RiskMAP
Increasing Resilience Together

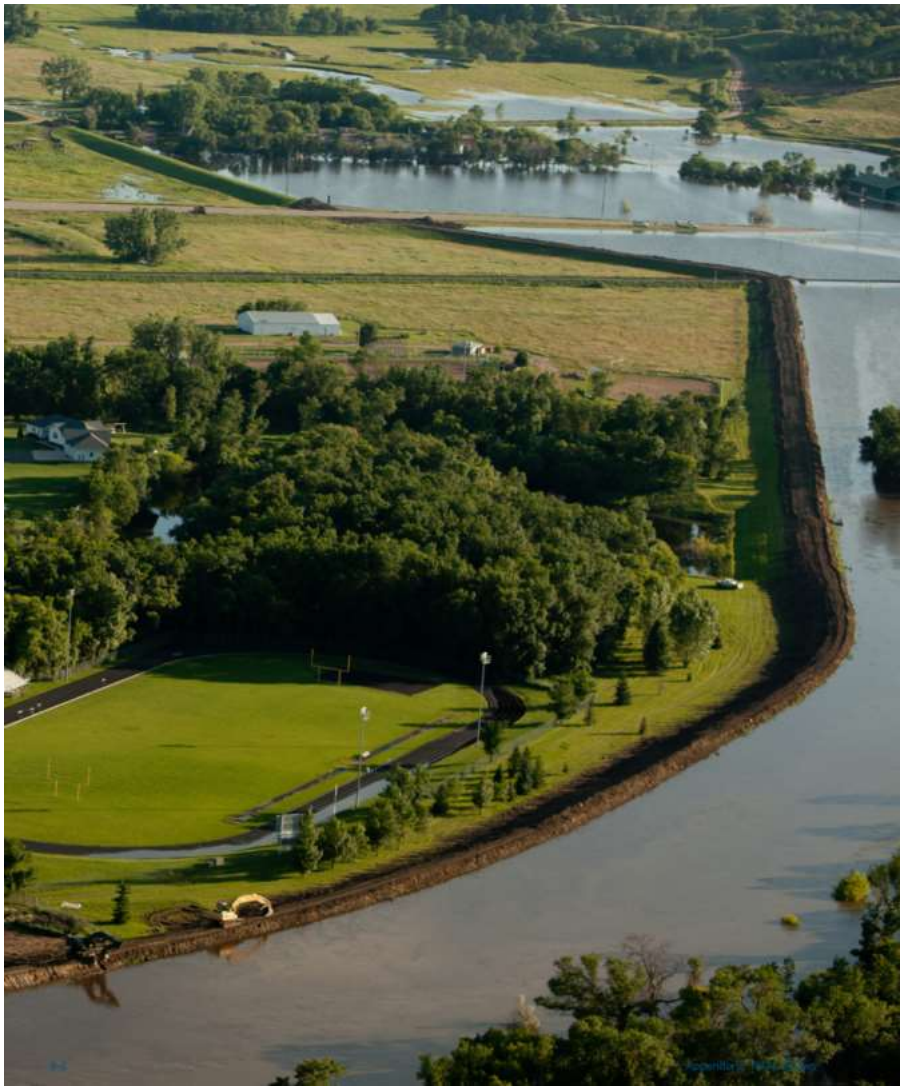
Risk MAP Exploratory Innovation Products, Part 2

ASFPM 2018 - Phoenix, AZ
Tuesday, June 19, 2019

FEMA

Need for Innovation

- **To address recommendations from:**
  - The National Academy of Sciences
  - Technical Mapping Advisory Council
  - BW-12 and HFIAA 2014
- **To explore additional initiatives that could help advance program objectives**

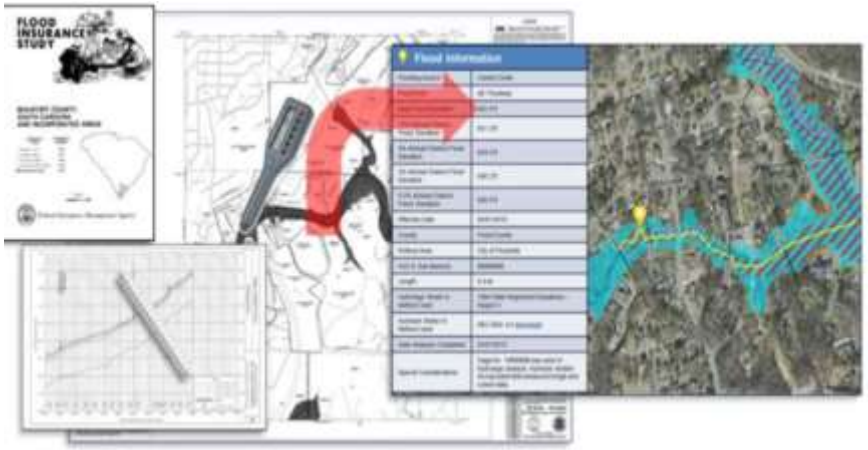


Recap of ASFPM 2017 – Innovations Part 1

- **Database-Derived Digital Display Environment: Geodatabase Gap Analysis**
- **Regulatory-Quality WSEL Grids (“Point & Click BFEs”): Feasibility**
- **Structure-Level Risk: Data and Methodology Investigations**
- **2D Modeling: Zone AE Model Upgrade and Floodway Best Practices**
- **Flood Hazard Modeling Parameters: Impact on BFEs and Top Width**
- **Mitigation Decision Support System (MDSS) Scenario Templates**

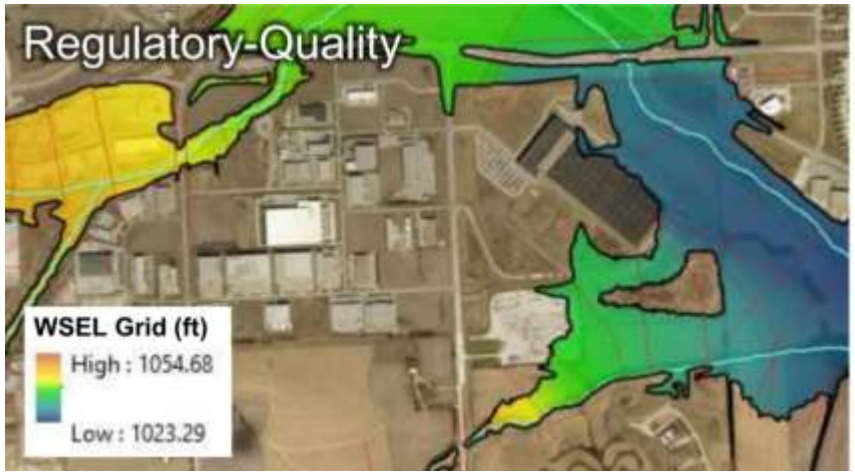
Recap of ASFPM 2017 – Innovations Part 1

Database-Derived Digital Display Environment: Geodatabase Gap Analysis



Current Status:
Additional Analysis

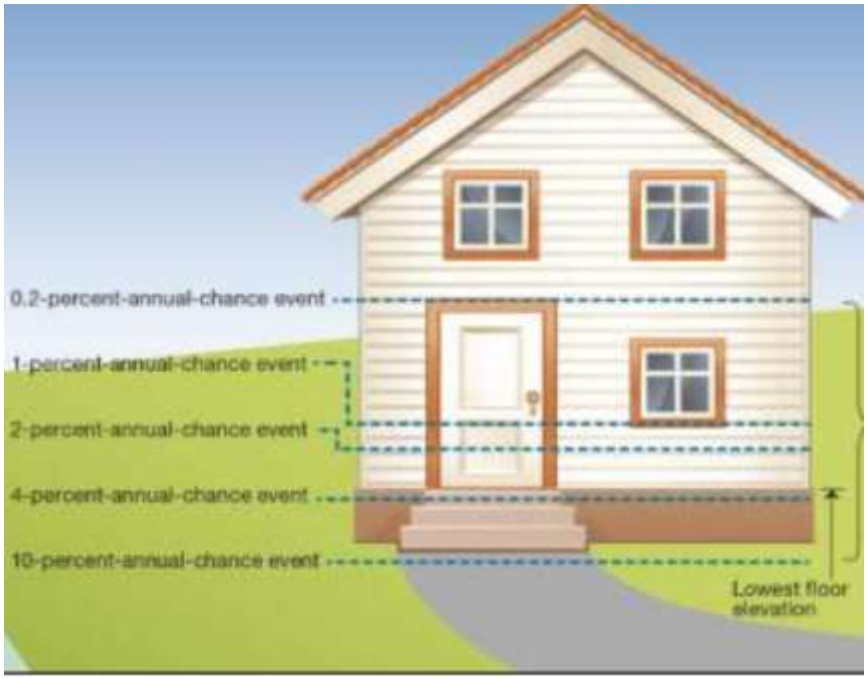
Regulatory-Quality WSEL Grids ("Point & Click BFEs"): Feasibility



