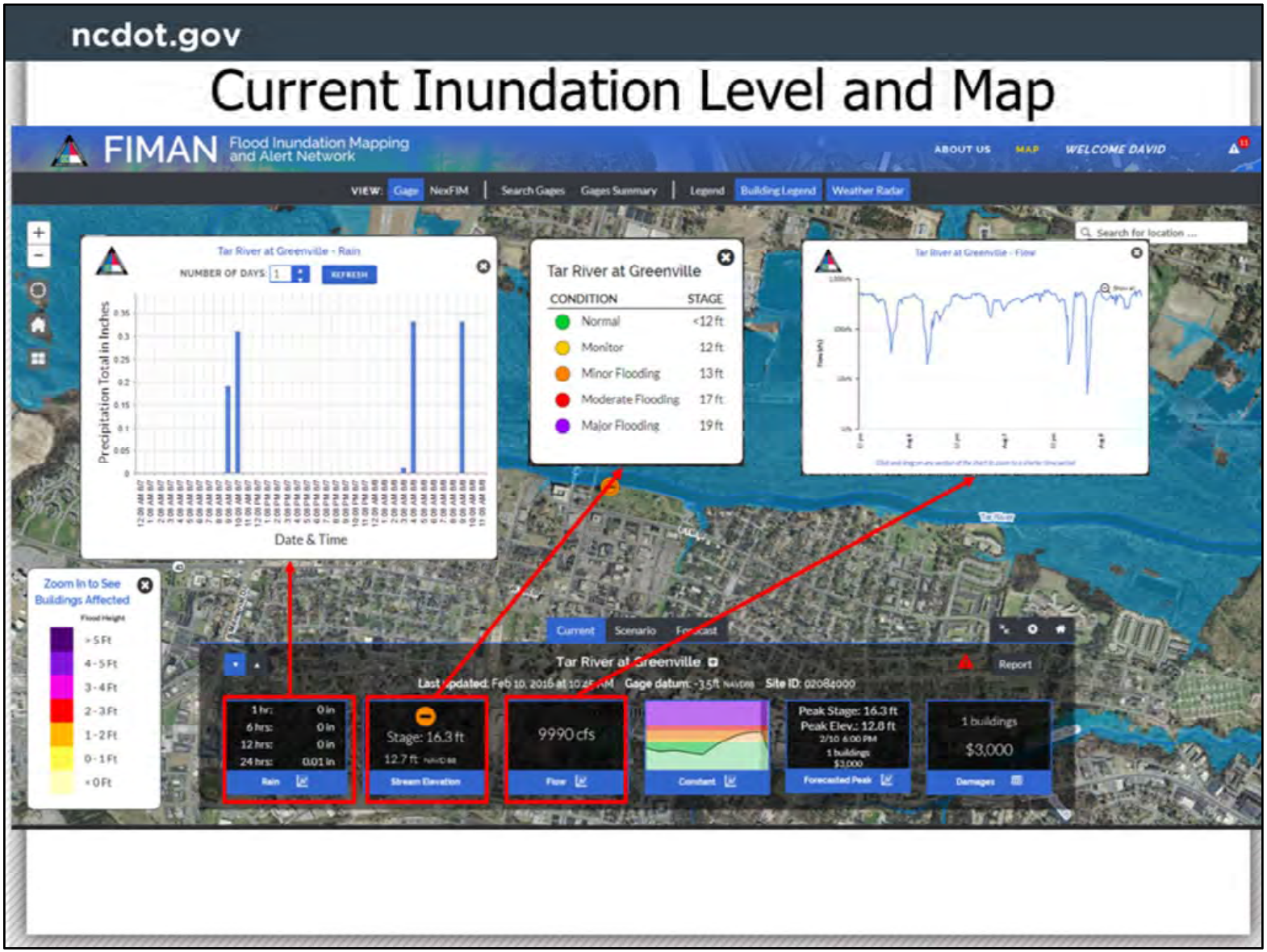
A specific stream or precipitation gage can be located by major river, gage type, gage name or using a geographic radius based on your approximate location.



