# DEVELOPING A COMMUNITY MITIGATION PROGRAM

## RECIPES FOR SUCCESS FROM MECKLENBURG COUNTY, NC

ASFPM Presentation

May 23, 2019 - Concurrent Session J3 (4:00-5:30pm)

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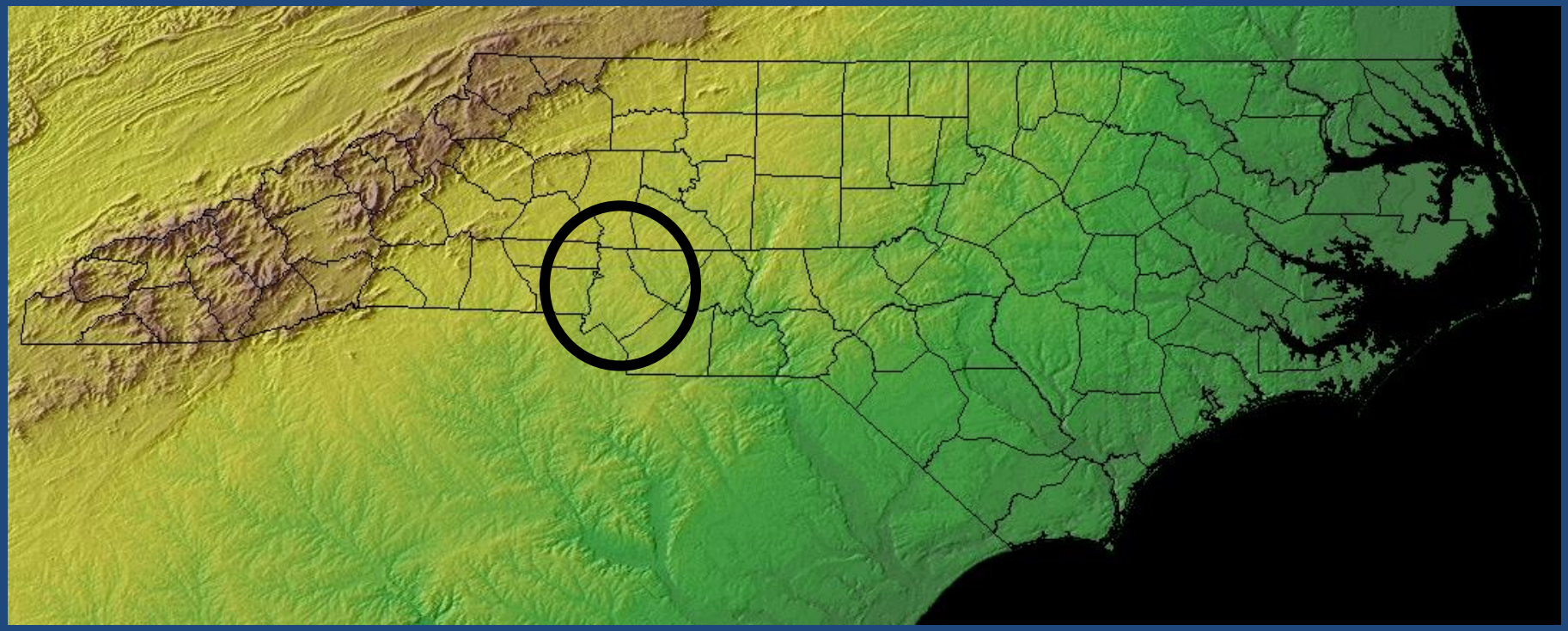
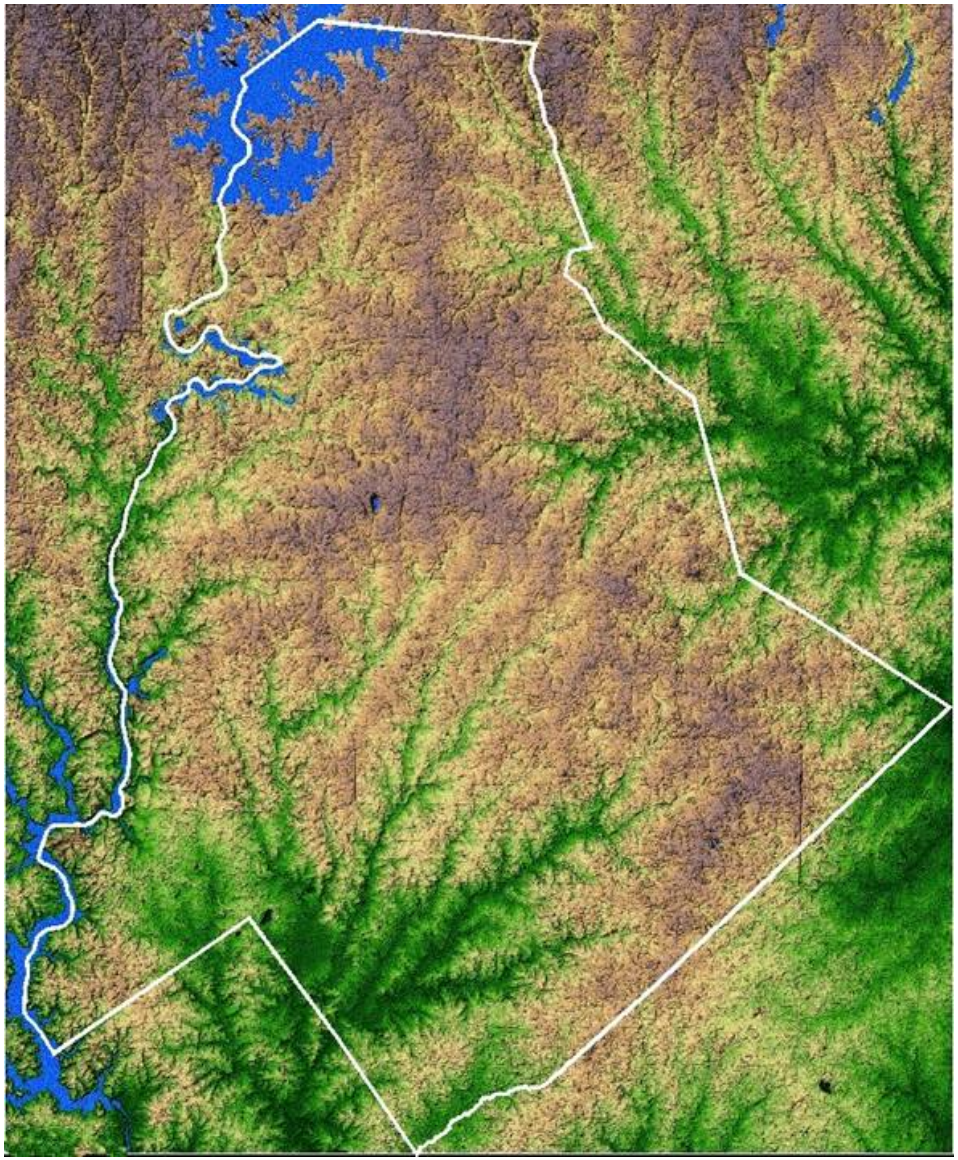
# Ingredients for Success

- Cooperating Technical Partner (CTP)
- Future Conditions Mapping & Ordinance Regulation
- Real-time Flood Warning System (FINS)
- Buyout Program
- Risk Assessment/Risk Reduction (RARR) tool
- Flood Mitigation Grant Program (RetroFIT)

# CHARLOTTE-MECKLENBURG STORMWATER SERVICES OVERVIEW





## Significant Flood Risk

- Most populated county in NC
- 370+ miles of FEMA streams
- 4,000+ Buildings in Floodplain

## Progressive/Proactive Program

- One of first designated stand alone CTPs
- CRS Class 4
- Sophisticated flood mitigation planning tools (RARR)
- 400+ buyouts and marquee community amenity projects
- Local flood mitigation grant program

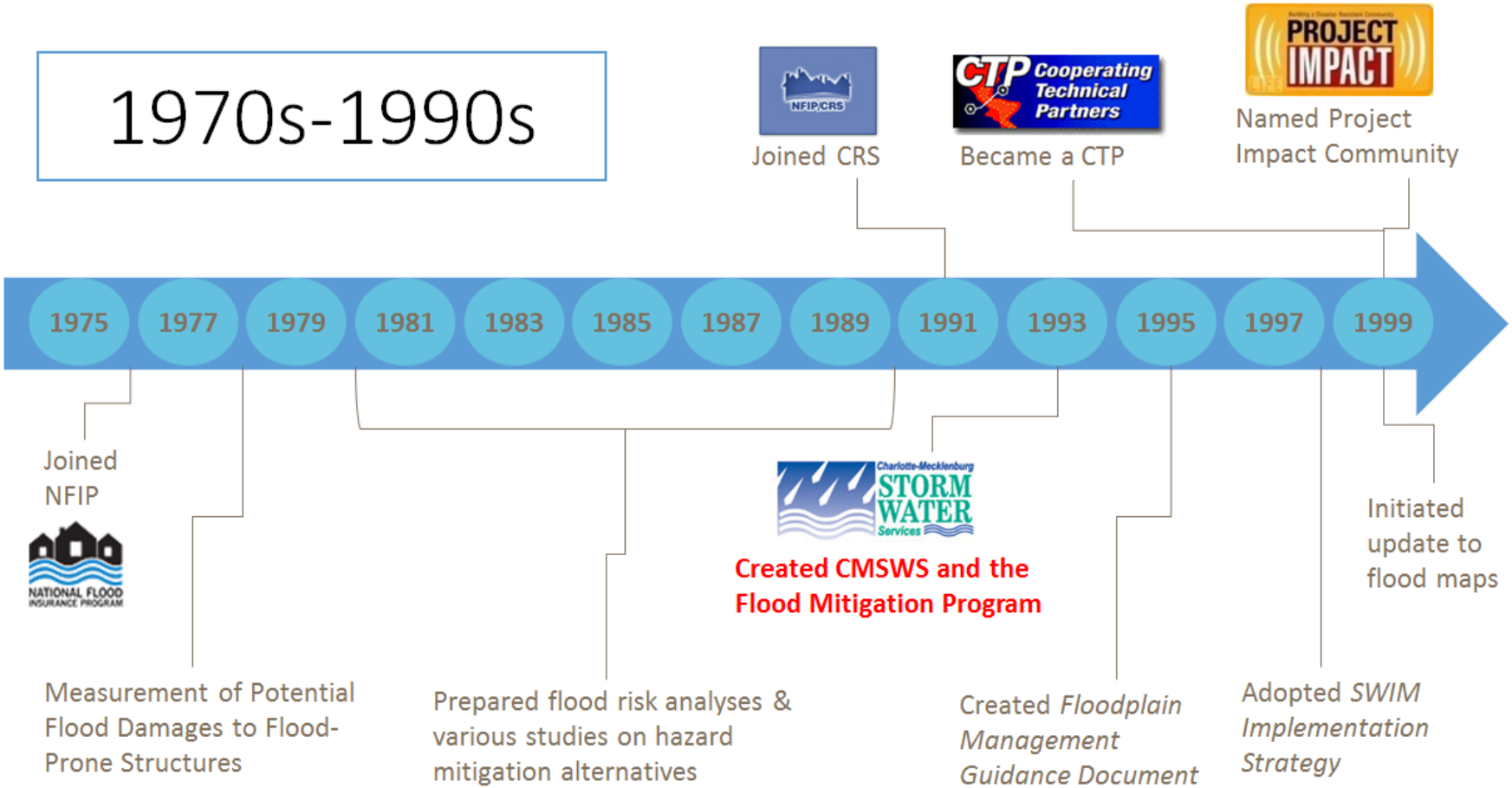
## Higher Standards

- Regulates to future conditions
- Floodways on all streams based on lower allowable surcharges