Current Status:
FRP Integration and Pilots

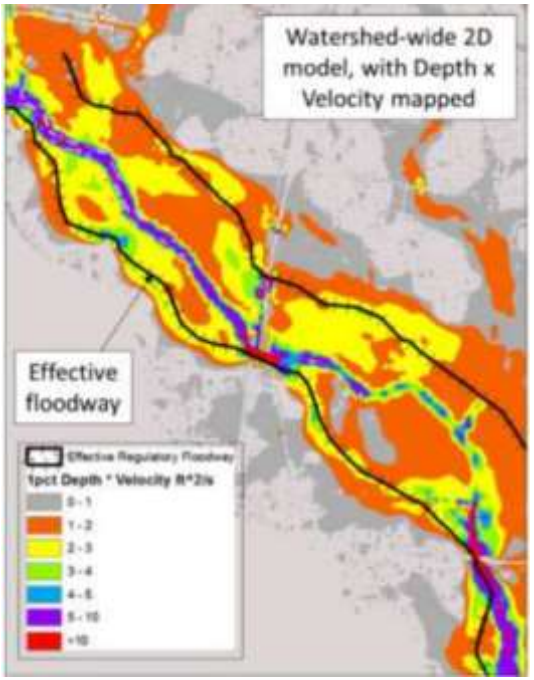
Recap of ASFPM 2017 – Innovations Part 1

Structure-Level Risk: Data and Methodology Investigations



Current Status:
Additional Analysis

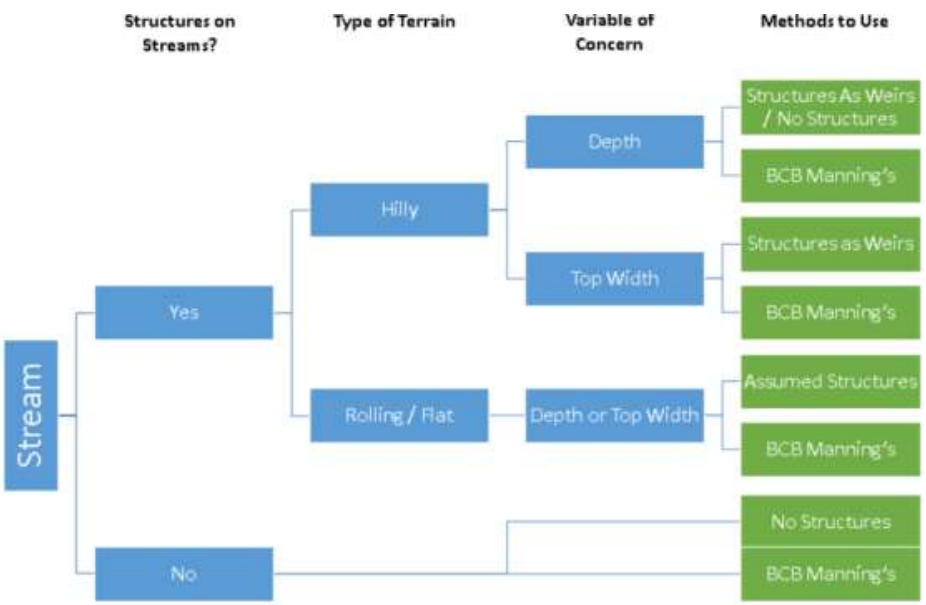
2D Modeling: Zone AE Model Upgrade and Floodway Best Practices



Current Status:
Additional Analysis

Recap of ASFPM 2017 – Innovations Part 1

Flood Hazard Modeling Parameters: Impact on BFEs and Top Width



Current Status:
Complete

Mitigation Decision Support System (MDSS) Scenario Templates

Current Status:
Additional Analysis

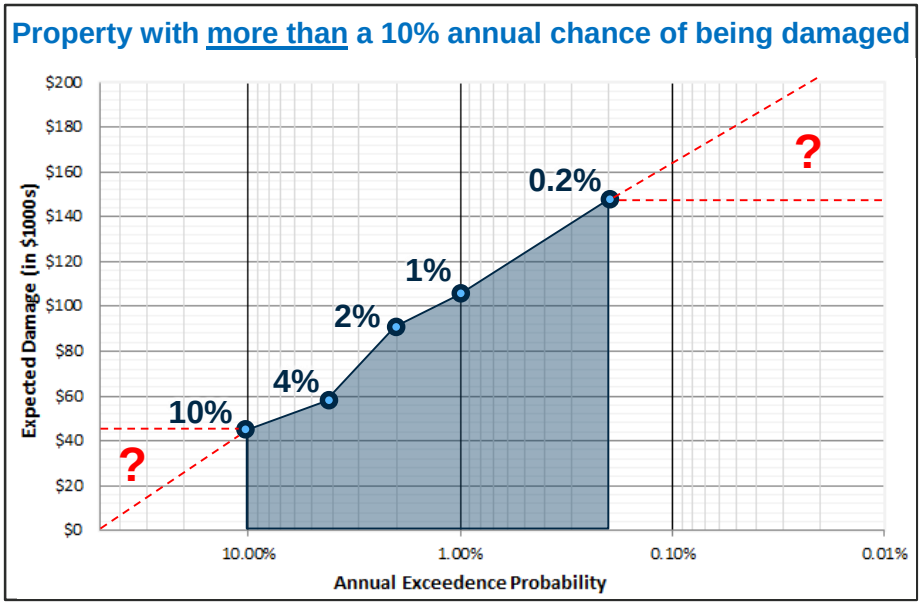
Innovations Part 2

- **Probabilistic Modeling Simulations**
- **Mitigation Decision Support System**
- **Point-and-Click WSEL Grid Pilots**

Probabilistic Modeling

Probabilistic Modeling

- Innovation Purpose
  - Although most Flood Risk Projects have typically used a “deterministic” analysis of multiple events, they have rarely considered the uncertainty that inherently exists in much of the hydrology and hydraulics of the analysis.
  - By leveraging advances in hardware and software, the probabilistic modeling, mapping, and risk assessment approach is able to do a more comprehensive and credible analysis of the flood hazard than has traditionally been performed.