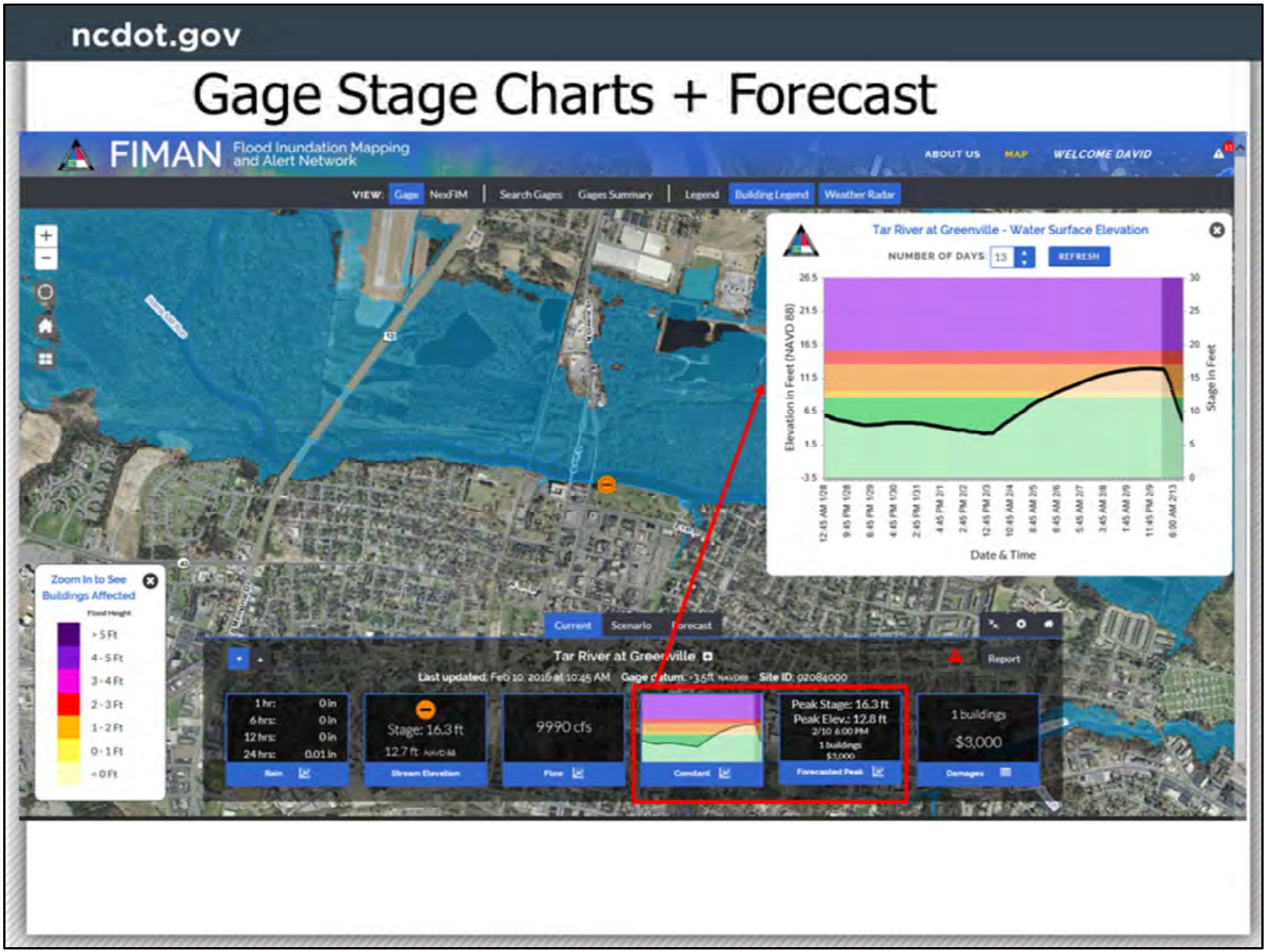
There are two option for real-time data on our site including gage specific flood libraries and our NEXFIM application, will show inundation along a major stream including in between gages during a significant flood event.



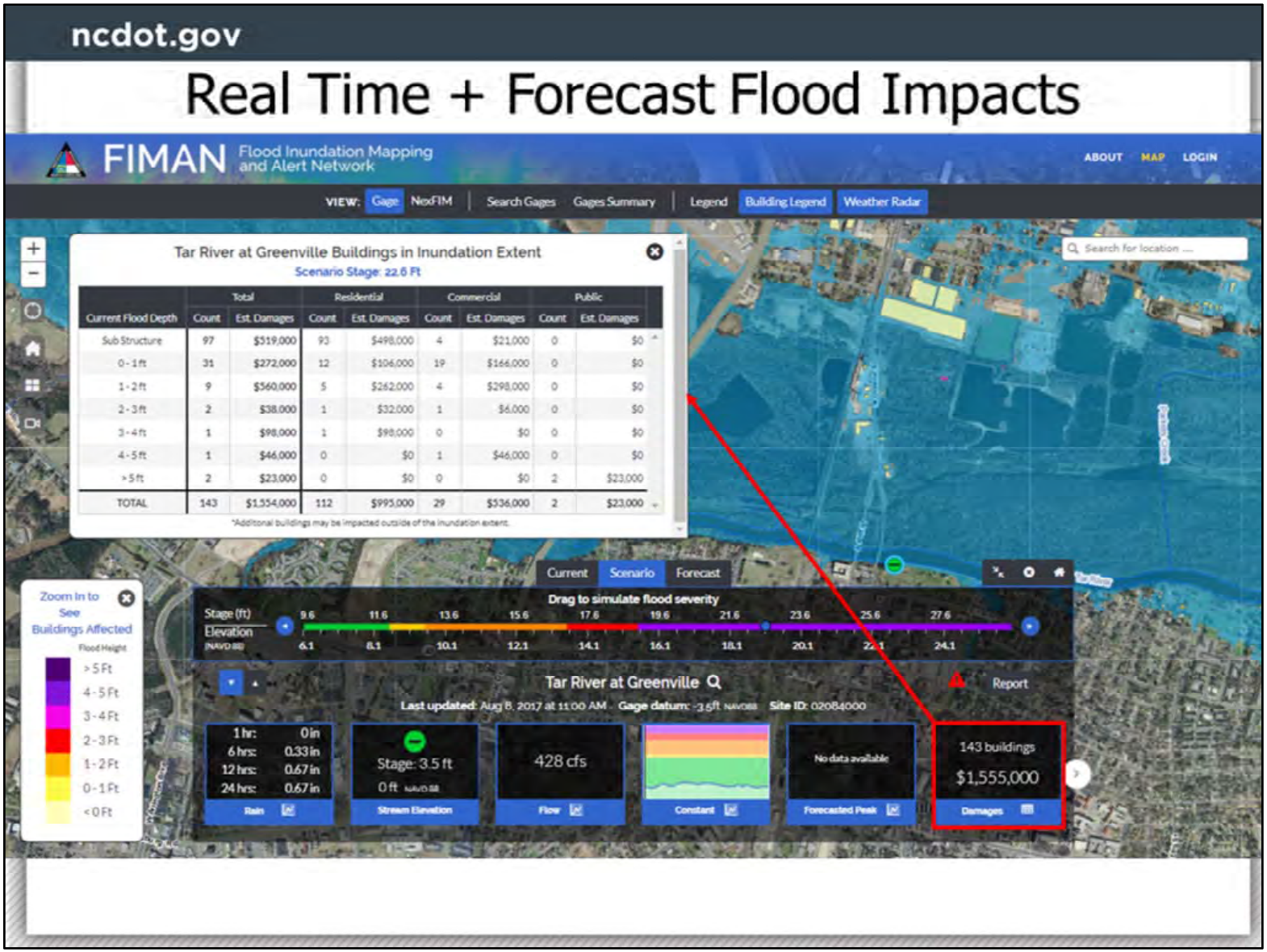
Once you have selected a gage a dashboard will appear containing current, scenario and possibly forecast information. The current scenario tab provides the most recent inundation extent and is the default view in the site. The scenario tab allows you to visualize flood extents and risk data based on different flood stages and the forecast tab show forecasted impact and flood extents, where forecast data is available from the RFCs or NOAA. The dashboard also contains interactive widgets for rainfall, stage, flow, current and forecast stage graphs and building impacts.