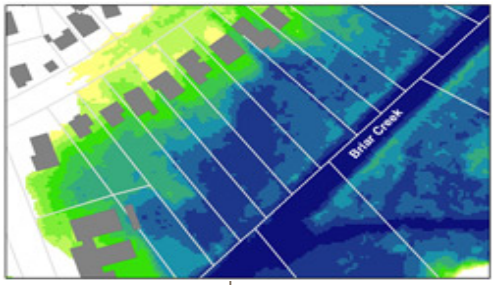
# Current Status of Mitigation Program

- Current mitigation measure – financial spending
  - Largely dependent on availability of FEMA grants
  - Grouped “marquee” projects, post-storm (Quick Buy), etc.
- Much of “low-hanging” projects have been picked
  - May see diminishing return
  - Less availability for grant funds, more reliance on local funds
- Establish “risk-based” mitigation annual target/goal
  - Level of service focus
  - Needs based budget
  - Maintain focus/follow-through on reducing risk
  - RARR Plan is backbone of data-driven engine
  - Still continue opportunistic projects where available, but don’t rely on it

# CMSWS's Floodplain Program: 1970 – 1999



# CMSWS's Floodplain Program: 2000-2009

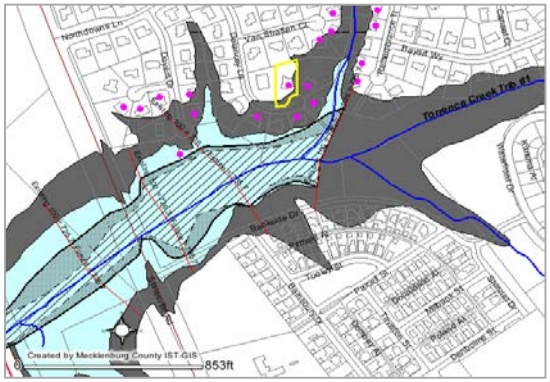



Initiated update to floodplain maps to include flood depths

Adopted *Multi-jurisdictional All-Hazard Mitigation Plan*

2000 2001 2002 2003 2004 2005 2006 2007 2008 2009

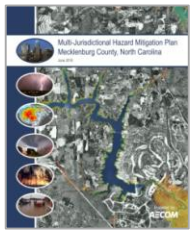
First community to show future and existing conditions on flood maps




Prepared 10 watershed-based preliminary engineering studies

Launched *Floodplain Buyout (Acquisition) Program*

# CMSWS's Floodplain Program: 2010-Present




Updated Hazard Mitigation Plan

PMR1 FIRMs issued effective

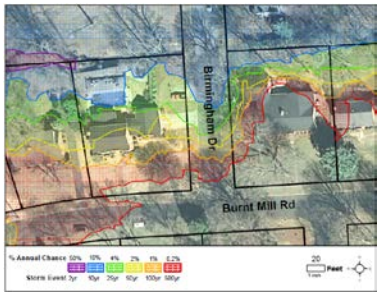
Countywide EC Update

Future Conditions Study

PMR3 FIRMs issued effective

2010 2011 2012 2013 2014 2015 2016 2017 2018 2019

Initiated Flood Risk Assessment and Reduction Plan




RetroFIT Program begins

PMR2 FIRMs issued effective

RARR Phase II

# Local Initiative Overview

## Buyout Program

- Voluntary acquisition over 400 floodprone structures since 2000
- $67M spent, but over 50% funding from grants/partnerships
- Combined with greenway/amenity which has created several marquee projects

## RetroFIT Program

- “Community” grant to offer financial (75% - 95%) & technical assistance for property owners to reduce flood risk
- Target properties that have risk, but may not be served by other initiatives
- RARR Risk score used to initial identify qualifying properties

RetroFIT Program Lifecycle

# Local Initiative Overview (cont.)

## FINS Flood Alert System

- Consists of over 70 rain and 50 stream gages that report real-time in public website
- Allows user to query historic data
- Automated notifications with associated actions sent based on rainfall/stage “triggers
- Dense network helps respond to flashy nature of Charlotte flooding

## 3D Floodzone

- Public website that provides multitude of property-level information to identify, assess, and reduce risk
  - Flood hazard & Enhanced Risk Map products
  - Building/Property elevation
  - Regulatory compliance and restriction information
  - Provides risk classification and list of applicable mitigation techniques based on RARR
- Used during map updates to collect/respond to citizen comments

# Mecklenburg FINS Flood Alert Website

Live Charlotte-Mecklenburg fins Flood Information & Notification System

Refresh Map

Rain Gage | Stage Gage | Lake Gage | Creek Cam

Last Refresh 05/22/2019 04:17 PM

Map | Satellite | Terrain

## Filter

### Quick Filter

Show values reported in the last

24 hours

Go

### Advanced Filter

Show values reported in the last

1 Month(s)

prior to

05/01/20:

Go

### Range Filter

Show values reported between

Earlier Date Later Date

Go

### Zoom To Gauge

Select Stage Gage

- Map Controls
- Legend
- Location Search
- Weather Warnings
- Gage Warnings
- Download Data

GIS Mecklenburg County

Charlotte-Mecklenburg STORM WATER Services

Live fins

4503: Irwin @ Starita (CRN03)

Provisional Data Subject to Revision

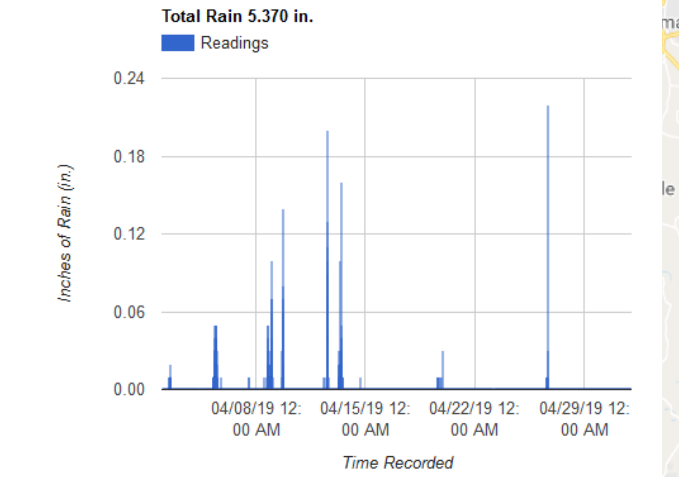
Data for this gauge is available from Jan 1, 2008

Quick Filter | Advanced Filter | Range Filter

Show values reported in the last 30 minutes

Go

Graph | Tabular | Picture




Google

Map data ©2019 Google Terms of Use Report a map error

Charlotte-Mecklenburg Storm Water Services

# 3D Interactive Floodzone Mapping

Reducing Risk for a Sustainable Future

Welcome | Map Layers | Risk Info | Glossary

Type Address/Parcel ID/Owner Name/Lndm

Streets | Aerials | Topo

Identify Risk | Assess Risk | Reduce Risk

Relocate structure - Relocating a flood-prone structure to a different parcel that's located outside the floodplain.

Elevate structure - Physically raising the lowest finished floor of an existing structure to an elevation above the Flood Protection Elevation.

# Local Initiative Overview (cont.)

## Enhanced Datasets

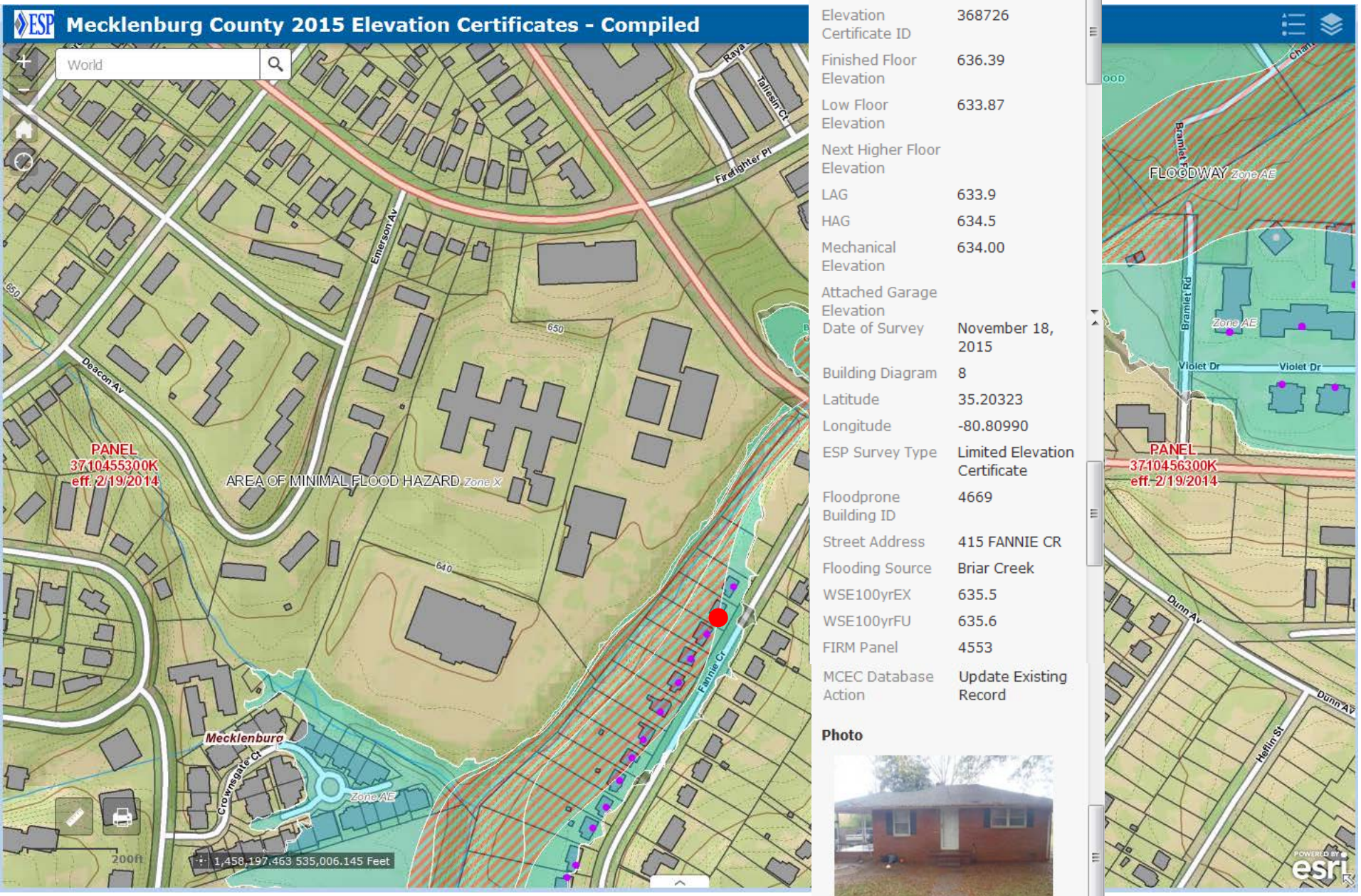
- ***Elevation certificates:*** GIS database and application storing over 9,000 EC compiled from permits and county mitigation initiatives
- ***FEMA Model Support Layers:*** Compiled datasets of attributed support layers attributed with inputs and model results (e.g. cross section, subbasins, stream surveys, land use projections, etc.)
- ***Stream Crossing Susceptibility:*** Provides classification and overtopping susceptibility for all crossings along FEMA stream