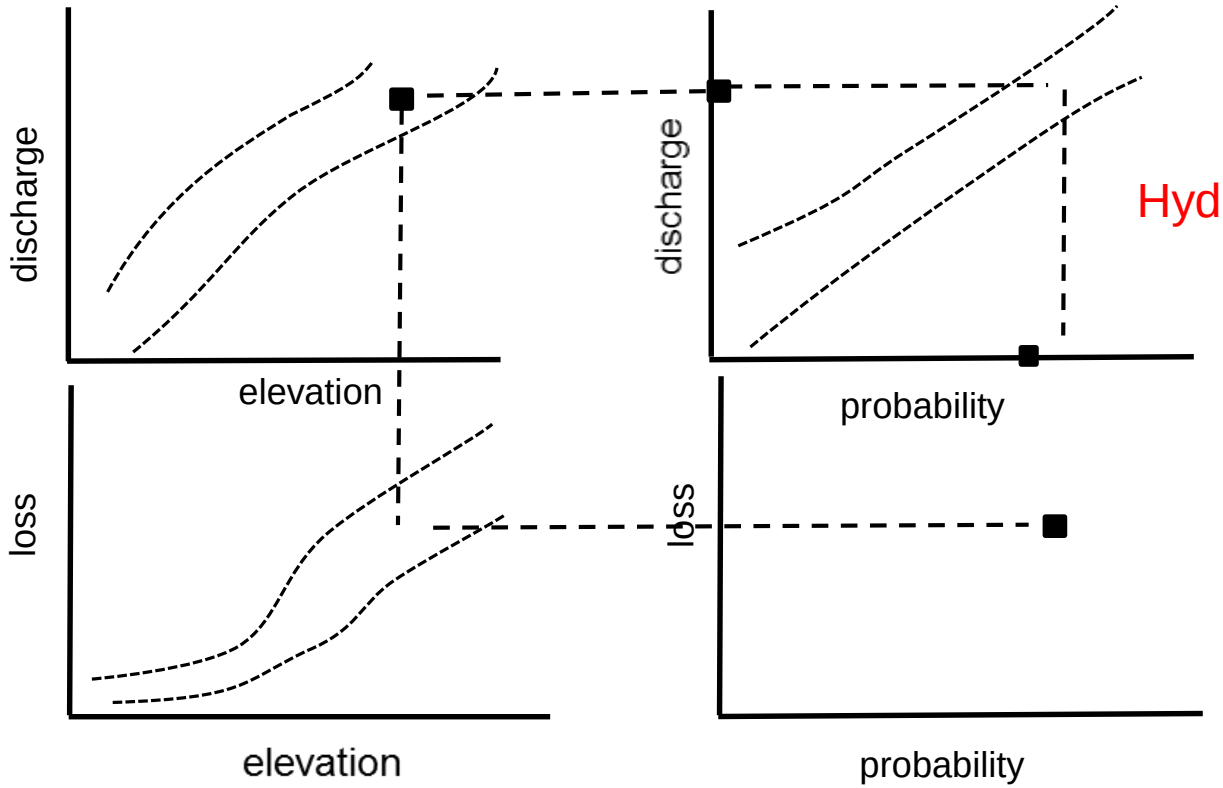


Probabilistic Approach

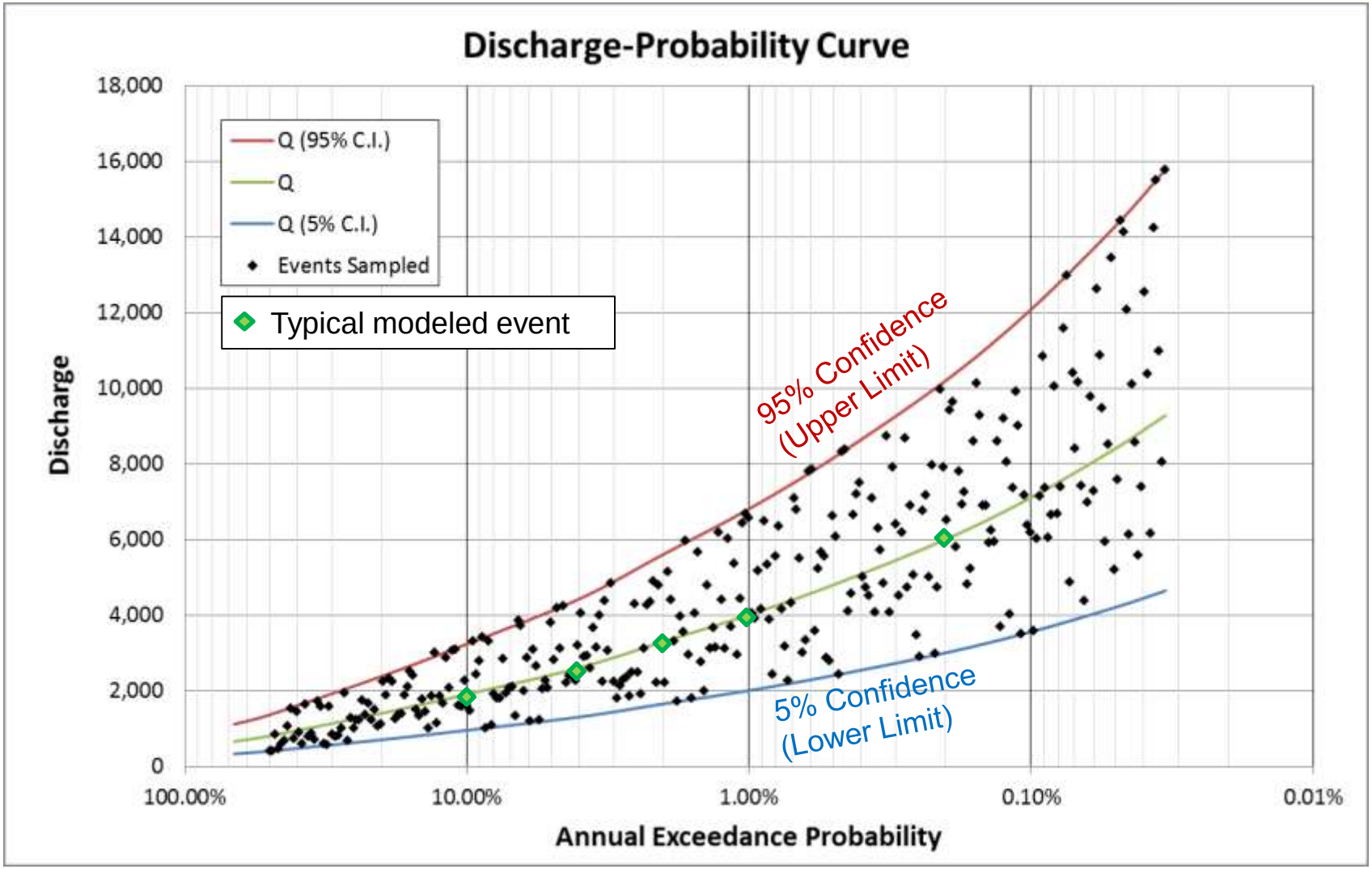
Hydraulics

Hydrology

Loss Calculations

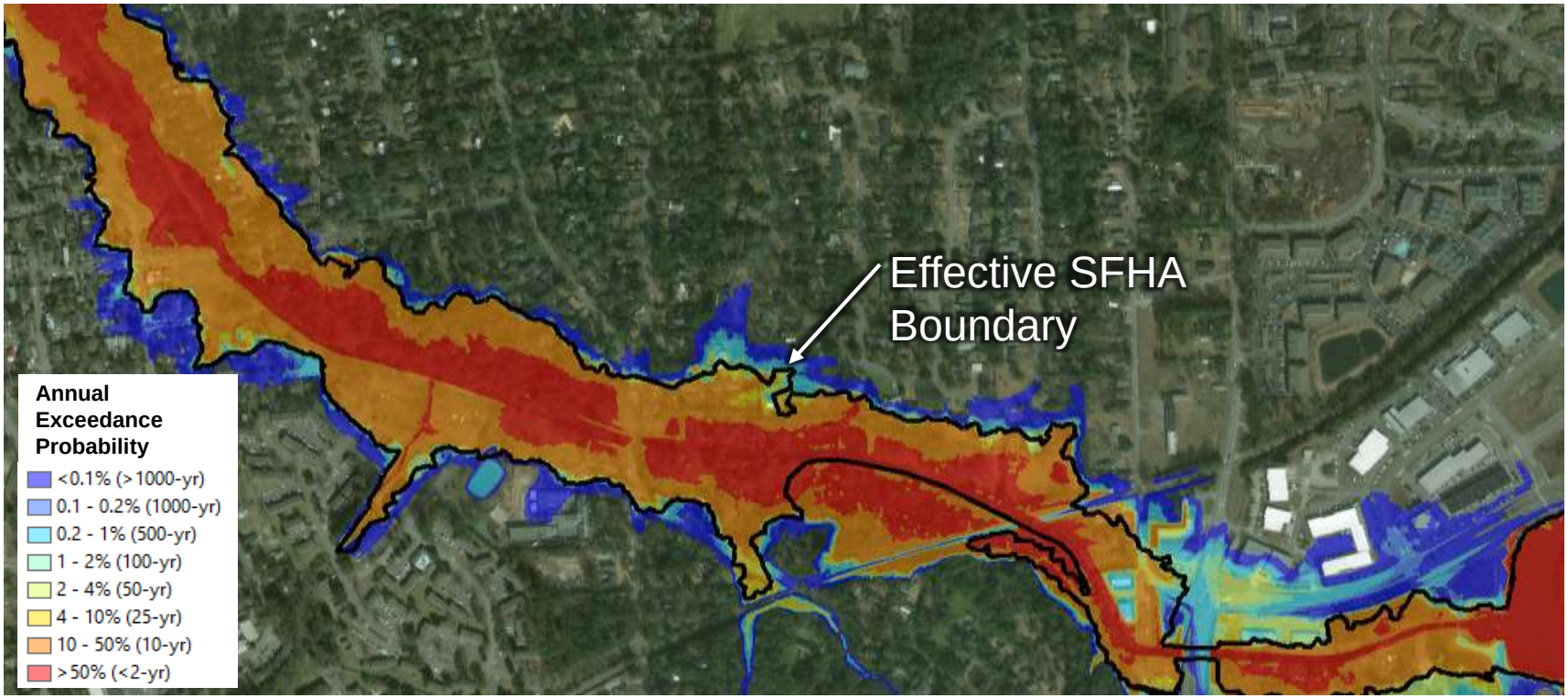


Hydrologic Uncertainty



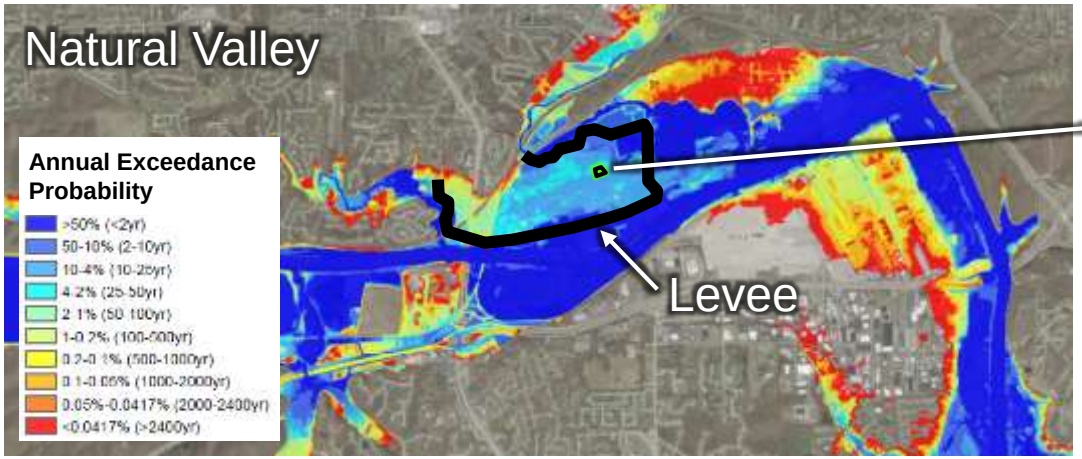
Annual Exceedance Probability Grid vs. 1-Percent-Annual-Chance Line (Deterministic)

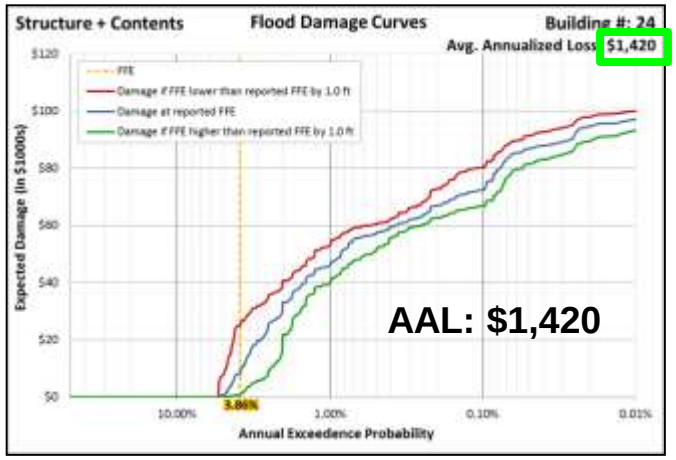