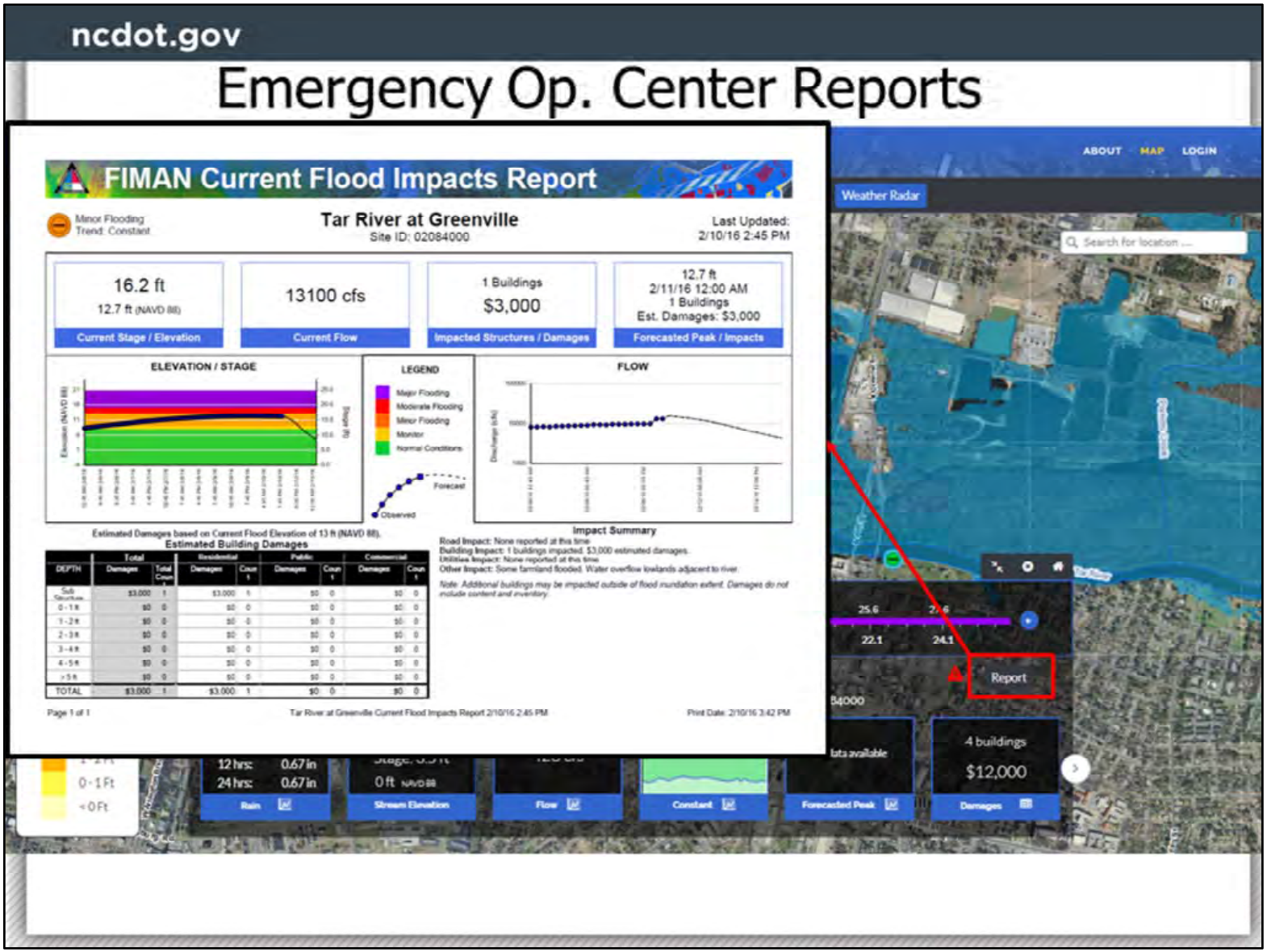
All items along the gage dashboard are interactive and dynamic. Clicking on the Rain window will bring up the rainfall hyetograph if available. The stream elevation window will show the gage specific flood risk rating stages and the flow tab has the hydrograph for the last 30 days.