## Risk Assessment / Risk Reduction (RARR)*

- Framework and associated tools to dynamically perform building-level risk assessment, mitigation evaluation, and “project” ranking

## Regulatory Future Floodplain Mapping**

- Regulate and plan to future conditions




**415 FANNIE CR**

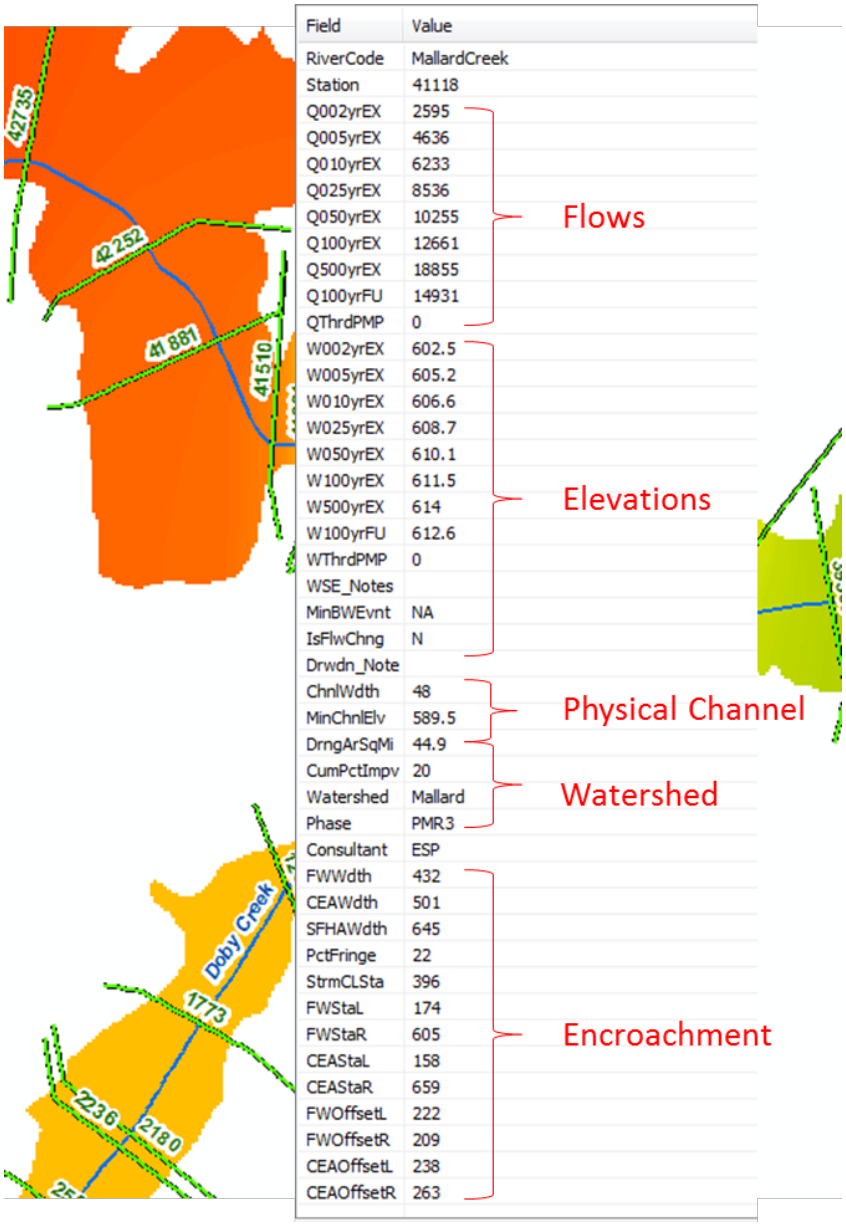
| | |
|---|---|
| Elevation Certificate ID | 368726 |
| Finished Floor Elevation | 636.39 |
| Low Floor Elevation | 633.87 |
| Next Higher Floor Elevation | |
| LAG | 633.9 |
| HAG | 634.5 |
| Mechanical Elevation | 634.00 |
| Attached Garage Elevation | |
| Date of Survey | November 18, 2015 |
| Building Diagram | 8 |
| Latitude | 35.20323 |
| Longitude | -80.80990 |
| ESP Survey Type | Limited Elevation Certificate |
| Floodprone Building ID | 4669 |
| Street Address | 415 FANNIE CR |
| Flooding Source | Briar Creek |
| WSE100yrEX | 635.5 |
| WSE100yrFU | 635.6 |
| FIRM Panel | 4553 |
| MCEC Database Action | Update Existing Record |