- **Probabilistic Approach: uncertainties considered, wide range of possible flood scenarios, credible risk gradation**
- **Deterministic (Current) Approach = No uncertainties, focused on 1%-annual chance flood, no risk gradation**

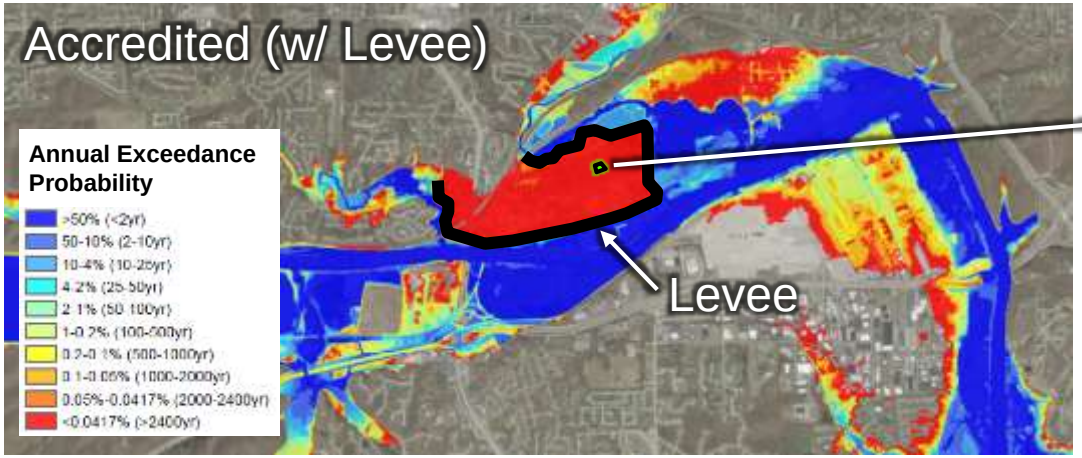


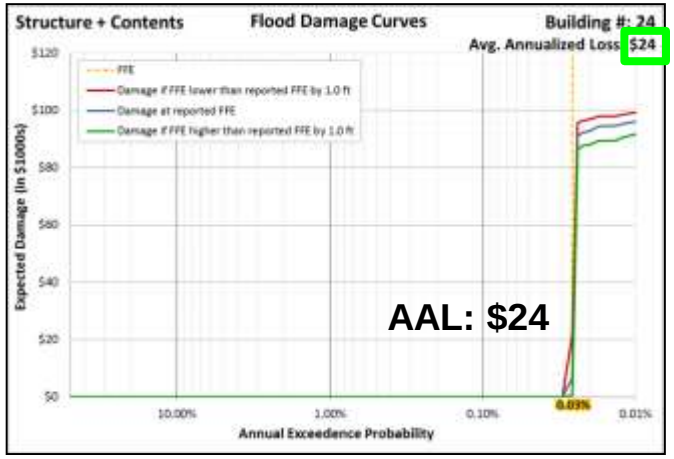
Risk Behind Levees

- **Probabilistic approach can consider accredited, breaching, and natural valley levee scenarios (each w/ associated probabilities)**