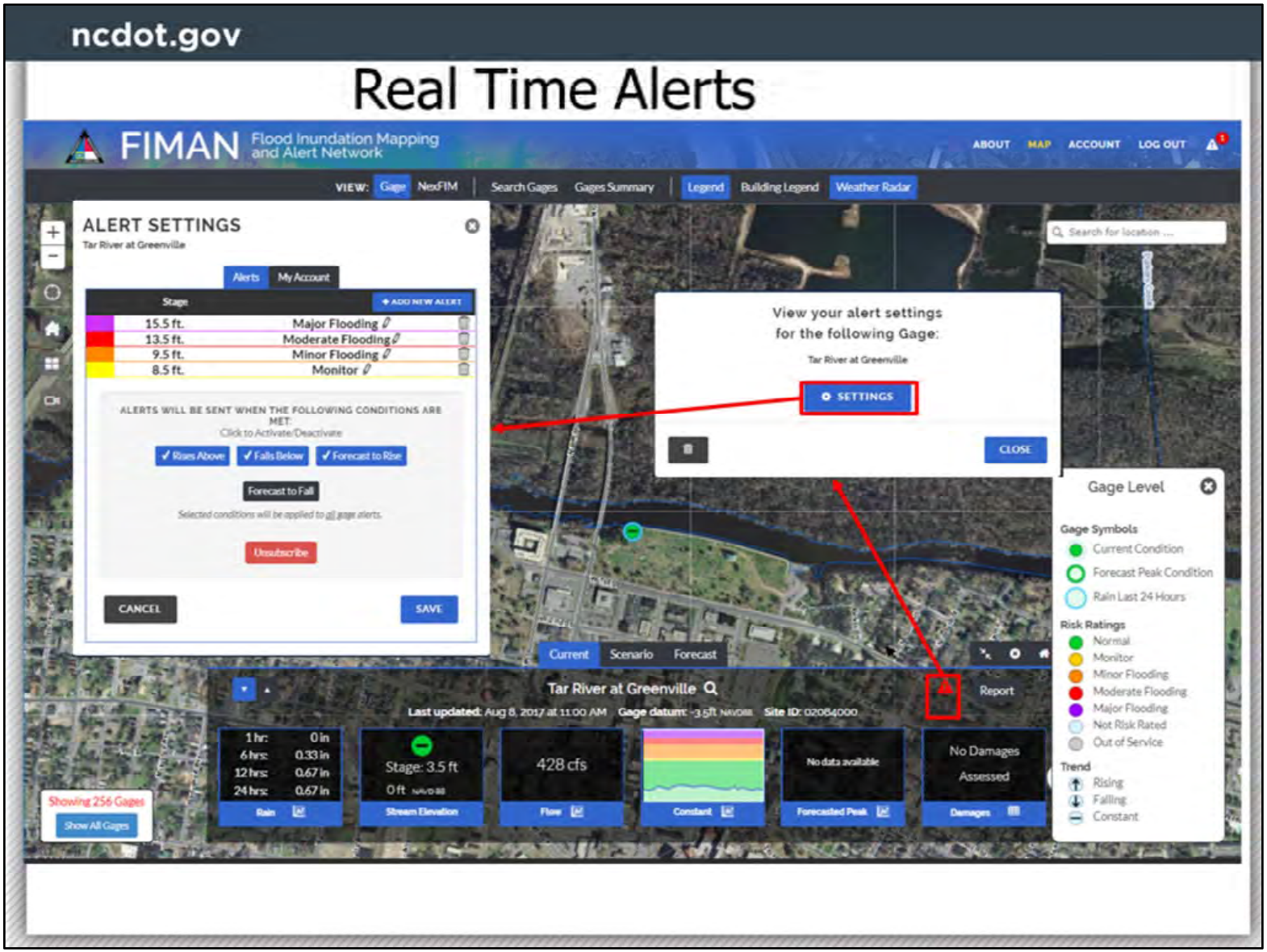
The Constant and forecast windows will bring up the stage graph which include historical and forecast stage.