**Photo**



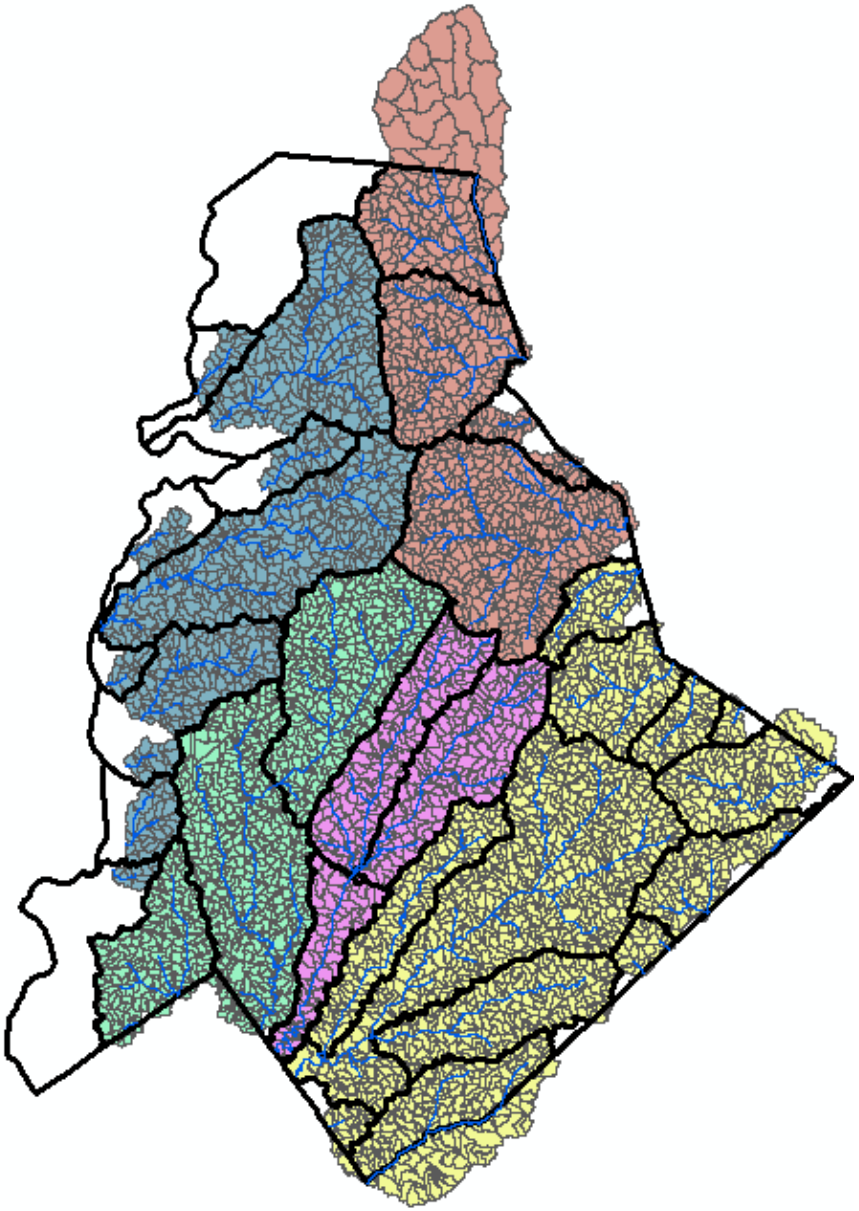
Zoom to

# Mecklenburg Enhanced Model Support Data Products



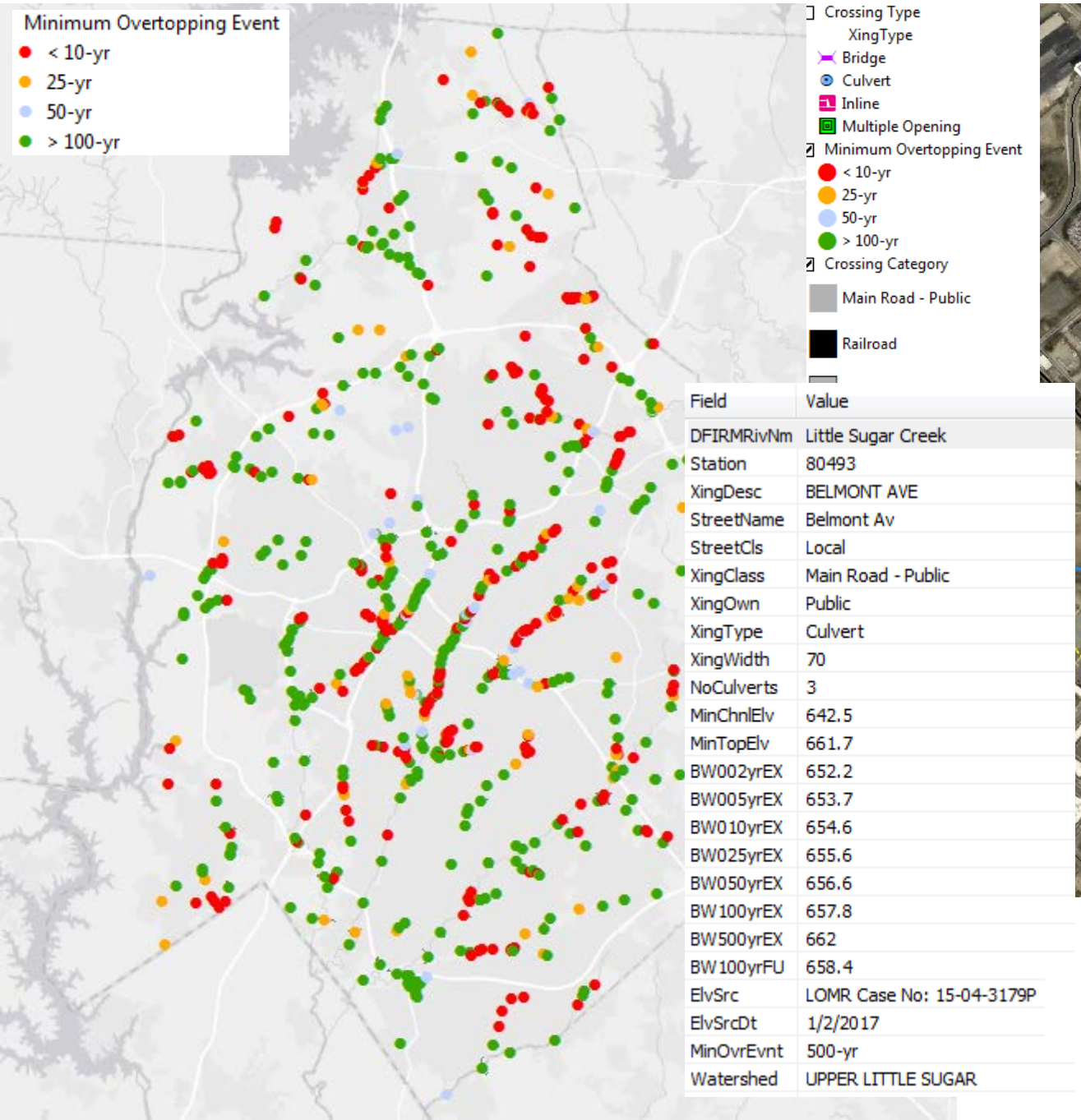

| Field | Value | |
|---|---|---|
| RiverCode | MallardCreek | |
| Station | 41118 | |
| Q002yrEX | 2595 | Flows |
| Q005yrEX | 4636 | |
| Q010yrEX | 6233 | |
| Q025yrEX | 8536 | |
| Q050yrEX | 10255 | |
| Q100yrEX | 12661 | |
| Q500yrEX | 18855 | |
| Q100yrFU | 14931 | |
| QThrdPMP | 0 | |
| W002yrEX | 602.5 | Elevations |
| W005yrEX | 605.2 | |
| W010yrEX | 606.6 | |
| W025yrEX | 608.7 | |
| W050yrEX | 610.1 | |
| W100yrEX | 611.5 | |
| W500yrEX | 614 | |
| W100yrFU | 612.6 | |
| WThrdPMP | 0 | |
| WSE_Notes | | |
| MinBWEvnt | NA | |
| IsFlwChng | N | |
| Drwdn_Note | | |
| ChnlWdth | 48 | Physical Channel |
| MinChnlElv | 589.5 | |
| DrngArSqMi | 44.9 | Watershed |
| CumPctImpv | 20 | |
| Watershed | Mallard | |
| Phase | PMR3 | |
| Consultant | ESP | |
| FWWdth | 432 | Encroachment |
| CEAWdth | 501 | |
| SFHAWdth | 645 | |
| PctFringe | 22 | |
| StrmCLSta | 396 | |
| FWStaL | 174 | |
| FWStaR | 605 | |
| CEAStaL | 158 | |
| CEAStaR | 659 | |
| FWOffsetL | 222 | |
| FWOffsetR | 209 | |
| CEAOffsetL | 238 | |
| CEAOffsetR | 263 | |

*Model Cross Sections*
*(> 6,600 across 115 FEMA streams)*



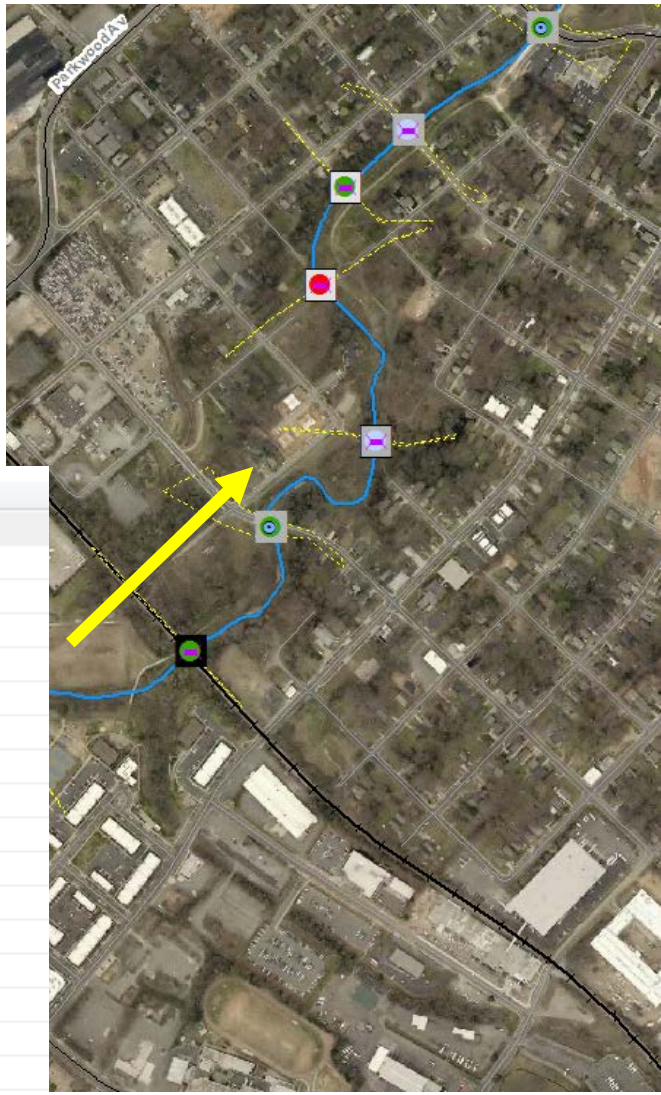
*Model Subbasins*
*(> 4,200 across 30 County watersheds)*

# *Mecklenburg Enhanced Model Support Data Products*




Crossing Type
XingType
Bridge
Culvert
Inline
Multiple Opening
Minimum Overtopping Event
< 10-yr
25-yr
50-yr
> 100-yr
Crossing Category
Main Road - Public
Railroad

| Field | Value |
|---|---|
| DFIRMRivNm | Little Sugar Creek |
| Station | 80493 |
| XingDesc | BELMONT AVE |
| StreetName | Belmont Av |
| StreetCls | Local |
| XingClass | Main Road - Public |
| XingOwn | Public |
| XingType | Culvert |
| XingWidth | 70 |
| NoCulverts | 3 |
| MinChnlElv | 642.5 |
| MinTopElv | 661.7 |
| BW002yrEX | 652.2 |
| BW005yrEX | 653.7 |
| BW010yrEX | 654.6 |
| BW025yrEX | 655.6 |
| BW050yrEX | 656.6 |
| BW100yrEX | 657.8 |
| BW500yrEX | 662 |
| BW100yrFU | 658.4 |
| ElvSrc | LOMR Case No: 15-04-3179P |
| ElvSrcDt | 1/2/2017 |
| MinOvrEvnt | 500-yr |
| Watershed | UPPER LITTLE SUGAR |




*FEMA Stream Crossings*
*750± across 115 FEMA streams)*

# Risk Assessment/ Risk Reduction (RARR) – Moving into the Future

# RARR Plan/Tool Overview

- Process with associated tools that evaluate risk and assess mitigation alternatives at building/property level across County
- Uses multi-tier scoring system to provide relative measure of risk and mitigation potential
- RARR simulations integrate input from:
  - Elevation Certificates - Finished Floor, LAG, HVAC elevations
  - FIS Modeling- Multi-Frequency (50% - 0.2% chance) Flood Elevations, velocities
  - Parcels – Occupancy/Use, Building characteristics and value
  - Others – public land, other projects, insurance claims, etc.
- Reduction in collective risk pool (i.e. total scores) can be used as the metric to drive Goals Driven initiative

# RARR Workflow

**Flood Risk Property Score**

- Flood Property Damage (Impacts)
- Storm Probability (Frequency)
- Structure Location

**Risk Reduction Recommendations**

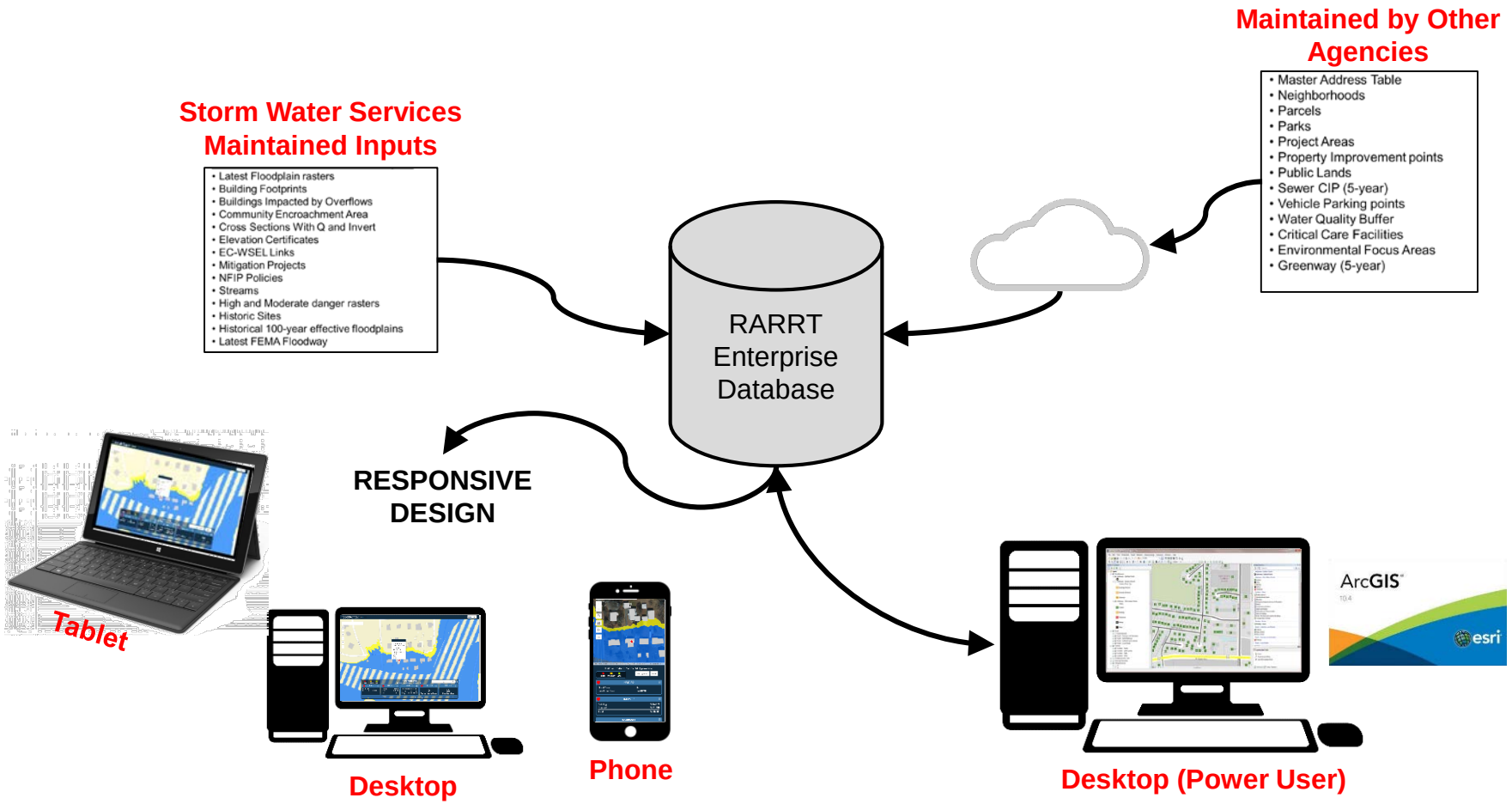
- Evaluate all flood mitigation techniques
- Four recommendation categories