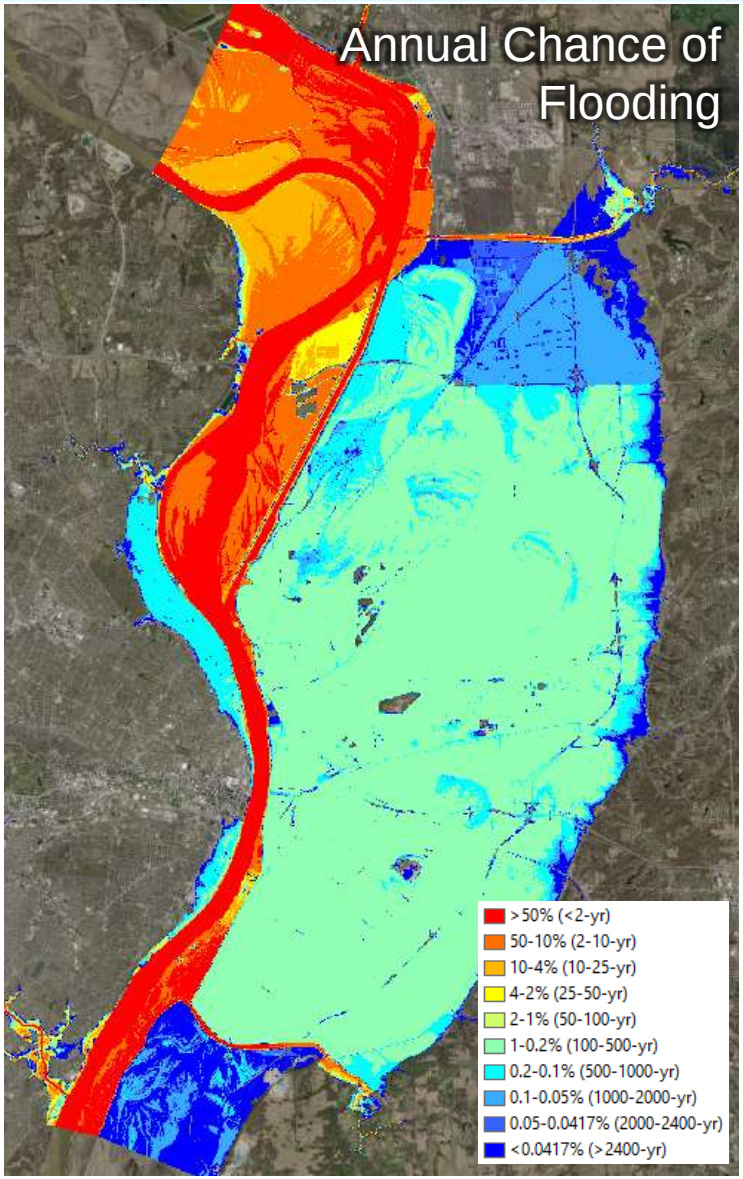


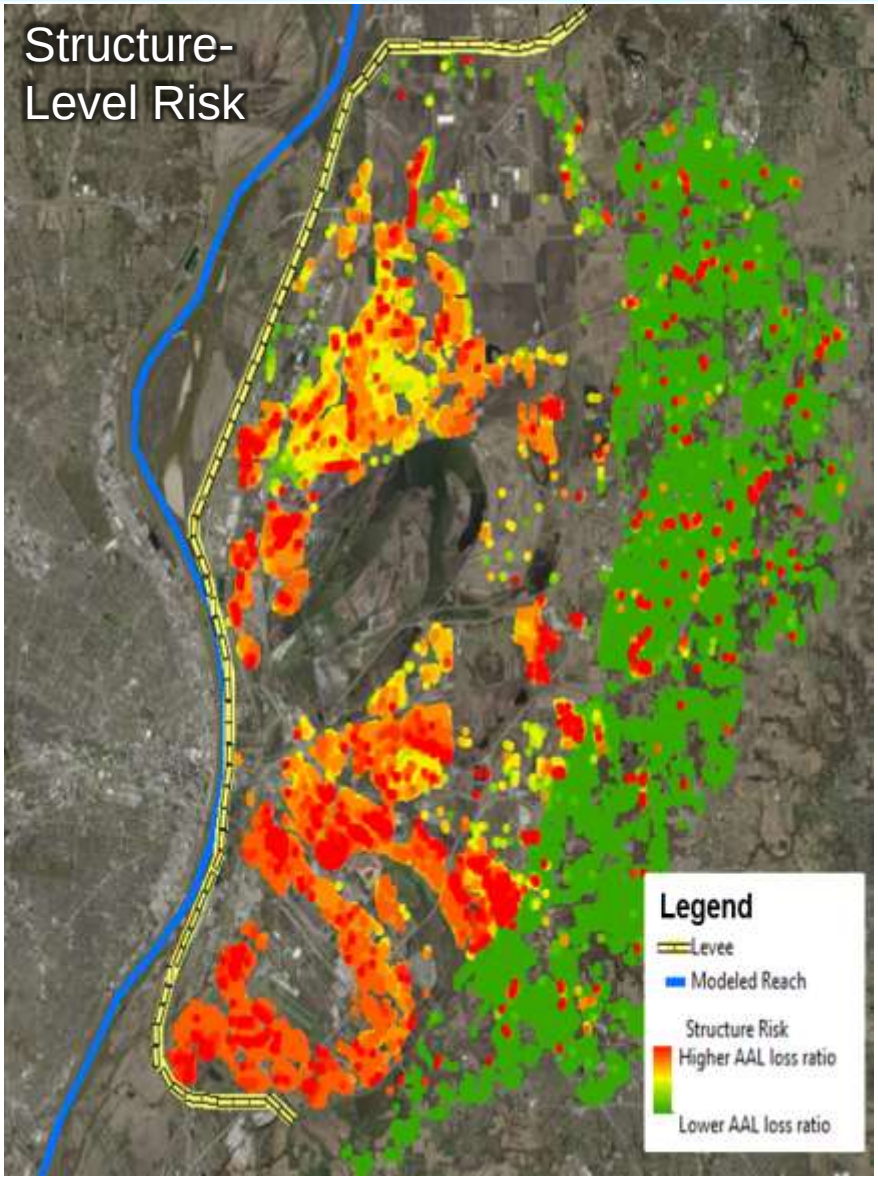






Probabilistic Modeling Pilots & Outputs





Probabilistic Modeling – Pilot Areas

- **Souris River**
  - Minot, ND
- **Red River**
  - Bossier Levee, LA
- **New River & Burnt Mill Creek**
  - Wilmington, NC
- **Meramac River**
  - St. Louis, MO
- **Mississippi River**
  - East St. Louis, IL
  - Multiple Leveed Areas in Southern Louisiana

Probabilistic Mapping – Benefits

- **More comprehensive analysis of the flood hazard –**
  - 50% (2-yr) to the 0.05% (2000-yr) annual chance or greater
- **More credible analysis of the flood hazard –**
  - Modeled scenarios consider multiple uncertainties
- **Increased confidence in the probability at which a flood would reach a structure's first floor elevation**
- **More accurate flood risk and annualized loss estimates**
- **Improved way to look at risk behind levees**
- **True multi-frequency grid outputs**
  - WSEL, depth, velocity, and depth * velocity
  - Applications in both pre- and post-disaster environments

Probabilistic Mapping

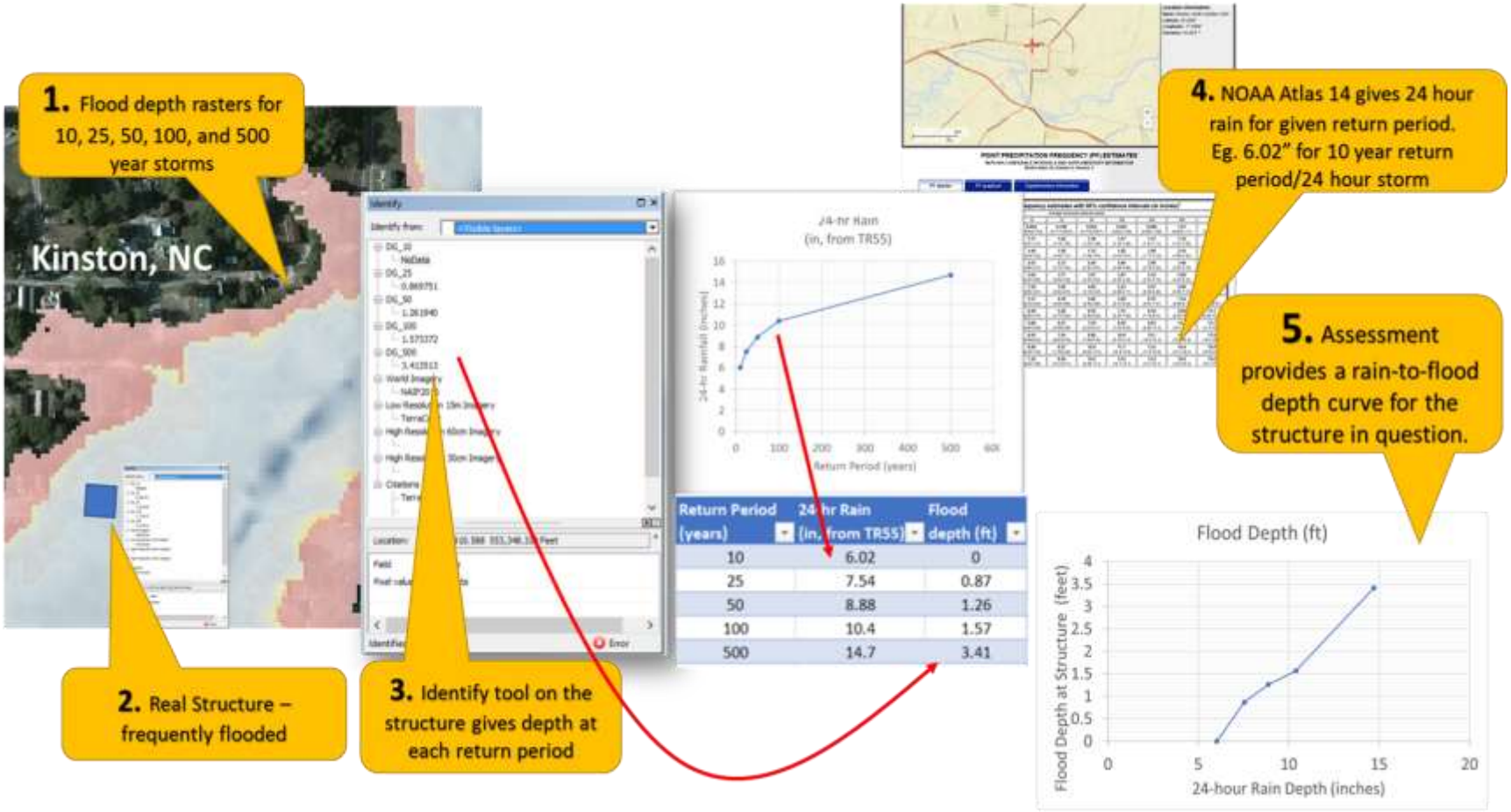
- **More In-Depth Discussion:**
  Session E1: 1:30pm on Wednesday, June 20