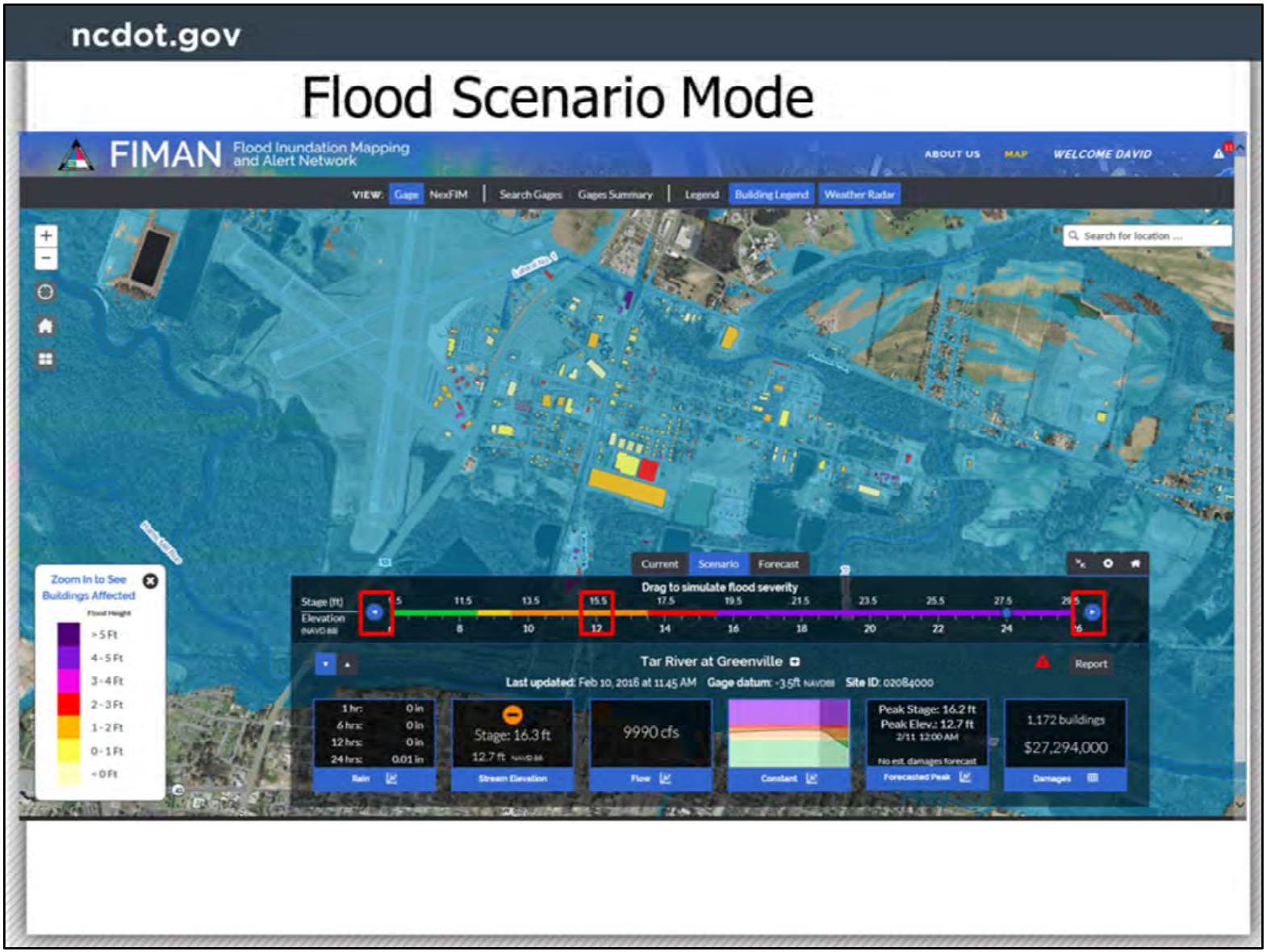
The final tab on the dashboard shows building impacts at the selected flood stage including depth of flooding and damages.



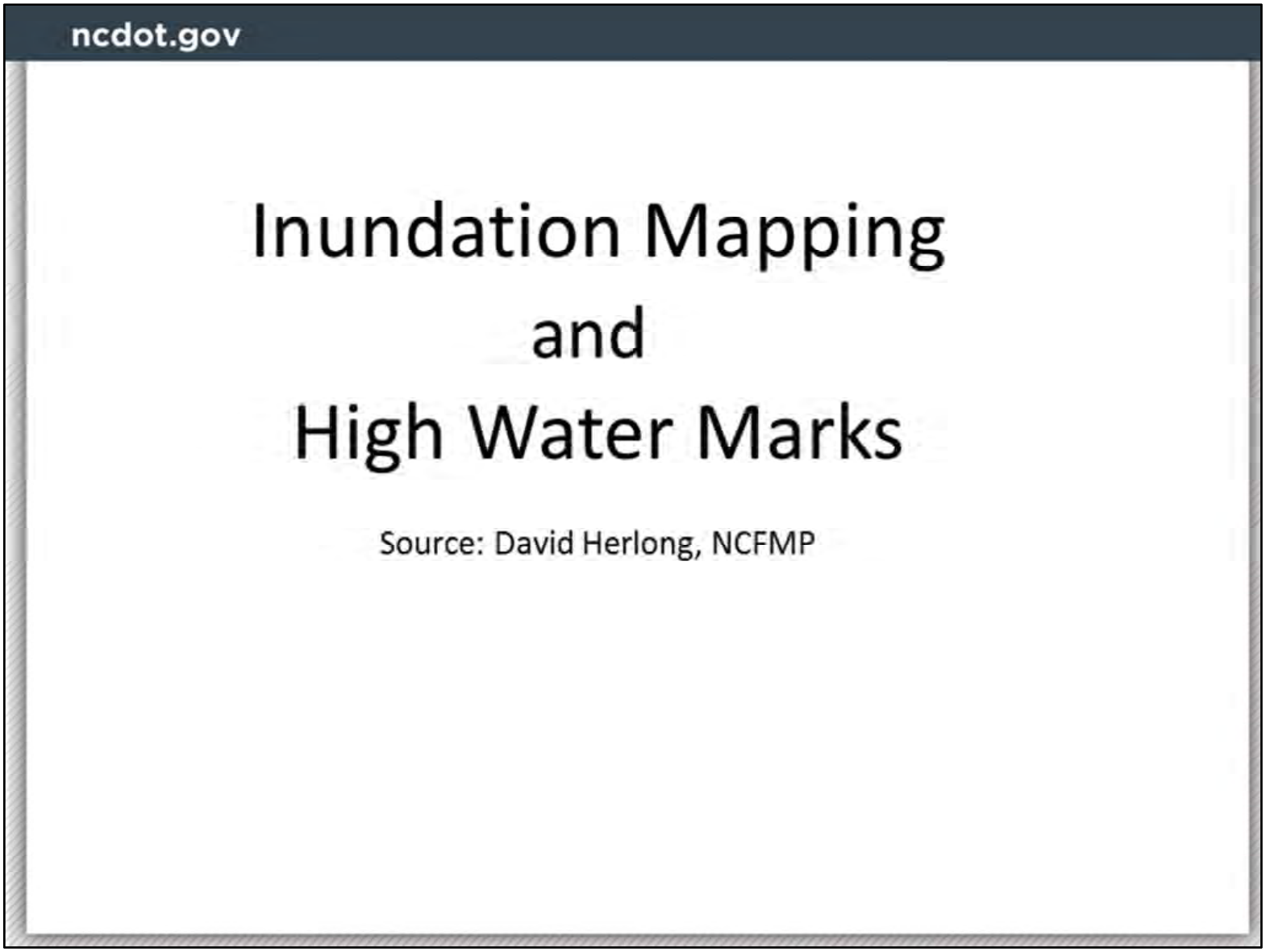
The report button on the dashboard summarizes the dashboard information and additional impacts for a specific flood stage in a gage report for EM.