**Mitigation Priority Scores**

- Accounts for other community benefits & factors not included in flood risk
- Combined with Risk Score to prioritize:
  - Properties
  - Projects (groups)

**Risk Assessment & Risk Reduction Plan**

# Envisioned Framework



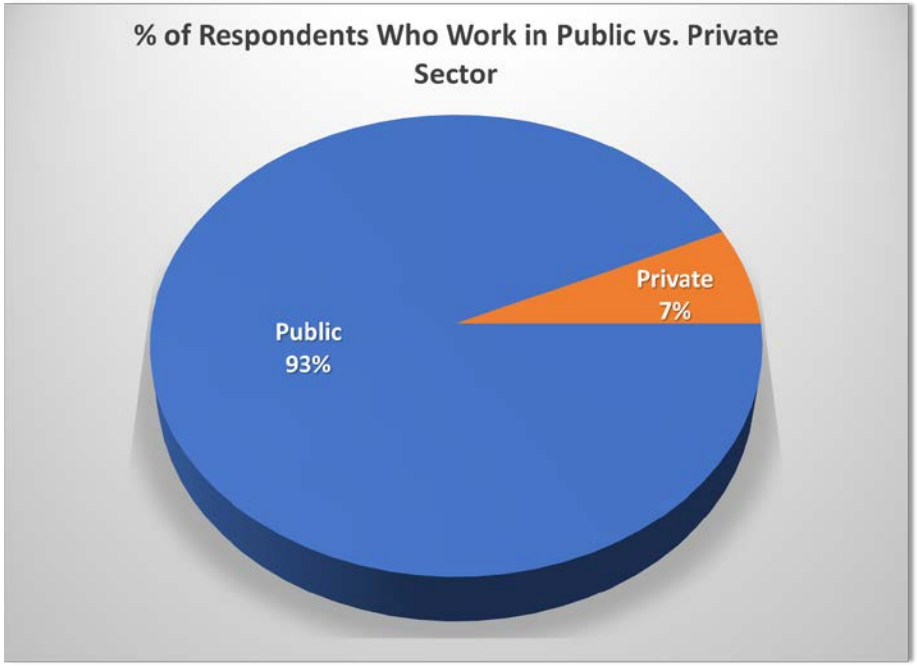
# Outreach Overview

## Purpose

Gather input from communities across the nation to inform development of Community Guidebook and Risk Assessment / Risk Reduction (RARR) tool enhancements

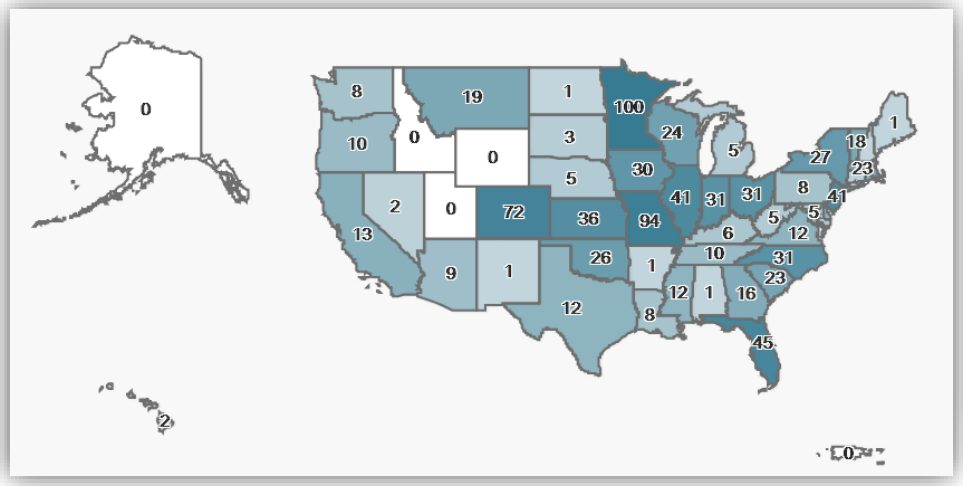
## Implementation

Developed an online survey and associated project website to solicit feedback from stakeholders between June – September 2018

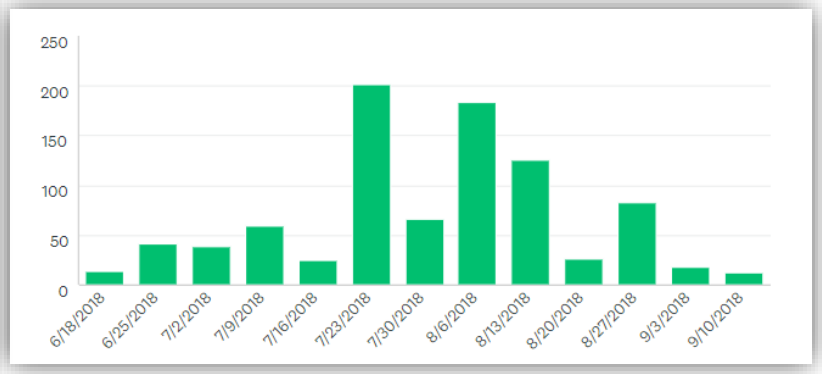


# Data Needs

- Over 74% of respondents are missing 1-2 essential data sets to manage flood risk at the building level.
- About 33% of respondents lack Base Flood Elevations in at least half their community.
- Nearly 20% of respondents are ‘not confident’ or don’t have adequate floodplain maps.
- Flood hazard mitigation plans are common, but rarely detailed to the building-level.




*Survey Response Totals by State*




*Weekly Survey Response Count*

# Considerations for the Guidebook and Tool Enhancements

- Identification of essential and supplemental data requirements, as well as, information on data collection/capture options for these datasets

- "Tiered" risk assessment and mitigation evaluation options (e.g. basic and enhanced) based on variable data availability

- Guidance on how to leverage and incorporate analyses and recommendations from existing local plans into a building-level approach community-wide

# Considerations for the Guidebook and Tool Enhancements

- Flexibility to allow communities to customize risk/mitigation weighting factors based on their individual needs and priorities
- Incorporation of parallel ranking systems – one that directly incorporates monetized avoided damages (cost-weighted) and one that does not (cost-neutral)
- Guidance applicable for low - moderate flood risk communities, as well as, higher risk communities like Mecklenburg County

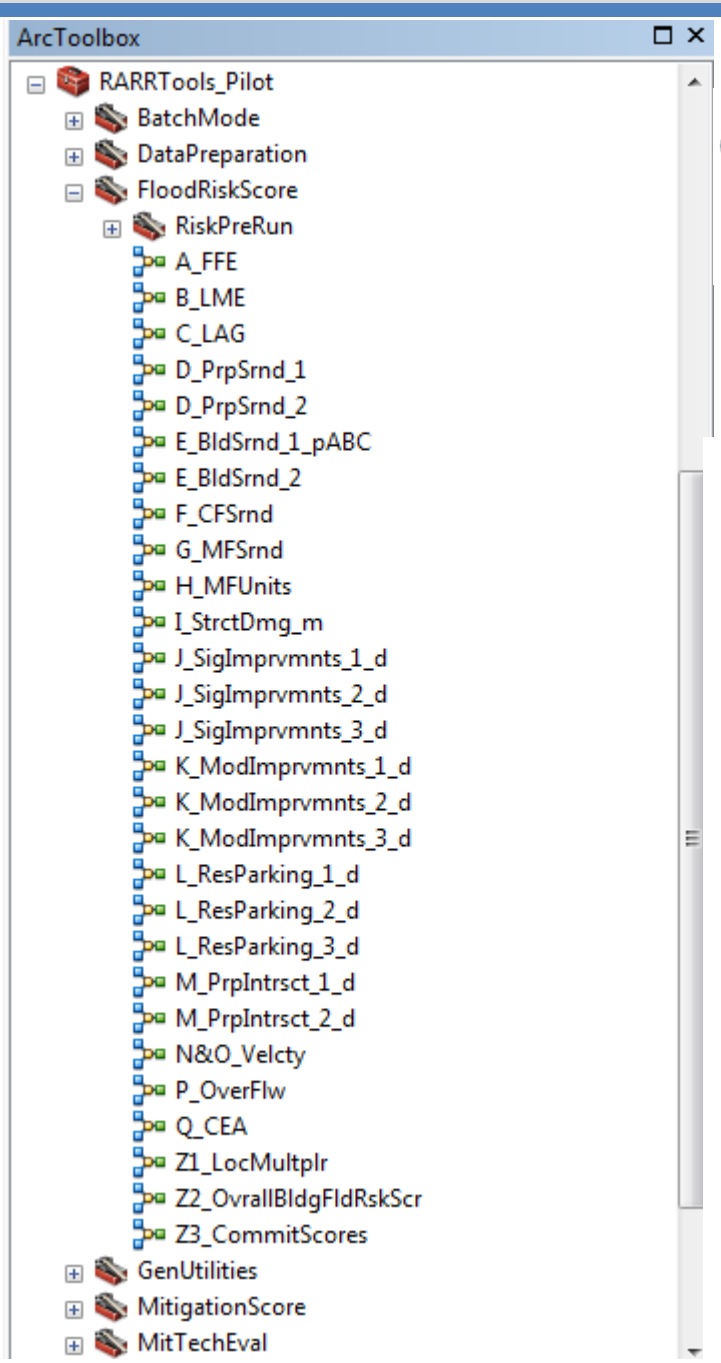
# Tool Updates/Enhancements

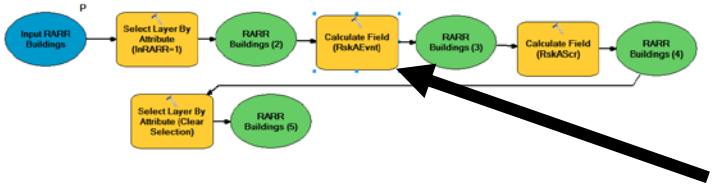
- Tools updates being performed in phases defined by grant:
  - ***Base Year:*** Replicate existing logic, but build to be more flexible and efficient
  - ***Option Year 1:*** New functionality, more robust considerations
  - ***Option Year 2:*** Advanced enhancements and integration with other technologies
- Tool enhancements identified through internal need assessment and external outreach (survey)