Mitigation Decision Support System (MDSS)

Mitigation Decision Support System - MDSS

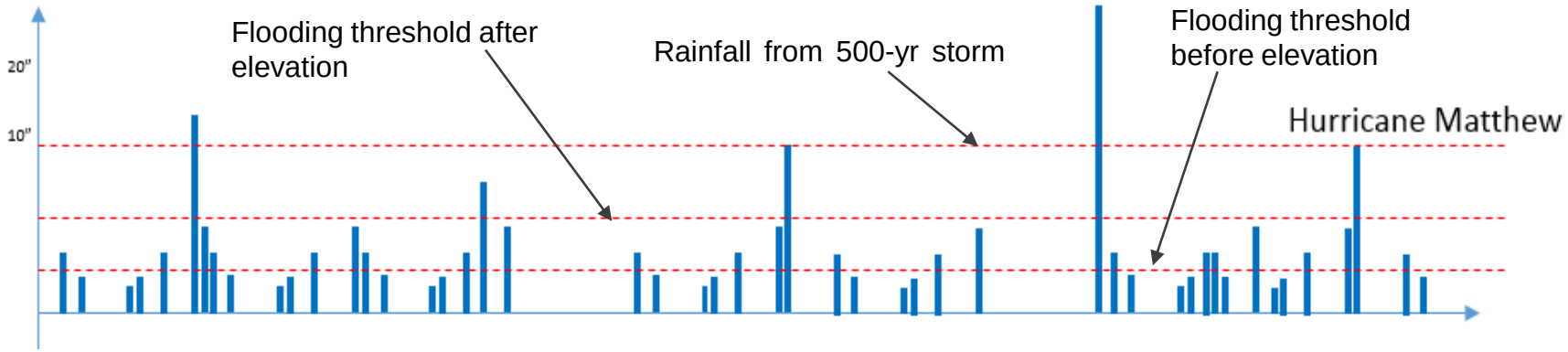
- Innovation Purpose
  - The Mitigation Decision Support System (MDSS) is being designed to help communities select the best options for mitigation. The tool, designed to be deployed on an ipad, allows creation of what-if scenarios, and evaluation of those scenarios using detailed flood data

MDSS – Estimating Flood Depth from Storm Size



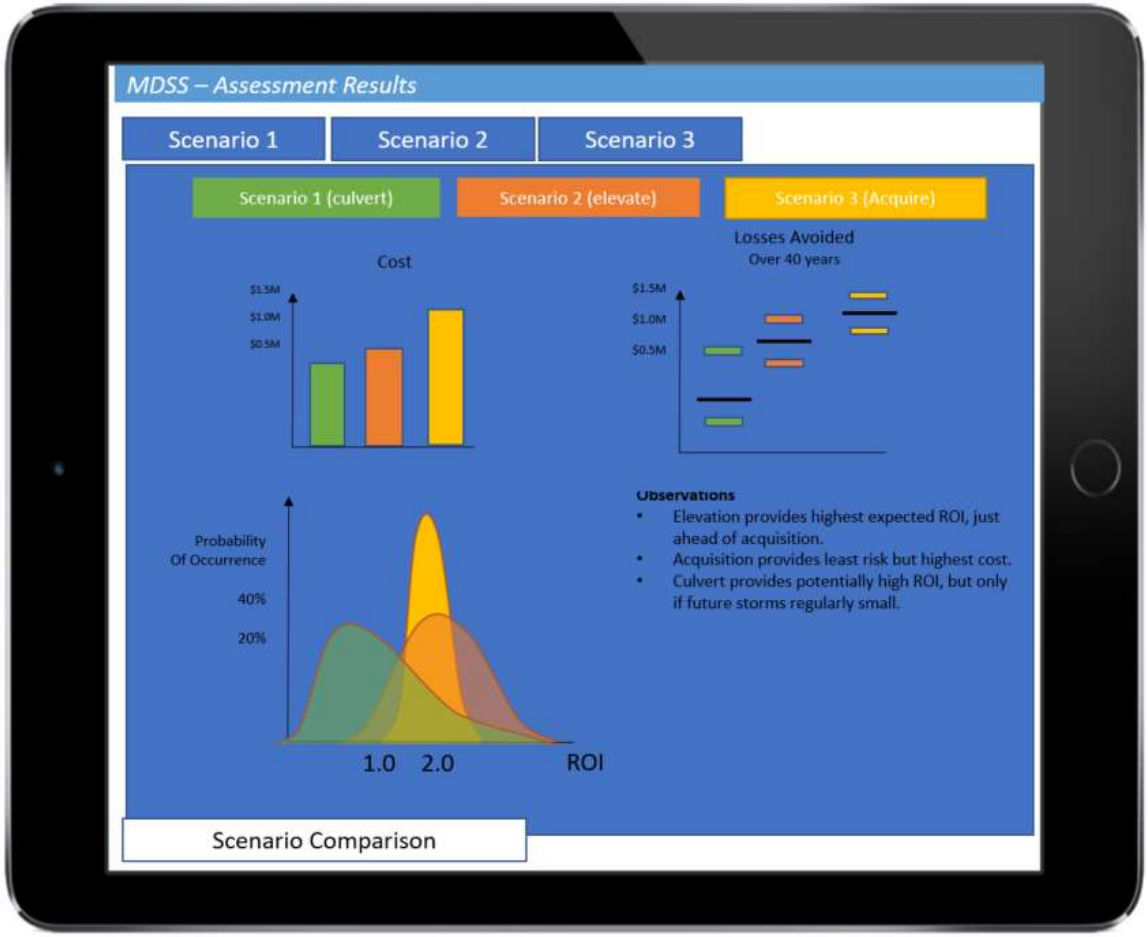
MDSS – Incorporating Climate

- Simulate Storm Events from present to 2050
- Rain projection is built from latest general circulation model projections from multiple centers around the world. All models run UN IPCC Green House Gas control scenarios.
- Includes shifts in storm size and frequency – capturing never before seen storms and droughts.
- Uses “ensemble” prediction to capture uncertainty: incorporates all model-scenarios as well as stochastic bootstrapping to create 1000 projections that are all evaluated.