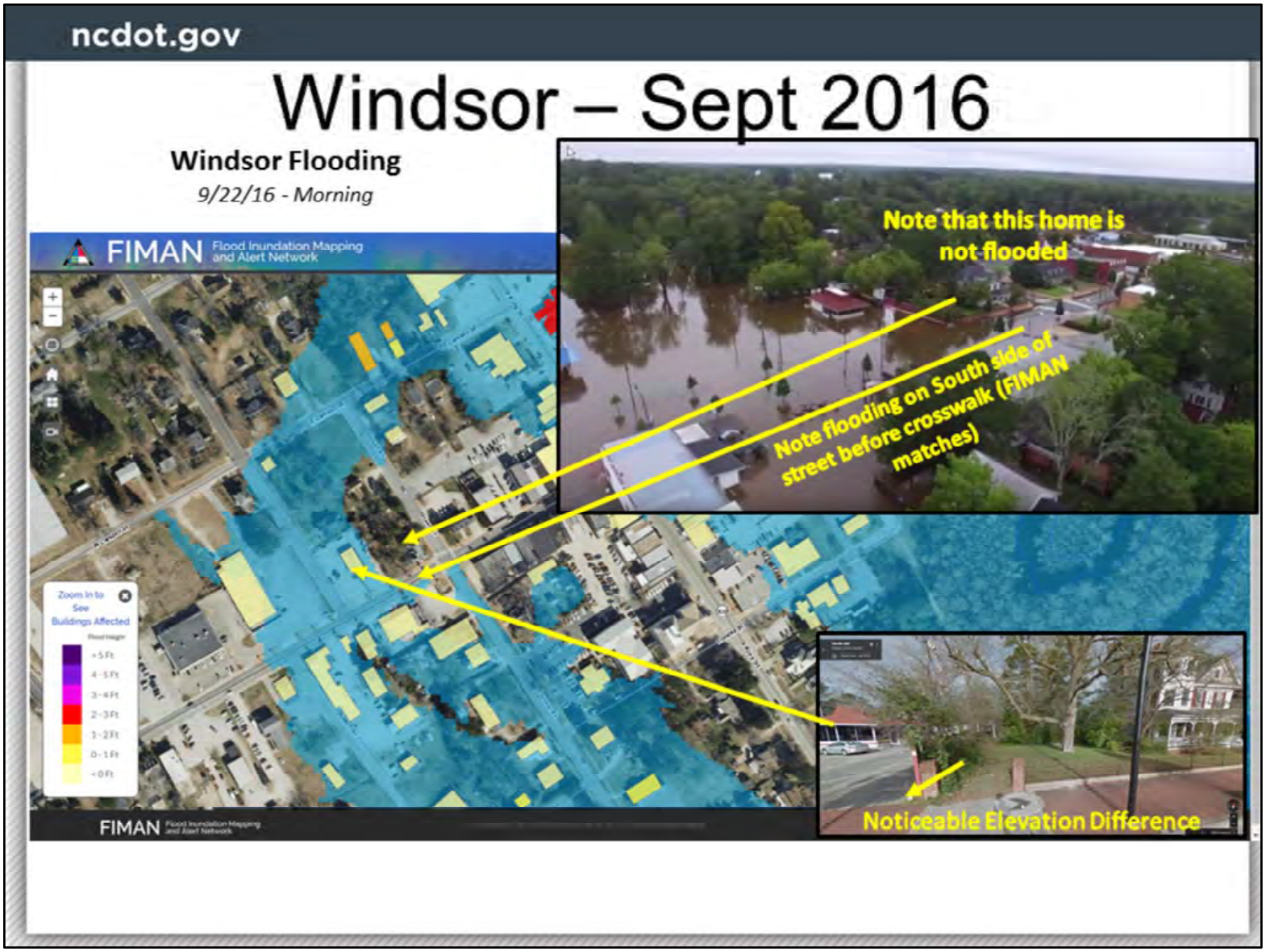
The alert tab allows users that have logged in to set up automated alerts and notifications based on a selected current or forecast flood level. Notified by text and email.