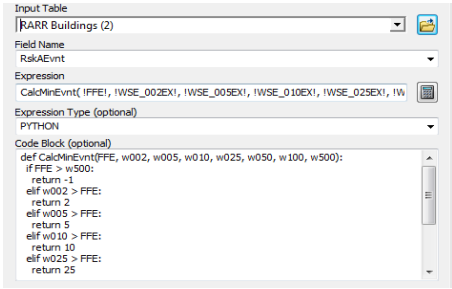
# Tool Updates/Enhancements

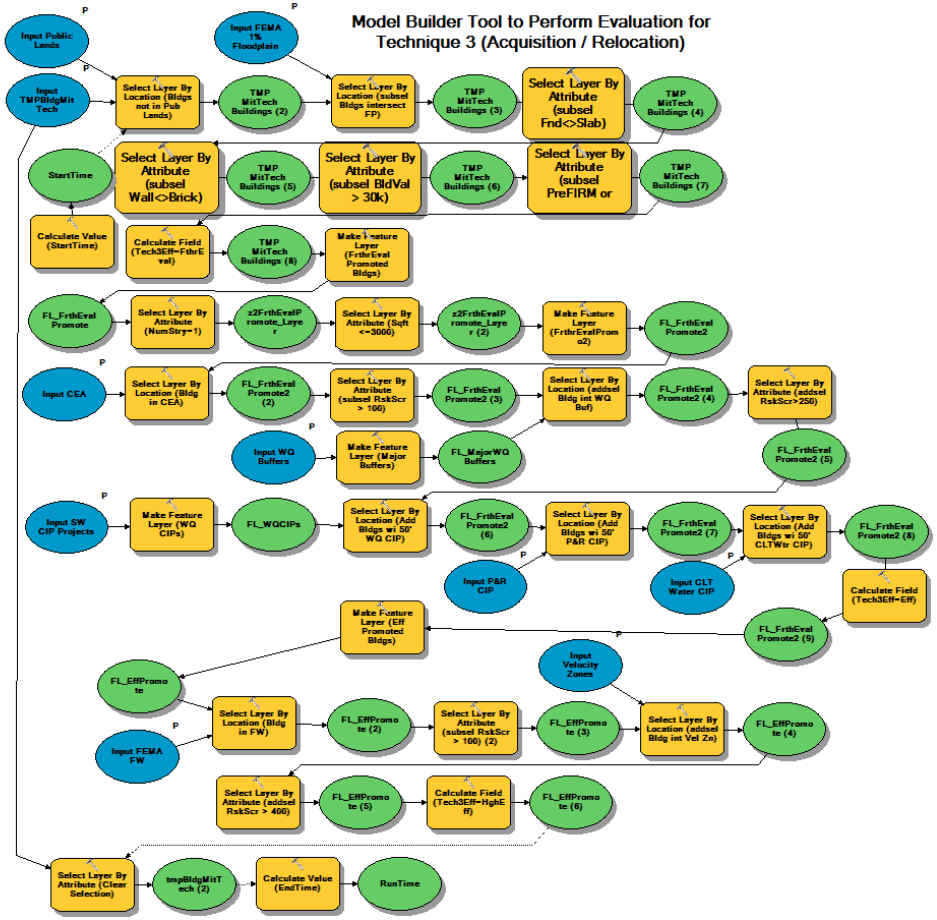
- Wrapping up Base Year updates now – testing and validating tools.
- Base Year tool update highlights:
  - Updating (and restructuring) input datasets and RARR databases
  - Rebuilding tools in combination ModelBuilder / Python
  - Developing updated SOPs to document changes
- Challenges:
  - Handling with multitude of input datasets that may be complex, may change, or may not be 100% complete/accurate
  - Evaluation logic structures that involve complex combination of spatial and attribute queries
  - Trying to make sure current changes can be expanded with future enhancements and longer-term web dashboard vision

# Base Year - RARR Toolbox with Update Tools



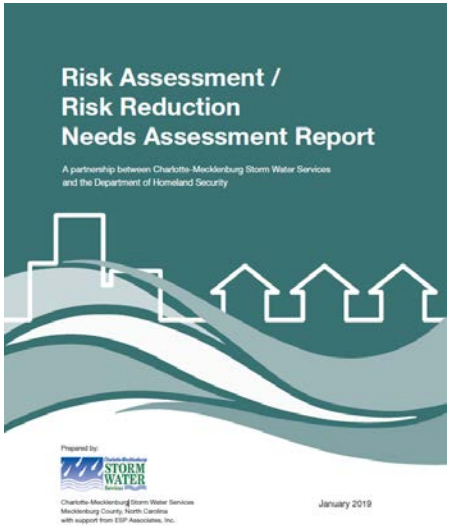



# Tool Enhancements

- Enhancements defined by internal needs assessment and feedback from external outreach (survey)
- Used modified Analytic Hierarchy Process (AHP) methodology to prioritize
  - Identified and prioritized 21 enhancements
  - Several enhancements broad ranging and will contain numerous sub enhancement
- Start work on Year 1 enhancements soon




| Community Guidebook Needs | RARR Tool Desired Enhancements |
|---|---|
| *(All Year 1)*<br>• Solutions to address data gaps<br>• Cost-weighted and cost-neutral assessments<br>• Flexibility for risk scoring and mitigation options<br>• Emphasis on highest mitigation priorities | • Update technology platform *(Base Year)*<br>• Increase tool processing efficiency *(Base Year)*<br>• Identify / Calculate missing data *(Base Year)*<br>• Indicate compliant / non-compliant status *(Base Year)*<br>• Incorporate updated FEMA BCA Methodology *(Year 1)*<br>• Incorporate enhanced mitigation benefits *(Year 1)*<br>• Incorporate partnerships into mitigation benefits *(Year 1)*<br>• Track residual risk *(Year 1)*<br>• Estimate future benefits *(Year 1)*<br>• Perform optimization of funding allocations *(Year 1)*<br>• Incorporate historical tracking of risk scores *(Year 1)*<br>• Provide enhanced dashboard / reporting features *(Year 1)*<br>• Incorporate mitigation actions in final risk scores *(Year 1)*<br>• Compute risk score with & without monetization *(Year 1)*<br>• Provide interactive scenarios to assess impacts of mitigation on score *(Year 1)*<br>• Compute highest contributing factor to score *(Year 1)*<br>• Include freeboard mapping or analysis *(Year 1)*<br>• Incorporate gages/sensor information to calculate flood loss and mitigation options in "real-time" *(Year 2)* |

# Future Conditions –

# A New Beginning Born From Disaster

- Two big floods, 2 years apart
  - 1995 – Tropical Storm Jerry ($16M losses)
  - 1997 – Hurricane Danny ($60M losses, 3 deaths)
- Maps out of date and not reliable
- County experiencing explosive growth

**Recognized need for updated floodplain maps**

# New Ideas

- Manage own maps
  - Become CTP (2nd in the country)
  - Develop customized FIRMs
    - More base map data for reference
    - Included BFE/FW info directly on FIRM
    - Customized layers
- Rethink floodplain regulations
  - Higher standards

**Regulate to Future Conditions Mapping**

# Why Future Floodplains?

- Minimize future flood risk to new/rebuilt structures
- Compliant buildings will still be in compliance for future map updates
- Account for future hydrologic changes
- Focus on the cumulative impacts on the watershed
- Preserve natural state of floodplains. Allow flood storage

# Key Decision Points

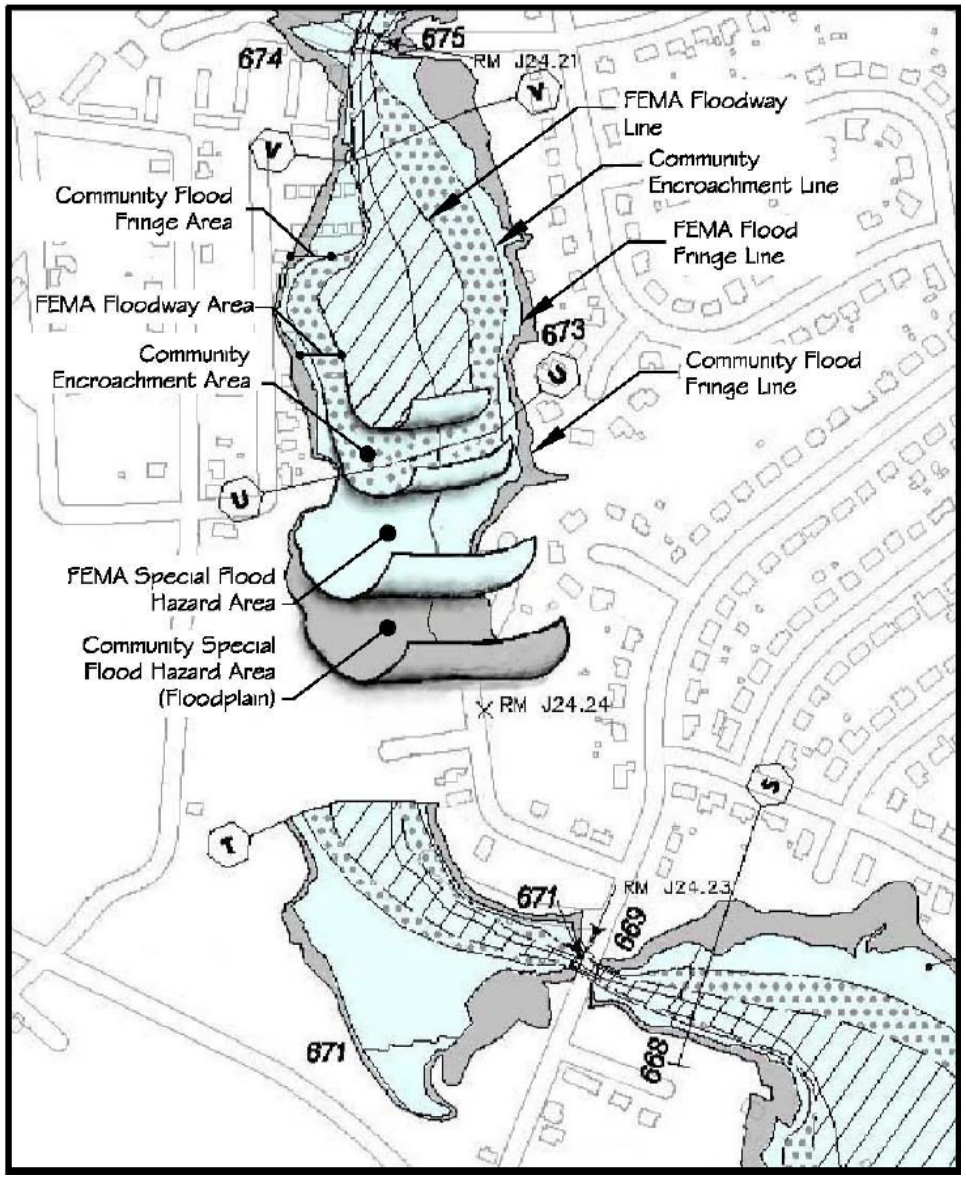
- Concept Acceptance
    - Convince decision makers (city council, politicians, public)
    - Stakeholders involvement (developers, realtor, builders)
        - More people will be in the floodplain
        - Higher flood elevations
    - FEMA approval
- Concept Development
    - Two Pilot Studies, Workshops
    - Technical considerations – what metrics will decide the future?
    - Methodology
- Concept Implementation
    - Enforcement for existing development
    - Permitting issues for existing structures
    - Disclosure during real estate transactions

# Timeline

- 2000
  - New studies with future condition floodplains adopted locally
  - Two (2) sets of maps – Existing and Future