Comparing Mitigation Options

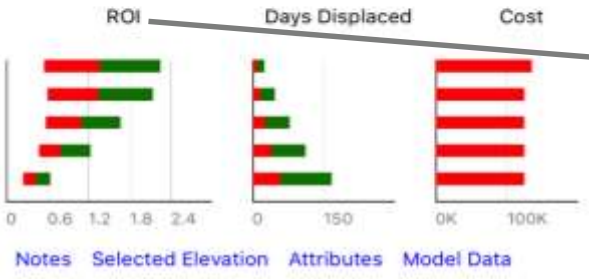
- **Add multiple scenarios to compare options**
- **Final comparison shows cost, losses avoided, and ROI comparison.**
- **Uncertainty is shown through providing distributions of Losses Avoided and ROI.**
- **A list of "Plain English" observations is provided to help interpret the results.**

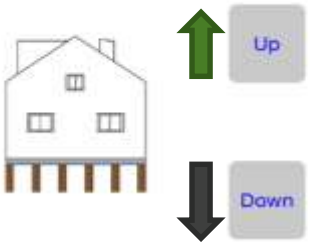


MDSS - Process

Add Structure Expand

Structure 1





2 ft above FFE

Community selected structure to elevate

Using online databases of housing value and cost, replacement costs, rain forecast, and flood risk, the tool can automatically build input data for a long terms flood forecast simulation.

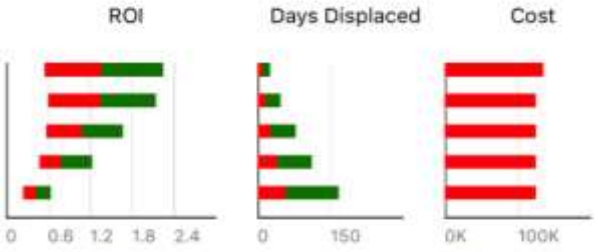
Tool evaluates ROI for multiple elevation levels.

Tool evaluates results and summarizes finding automatically

community can specify the elevation level they want to use for each structure.

Add Structure Expand

Structure 1



Expected Return on Investmnet is maximum at 4ft above BFE.

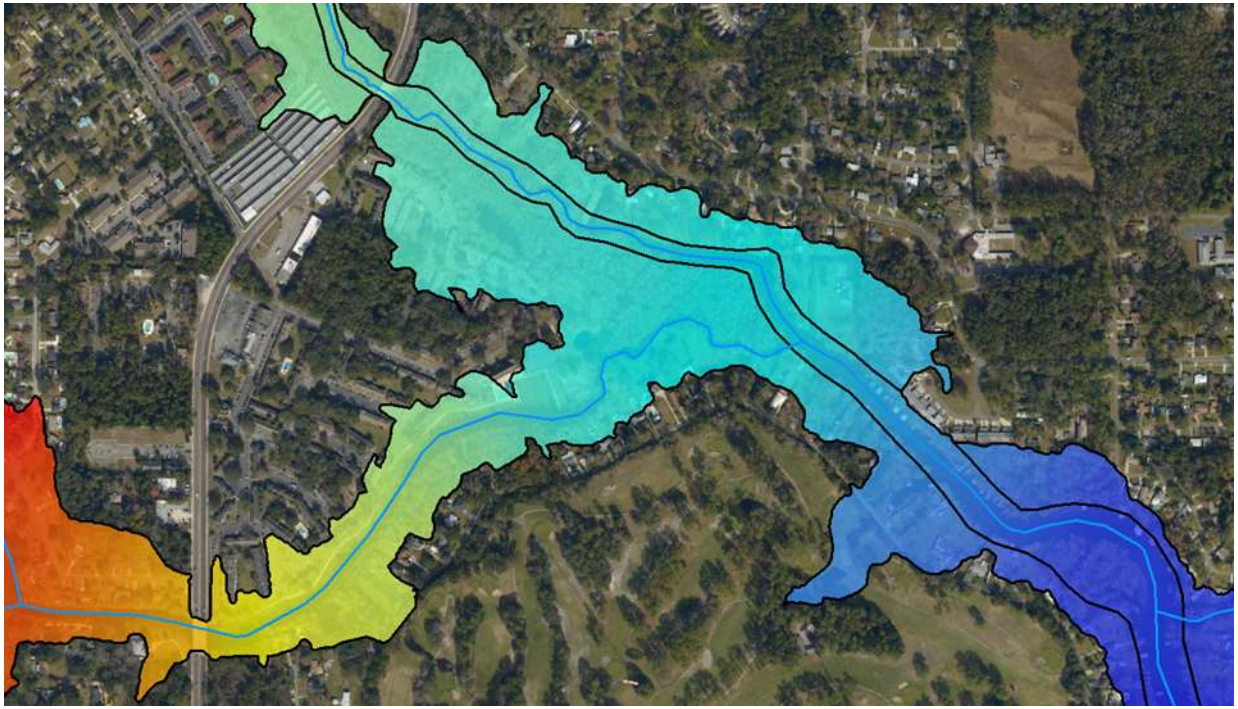
Worst Case ROI is 0.51 if you elevate the property to 4ft., which means you would recoup a minimum of 51% of your costs through avoiding losses from flood damage.

If you elevated this property to 4ft, you can still expect 10 days of displacement from the property due to flooding over the period 2018-2050.

Point-and-Click WSEL Grid Pilots

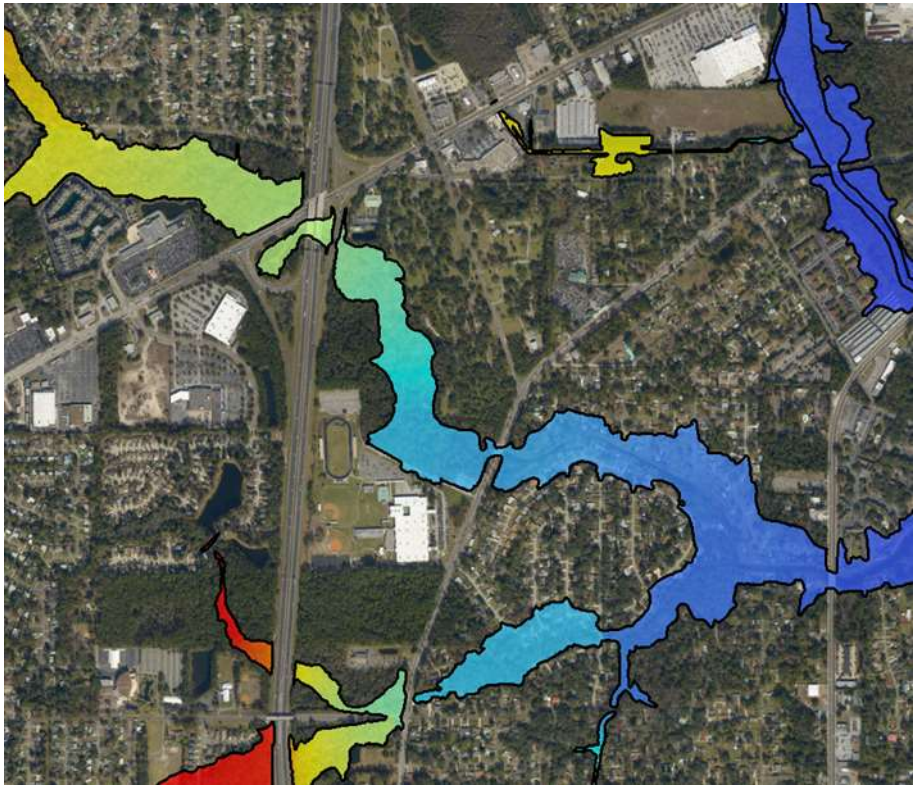
Point-and-Click WSEL Grid Pilots

- Innovation Purpose
  - Identify and produce Water Surface Elevation (WSEL) Grids that meet the quality requirements of the new FEMA standard on WSEL Grids (SID 415), and that can be used as an input to help CDS build a tool that can automate the checking of those grids