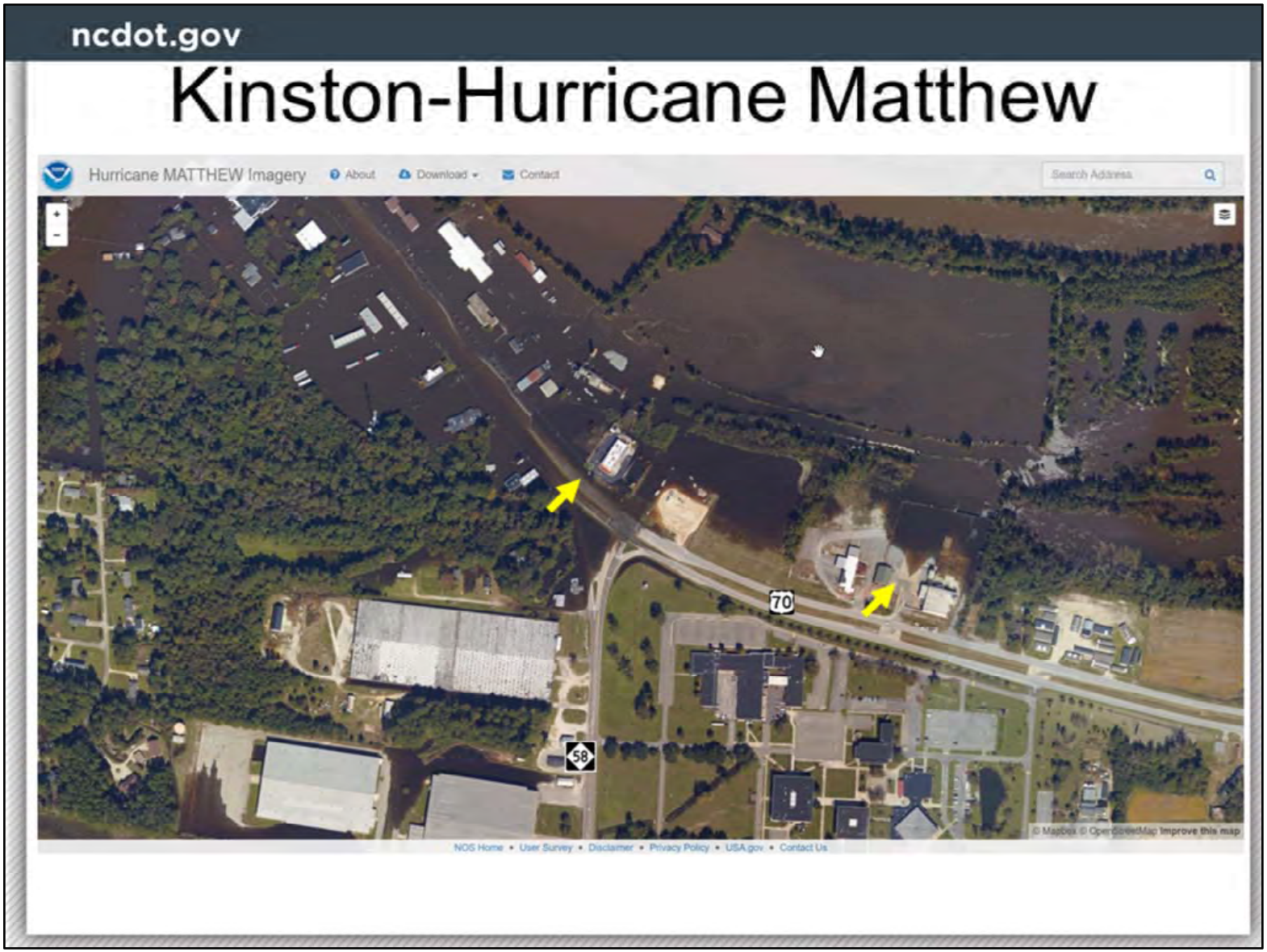
Flood extents and impacts for various flood levels can be visualized using the scenario tab on the dashboard. You can select different flood stages using the arrows at the left or right or by dragging the button on the stage graphic.



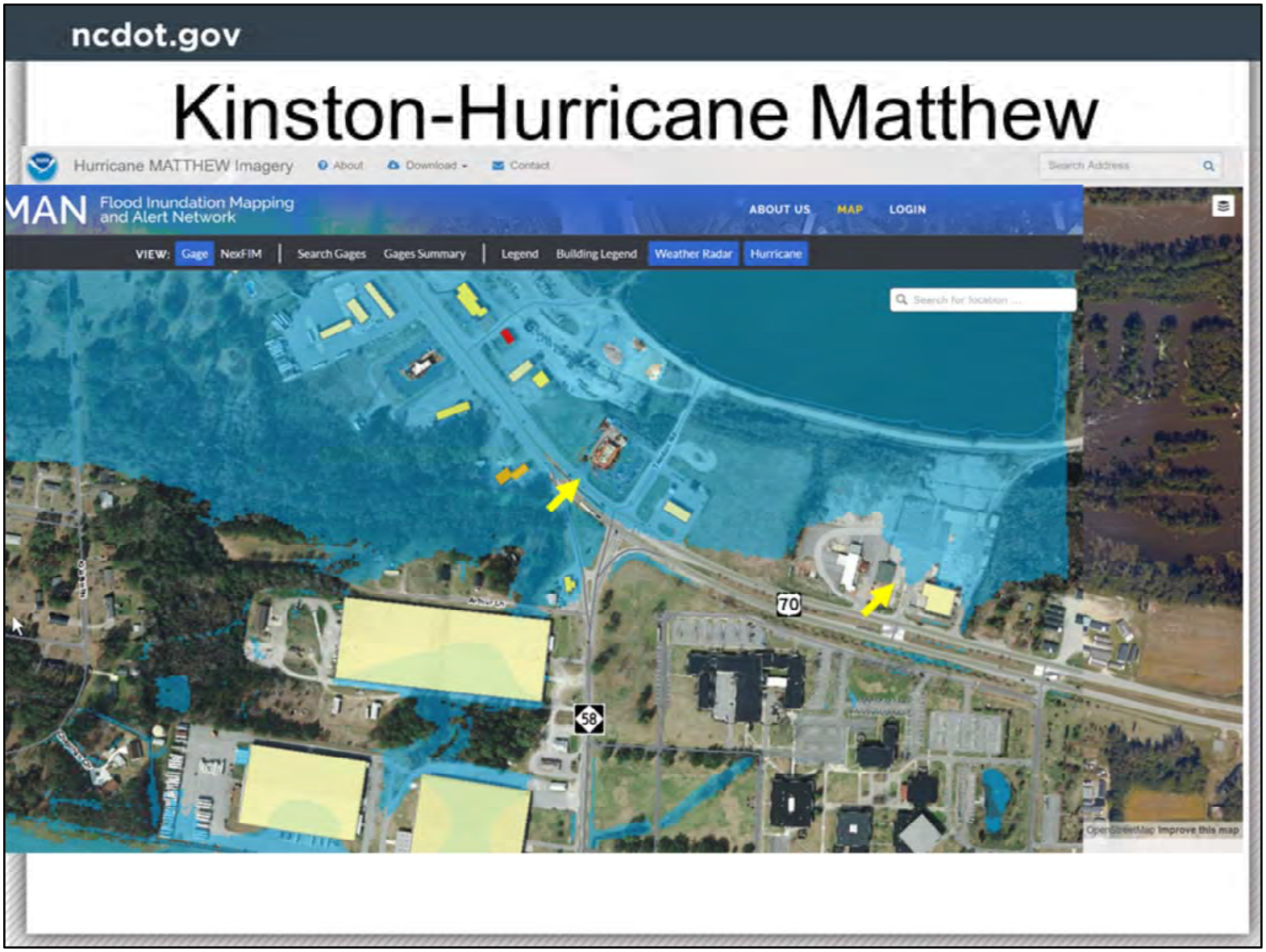
The next three slides demonstrate the accuracy of the FIMAN inundation mapping with examples from Hurricane Matthew, thus highlighting the importance of acquiring high water marks data after an event to calibrate the inundation models. This information was provided by David Herlong at NCFMP.