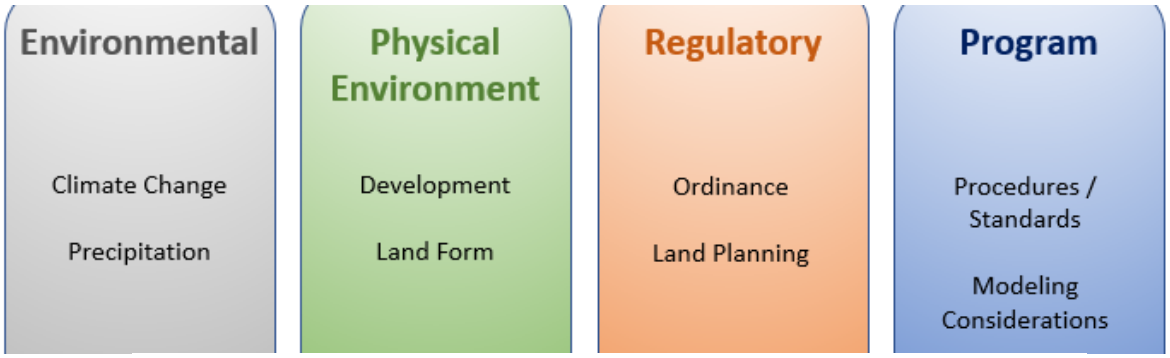
- 2004
  - FEMA published updated Mecklenburg County maps
  - One map with Existing, Future, and 2 floodways

*Mecklenburg FIRM Layers*



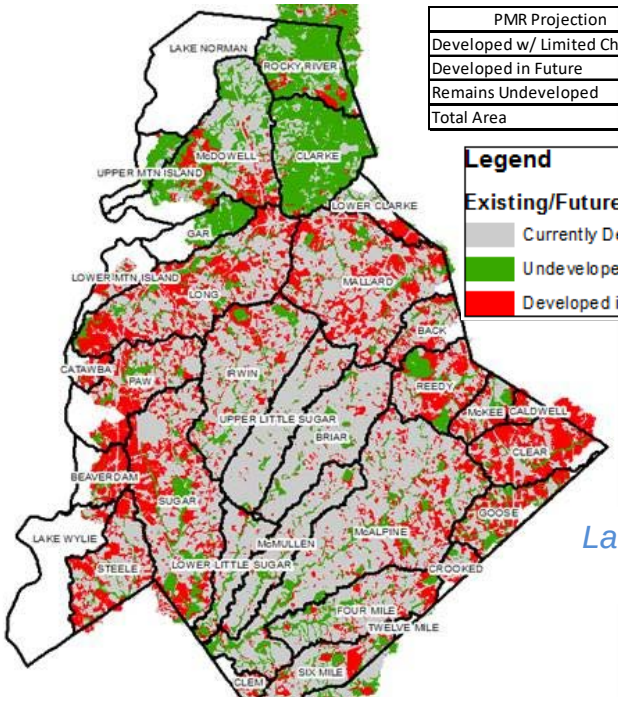
# 2017/2018 Future Methodology Revisit

- Initiated study to investigate more comprehensive consideration of future conditions
  - Recent map updates showed more change in future BFE than desired
  - Current methodology only accounts for increase in impervious
- Identified and evaluated range of other factors
  - Ran numerous model simulations to evaluate
  - Concluded that existing methodology may be underestimating future BFEs by over 1’
- Study recommended several adjustments
  - Vetted through public stakeholder process



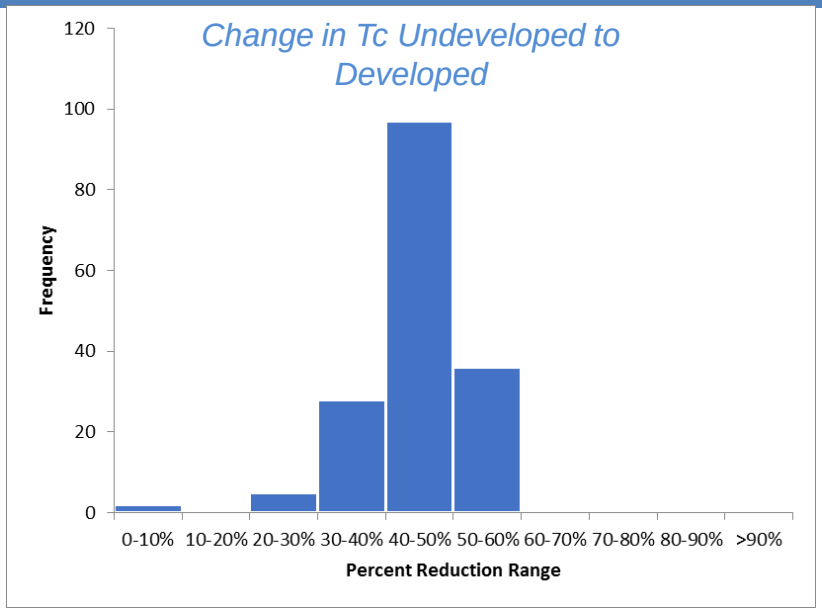

*Factors and Considerations Affecting Future Conditions Modeling*

# Future Condition Evaluation Data Analyses




| PMR Projection | Area (Sqmi) | % Area | Area (Ac) |
|---|---|---|---|
| Developed w/ Limited Change | 293.3 | 57% | 187,731 |
| Developed in Future | 116.3 | 23% | 74,460 |
| Remains Undeveloped | 103.0 | 20% | 65,910 |
| Total Area | 512.7 | 100% | 328,101 |

## Land Use Change Evaluation




## Storage and Attenuation Considerations

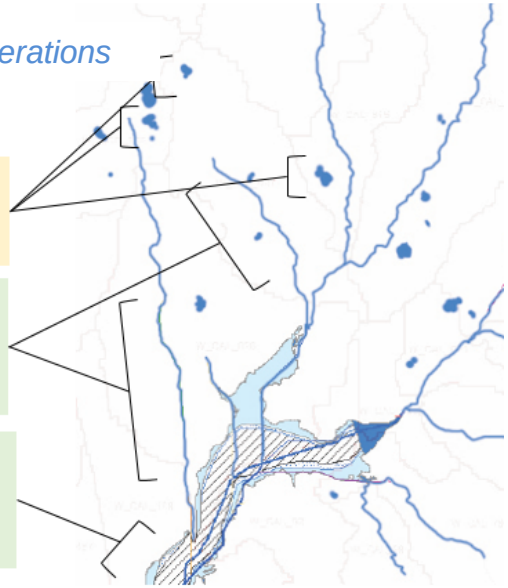
**Hydrologic Storage**
Areas that hold-back flood waters

**Attenuation**
Retard and reduce peak flow due to hydrologic storage

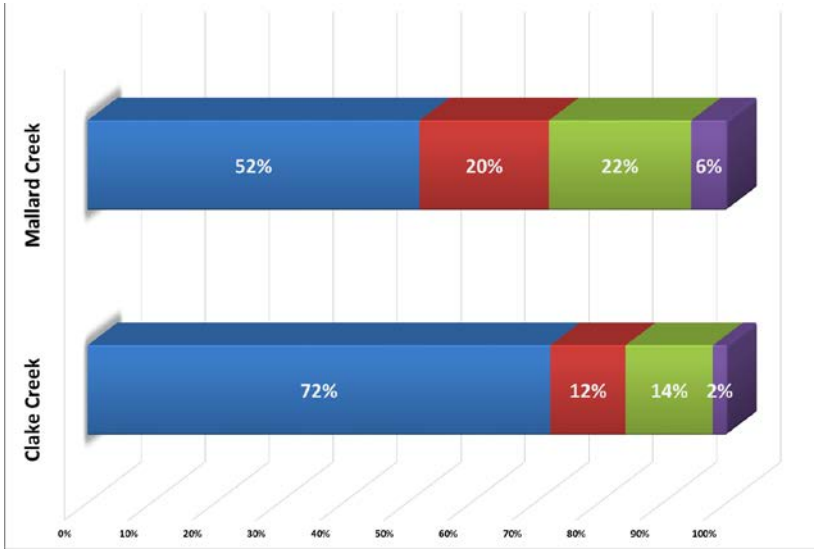
**Pond/Reservoir Storage** (natural & manmade)