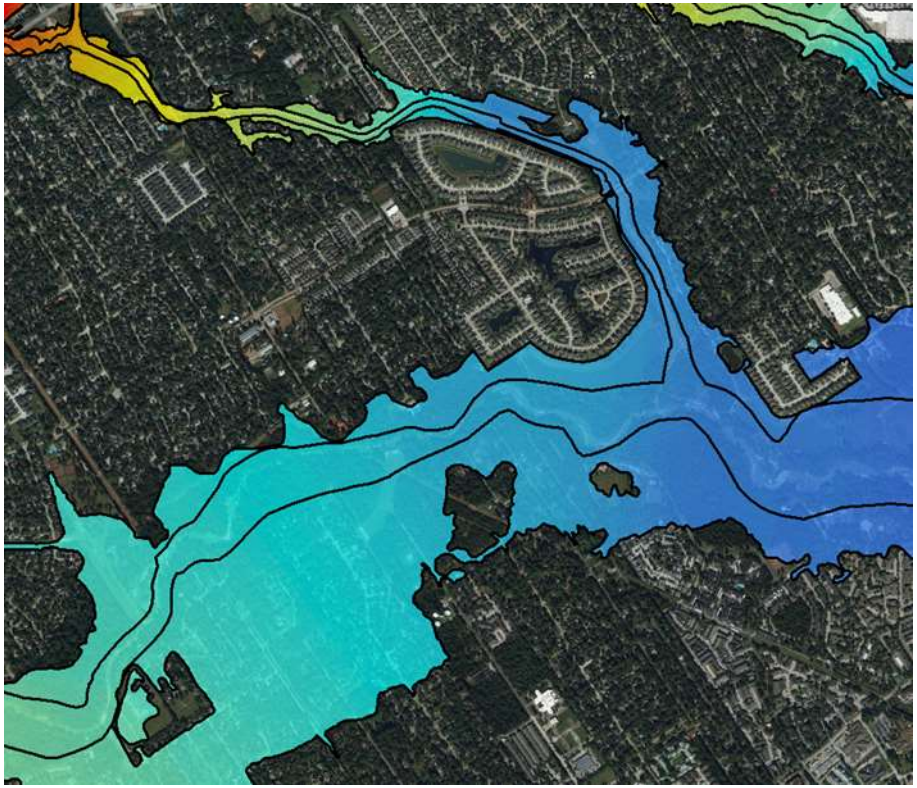


WSEL Grid Pilots

- **Duval Co, FL**



- **Harris Co, TX**

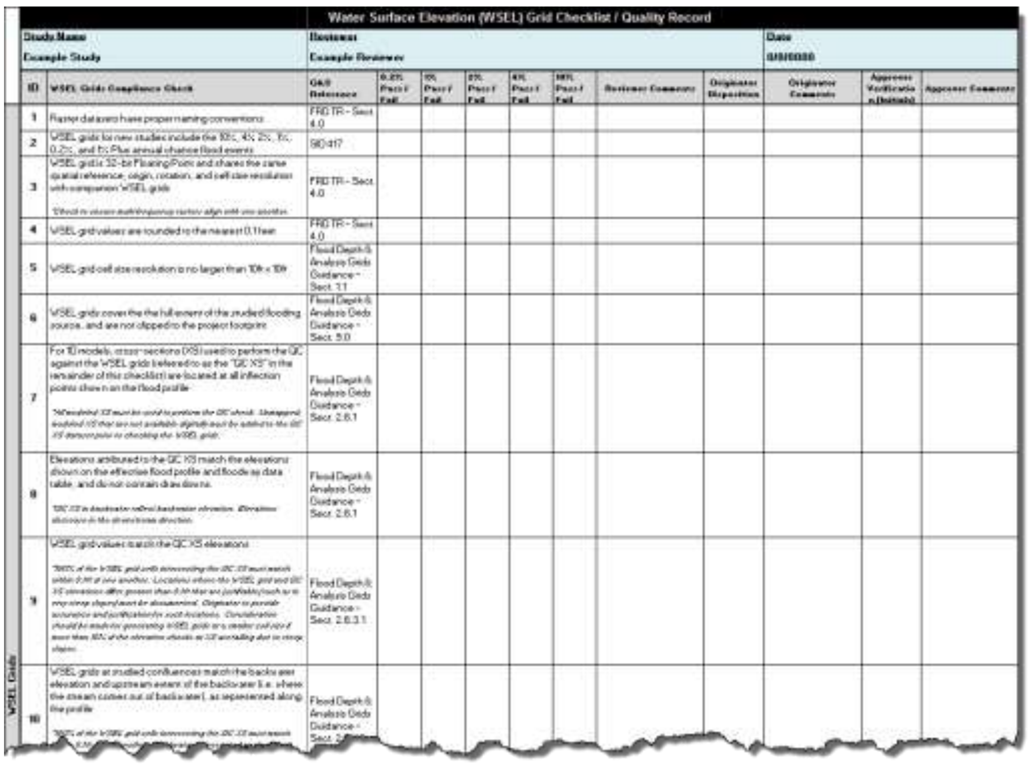


and Others…

(based on Effective data)

WSEL Grid QC Checks

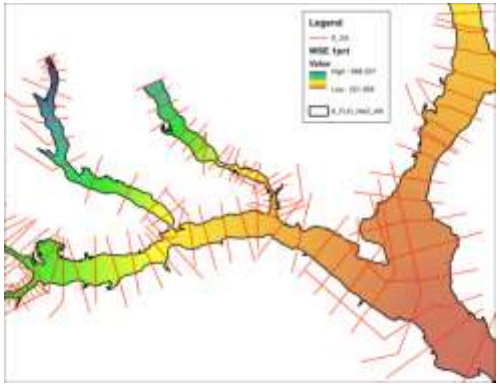
- **Development of a WSEL Grid QC Checklist**
- **Collaboration between PTS and CDS on ongoing development of an automated WSEL Grid QC tool (version 1.0 planned for Summer/Fall of 2018)**

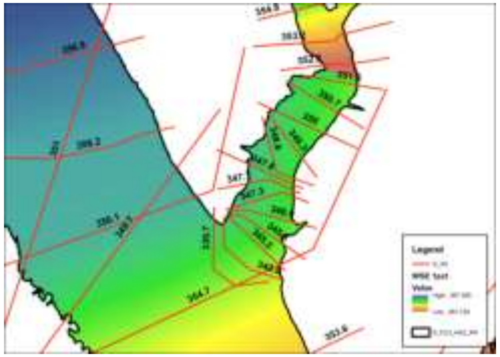


Water Surface Elevation (WSEL) Grid Checklist / Quality Record

Study Name	Reviewer	Date
Example Study	Example Reviewer	[illegible]

ID	WSEL Grids Compliance Check	G&S Reference	0.2% Pass / Fail	1% Pass / Fail	2% Pass / Fail	4% Pass / Fail	10% Pass / Fail	Reviewer Comments	Originator Disposition	Originator Comments	Approver Verification (Initials)	Approver Comments
1	Raster datasets have proper naming conventions	FRD TR – Sect 4.0										
2	WSEL grids for new studies include the 10%, 4%, 2%, 1%, 0.2%, and 1% Plus annual chance flood events	SID 417										
3	WSEL grid is 32-bit Floating Point and shares the same spatial reference, origin, rotation, and cell size resolution with companion WSEL grids [illegible]	FRD TR – Sect 4.0										
4	WSEL grid values are rounded to the nearest 0.1 feet	FRD TR – Sect 4.0										
5	WSEL grid cell size resolution is no larger than 10ft x 10ft	Flood Depth & Analysis Grids Guidance – Sect. 1.1										
6	WSEL grids cover the full extent of the studied flooding source, and are not clipped to the project footprint	Flood Depth & Analysis Grids Guidance – Sect. 5.0										
7	For 1D models, cross-sections (XS) used to perform the QC against the WSEL grids (referred to as the "QC XS" in the remainder of this checklist) are located at all inflection points shown on the flood profile [illegible]	Flood Depth & Analysis Grids Guidance – Sect. 2.6.1										
8	Elevations attributed to the QC XS match the elevations shown on the effective flood profile and floodway data table, and do not contain drawdowns [illegible]	Flood Depth & Analysis Grids Guidance – Sect. 2.6.1										
9	WSEL grid values match the QC XS elevations [illegible]	Flood Depth & Analysis Grids Guidance – Sect. 2.6.3.1										
10	WSEL grids at studied confluences match the backwater elevation and upstream extent of the backwater [illegible]	Flood Depth & Analysis Grids Guidance – Sect. [illegible]										





Upcoming/Ongoing Innovations

- **Additional Probabilistic Modeling Pilots**
- **Urban/Pluvial (Rainfall) Flooding Pilots**
- **Continued Evaluation, Analyses, and Piloting of Transition Towards Database-Derived Digital Display Environment**
- **MDSS Development Advancement**
- **Continued Advancement Towards Point-and-Click WSEL Data and Structure-Level Risk**
- **Velocity Grid Creation Pilots and Impacts on Building Science Use**