FMP has inundation maps at a number of sites across the state. They have 96 inundation mapped sites currently. What this does is it allows use of hydraulic modeling to determine where the extents of flooding would be for a given rise in water surface elevation. In this case, this is an event where they did some ground trothing. There's a building here that you can clearly see is out of the flooded area. Right across the street is where flooding starts to creep on to the sidewalk. At the building right next to it, which is at a lower elevation, it is shown flooded in this condition.



This is another example of the flooding during Matthew. This one is the aerial photo in which you can see the flooded areas. Notice the two yellow arrows - there's a building on the left in an area where the water is approaching the building, but the one on the right is not flooded.



If we overlay the inundation map for this location, you can see that the building on the right is high enough not to be flooded; whereas, the other building on the left is in the area where the water is creeping in, and it was pretty much right on what the aerial imagery showed.

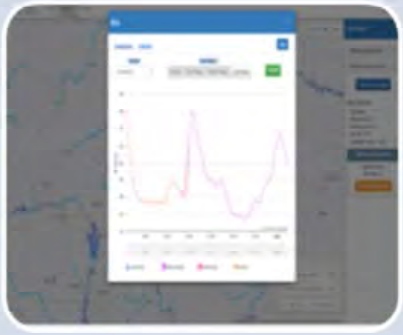
As previously noted, this highlights the importance of getting good high water marks after an event to calibrate our hydraulic models that generate the inundation maps.

Potential Future FIMAN Enhancements

Installation of ultrasonic low-cost water level sensors at NCDOT structures

Create road impacts view in FIMAN

- Link to TIMS, Google Maps, etc



Forecast road closures

- National water model
- 2-D hydrologic models linked to structures

Lessons Learned / Future Goals

- Lessons learned
  - Communication / Documentation is Key
  - Value of Interagency Collaboration
  - Benefits of Leveraging Technology and Innovation
- Future goals
  - More programmatic approach to MOA
  - Continued technological development
  - Joint research efforts
  - Innovation - more 2-D modeling
  - NCDOT liaisons working at NCFMP office

Future goals

- Develop a more “programmatic” approach to the MOA – fewer “MOA types” and funding annual program budget, rather than “per project” invoicing.
- Continued development of FIMAN and other tools (e.g. FRIS, ATLAS, SERA) to promote resilience and sustainability.
- Participation with NCFMP in joint research projects to promote greater efficiency and quality in the services provided by our agencies to the public. (e.g. Using UAVs and Geiger LiDAR for bridge surveys.)
- Utilization of 2-D modeling (per CHANGE initiative) on NCDOT projects and supporting NCFMP’s efforts in coordinating with FEMA to update regulations.
- At one time we had a NCDOT-funded position at NCFMP when they were getting started, which was a mutually beneficial arrangement for quality assurance and control of the hydrologic and hydraulic studies done in the first phase of remapping the state. Efforts are under way to establish engineering and possibly technology/GIS specialist positions specifically devoted to facilitating ongoing NCDOT project delivery and operational needs and helping NCFMP maintain high quality, up-to-date data on NCDOT’s transportation improvements statewide.

For additional information:

- References
  - Memorandum of Agreement (MOA) between NCDOT and NCFMP as modified August 12, 2016
  - NCDOT *2016 Guidelines for Drainage Studies and Hydraulic Design*, Chapter 15 Floodplain Management
  - Title 44 parts 59, 60, 65 and 70, Code of Federal Regulations (CFR)
- Websites:
  - flood.NC.gov
  - NCDOT Hydraulics/FEMA Coordination Connect Site

    (https://connect.ncdot.gov/resources/hydro/Pages/FEMA-Interagency-Design.aspx)

These hyperlinks will take you to the websites.