**Headwater Stream Corridor Storage** (upstream of FEMA mapping)

**Floodplain Stream Corridor Storage** (FEMA mapped stream)

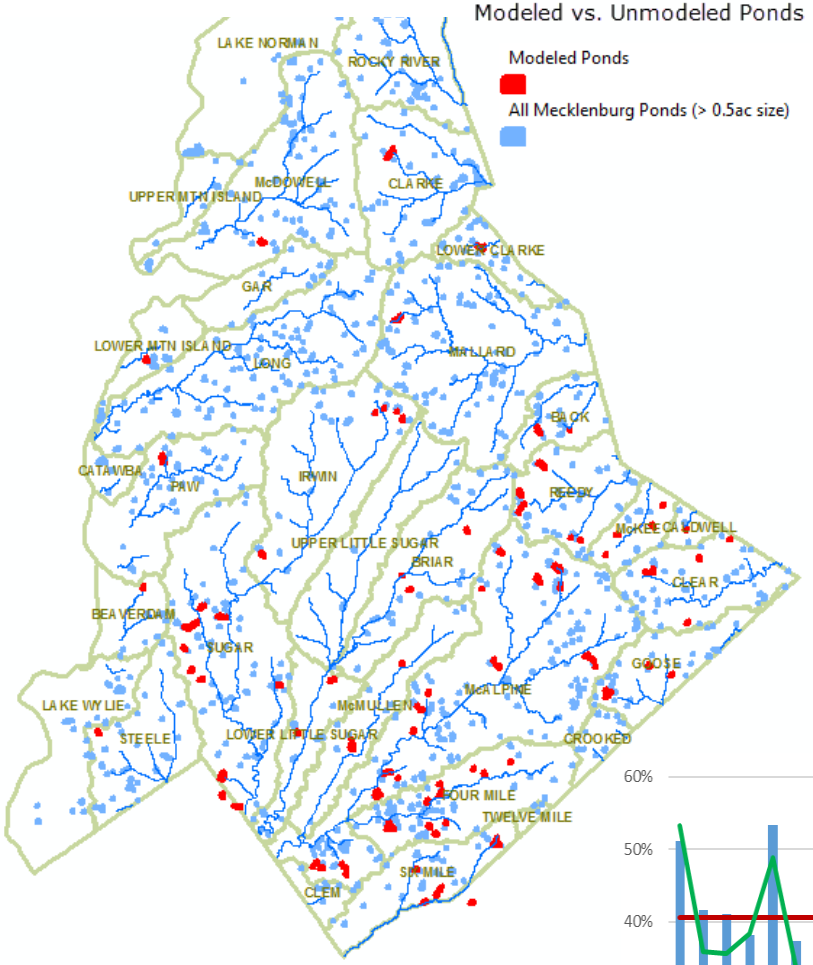


## Percent Total Travel Time by Flow Regime



# Future Condition Evaluation Data Analyses

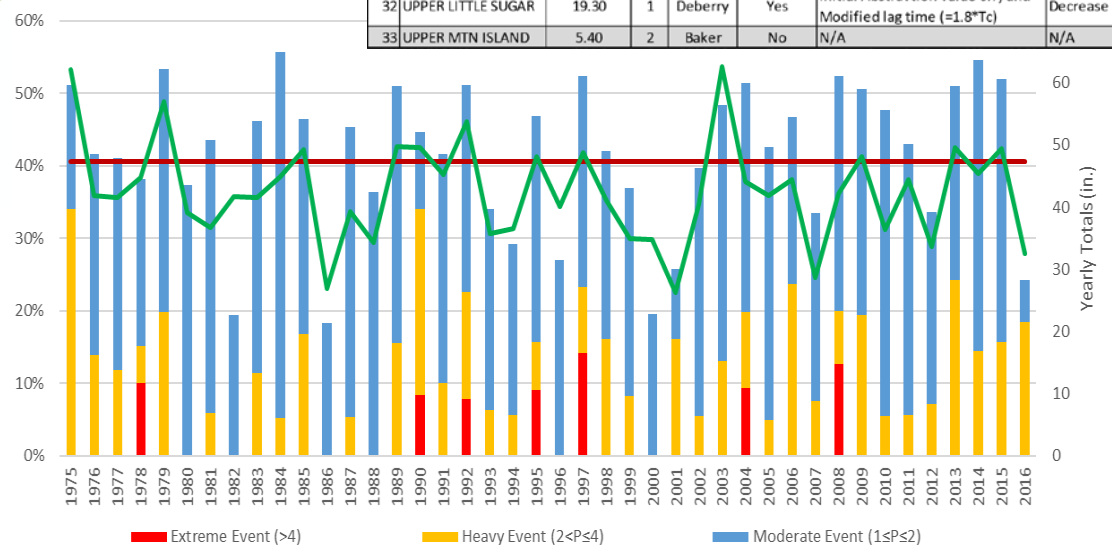
## Modeled vs. Unmodeled Ponds




## Model Calibration Impact Summary

| # | Watershed | Area (Sqmi) | PMR | Company | Calibration | Note | Calibration Intent |
|---|---|---|---|---|---|---|---|
| 1 | BACK | 7.87 | 1 | AECOM | Yes | Stream based adjusted IA and CN | Decrease Peak Flow |
| 2 | BEAVERDAM | 7.37 | 2 | Baker | No | N/A | N/A |
| 3 | BRIAR | 21.60 | 1 | Deberry | Yes | Initial Abstravtion value 0.7, and Modified lag time (=1.8*Tc) | Decrease Peak Flow |
| 4 | CALDWELL | 2.09 | 1 | AECOM | Yes | Stream based adjusted IA and CN | Decrease Peak Flow |
| 5 | CATAWBA | 3.07 | 2 | Baker | No | N/A | N/A |
| 6 | CLARKE | 21.50 | 3 | ESP | No | N/A | N/A |
| 7 | CLEAR | 15.33 | 1 | AECOM | Yes | Stream based adjusted IA and CN | Decrease Peak Flow |
| 8 | CLEM | 2.89 | 1 | AECOM | Yes | Stream based adjusted IA and CN | Decrease Peak Flow |
| 9 | CROOKED | 3.22 | 1 | AECOM | Yes | Stream based adjusted IA and CN | Decrease Peak Flow |
| 10 | FOUR MILE | 18.57 | 1 | AECOM | Yes | Stream based adjusted IA and CN | Decrease Peak Flow |
| 11 | GAR | 8.29 | 2 | Baker | No | N/A | N/A |
| 12 | GOOSE | 11.23 | 1 | AECOM | Yes | Stream based adjusted IA and CN | Decrease Peak Flow |
| 13 | IRWIN | 29.98 | 2 | AECOM | Yes | Stream based adjusted IA and CN | Decrease Peak Flow |
| 15 | LAKE WYLIE | 20.25 | 2 | Baker | No | N/A | N/A |
| 16 | LONG | 36.34 | 2 | Baker | Yes | Stream based adjusted IA and CN | Decrease Peak Flow |
| 17 | LOWER CLARKE | 5.70 | 3 | ESP | No | N/A | N/A |
| 18 | LOWER LITTLE SUGAR | 10.07 | 1 | Deberry | Yes | Initial Abstravtion value 0.7, and Modified lag time (=1.8*Tc) | Decrease Peak Flow |
| 19 | LOWER MTN ISLAND | 6.66 | 2 | Baker | No | N/A | N/A |
| 20 | MALLARD | 38.78 | 3 | ESP | No | N/A | N/A |
| 21 | McALPINE | 59.24 | 1 | AECOM | Yes | Stream based adjusted IA and CN | Decrease Peak Flow |
| 22 | McDOWELL | 32.49 | 2 | Baker | No | N/A | N/A |
| 23 | McKEE | 5.85 | 1 | AECOM | Yes | Stream based adjusted IA and CN | Decrease Peak Flow |
| 24 | McMULLEN | 15.21 | 1 | AECOM | Yes | Stream based adjusted IA and CN | Decrease Peak Flow |
| 25 | PAW | 20.01 | 2 | Baker | No | N/A | N/A |
| 26 | REEDY | 14.19 | 1 | AECOM | Yes | Stream based adjusted IA and CN | Decrease Peak Flow |
| 27 | ROCKY RIVER | 15.42 | 3 | ESP | Yes | CN Adjustment | Decrease Peak Flow |
| 28 | SIX MILE | 12.78 | 1 | AECOM | Yes | Stream based adjusted IA and CN | Decrease Peak Flow |
| 29 | STEELE | 15.55 | 2 | AECOM | Yes | Stream based adjusted IA and CN | Decrease Peak Flow |
| 30 | SUGAR | 37.53 | 2 | AECOM | Yes | Stream based adjusted IA and CN | Decrease Peak Flow |
| 31 | TWELVE MILE | 0.72 | 1 | AECOM | Yes | Stream based adjusted IA and CN | Decrease Peak Flow |
| 32 | UPPER LITTLE SUGAR | 19.30 | 1 | Deberry | Yes | Initial Abstravtion value 0.7, and Modified lag time (=1.8*Tc) | Decrease Peak Flow |
| 33 | UPPER MTN ISLAND | 5.40 | 2 | Baker | No | N/A | N/A |

## Percent Contribution of Total Precipitation from Significant Rain Events

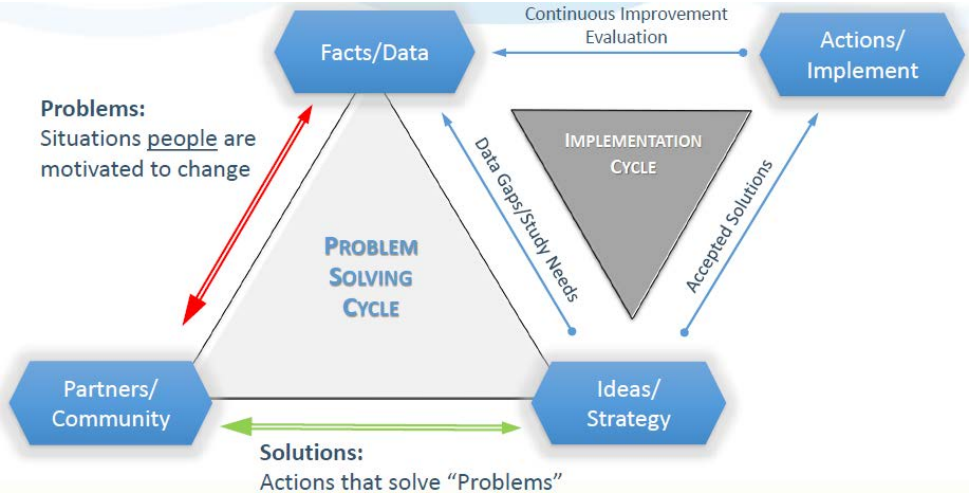


# *Future Condition Evaluation Report with Recommendations*

| Model Element | PROBLEM SUMMARY | SOLUTION RECOMMENDATIONS | Notes |
|---|---|---|---|
| Floodplain Storage & Impoundments | • Floodplain storage occurring outside the Community Floodway could be removed by filling in the future. Consider assumptions for the loss of some portion of that hydraulic storage.<br>• Ponds in headwaters could be removed on case by case basis in the future. Consider criteria for removing individual ponds based on likelihood they will be removed. | • Remove storage between floodplain and Community Encroachment Area<br>• Create process to identify ponds likely required to remain. Remove all others from hydrologic model. | *• Headwater storage areas (hydrologic routing reaches) are relatively well protected from being removed/altered in the future (by buffers, stream impact permitting, etc.).*<br>*• Pond storage information comes from NC Dam Safety and supplemented by field survey if needed. Storage in input into the hydrologic model.* |
| Peak Flow Timing | • Peak flow timing will change in future conditions modeling after land use changes. Develop methods to include effects of those changes to future conditions flood elevations. | • In sub basins where more than 50% of the area is changing to a developed land use, adjust the peak flow timing. Where available, reduce sheet flow length to 100'. Where not available reduce TC by 40%. | |
| Model Calibration | None identified | No changes | *• Elements of calibration are included in other areas reviewed* |
| Future Land Use Projections | • Some golf courses may be re-developed in the future and currently shown as "No Change" areas.<br>• Current future land use methods don't accurately account for potential growth in areas not explicitly show as "No Change". Biggest issues are with land use descriptions for Rural & Rural Subdivision in northern towns that have broad and vague future development definitions. | • Change golf courses in GC03 (private owned only) and GC04 to match zoning designation.<br>• Create a new future land use category (13th) for "undefined future development". Use for all undeveloped and unprotected areas that are not explicitly identified as "no change" areas. Assume 20% impervious for future development. | |
| Rainfall Uncertainty | • There is uncertainty, and spatial & temporal variability in the 1% rainfall, as shown by local & regional rain gage data trends and the NOAA Atlas 14 study. This could impact future floodplain changes. | • Use 7.85" as the 100-year 24-hr rainfall (8% uncertainty band of NOAA Atlas 14) to account for rainfall uncertainty. | *• Mixed opinions on whether uncertainty in rainfall probabilities and variability in trends will present a problem in the future. All wanted a "justifiable" number for any change made to account for unknowns.* |
| Overall | • Cumulative impacts of problems identified in current future conditions mapping could increase BFE's by averages of 1.1'-1.6' (Rural watersheds) and 0.4'-1.3' (Urban watersheds). Floodplain mapping can take years to develop, review and adopt. | • Add 1' freeboard of to the Flood Protection Elevation for a maximum of 2' total. Clearly identify the added freeboard as a temporary standard until the future floodplain is updated, at which time the added freeboard will be eliminated. | • Stakeholders want Storm Water to update the future floodplain in the near future. |

# Future Methodology Update Implementation

- Plan to fully implement changes in future conditions update only PMR or next FIS update
  - Investigating funding and logistics
- As temporary stop-gap, plan to increase freeboard by 1’




# Conclusions & Lessons Learned

# Ingredients for Success

- Importance of Collaboration
- Data Investment
- Planning for the Future Loss
- Ownership of Programs

# QUESTIONS??