Flood Risk Review (FRR)
Benton County, Missouri

First FRR Meeting –March 7, 2023

Second FRR Meeting – March 24, 2025

Our Agenda

Project Goals;

Where We've Been;

Where We Are;

Where We're Going;

Flood Risk Review #2 (FRR#2) Meeting Agenda

- **Project Goals**
- **Where We've Been**
  - Data and Processes used to develop Flood Risk Data #1
- **Where We Are**
  - New Data and Updated Flood Risk Data #2
- **Where We're Going**
  - Review of Flood Risk Review Data #2
  - 30 Day Comment Period – an opportunity for input on the updated data
  - How to make comments: Outreach Site, email, phone call, postal mail
  - Future Production of Preliminary Maps and Flood Insurance Study
  - Post Preliminary Processing – Due Process and Final Mapping
  - Additional Flood Risk Products (Rasters)

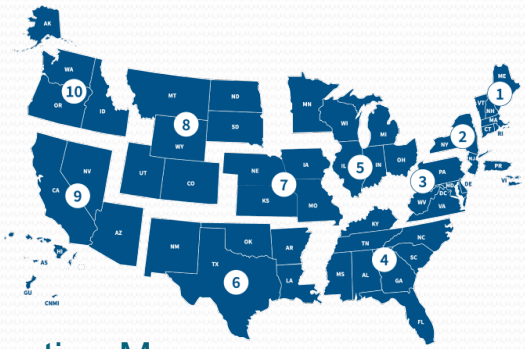
Website to view Draft Data: http://bit.ly/MOSEMAOutreach
or on smart phone or tablet: http://bit.ly/mobile_MOSEMAOutreach

For questions contact:

Sydney Roberts
sydney.roberts@sema.dps.mo.gov 573-526-9383
or Stephen Noe
stephen.noe@wsp.com (cell) 615-430-0456

Introductions

- FEMA Region 7 – **Federal Emergency Management Agency**
  - Dawn Livingston – Regional Project Officer
  - Andy Megrail – CTP Program Supervisor



- Missouri SEMA – **State Emergency Management Agency**
  - Sydney Roberts – Floodplain Engineering and Mapping Section Manager
  - Patrick Lower – Floodplain Mapping Technical Assistant
  - Jacob Wornson – GIS Floodplain Mapping Technical Assistant

- WSP USA – **SEMA Mapping Partner**
  - Stephen Noe – Program Manager
  - Alicia Williams – Associate Project Manager
  - Ben Rufenacht – Lead Engineer

- And You!

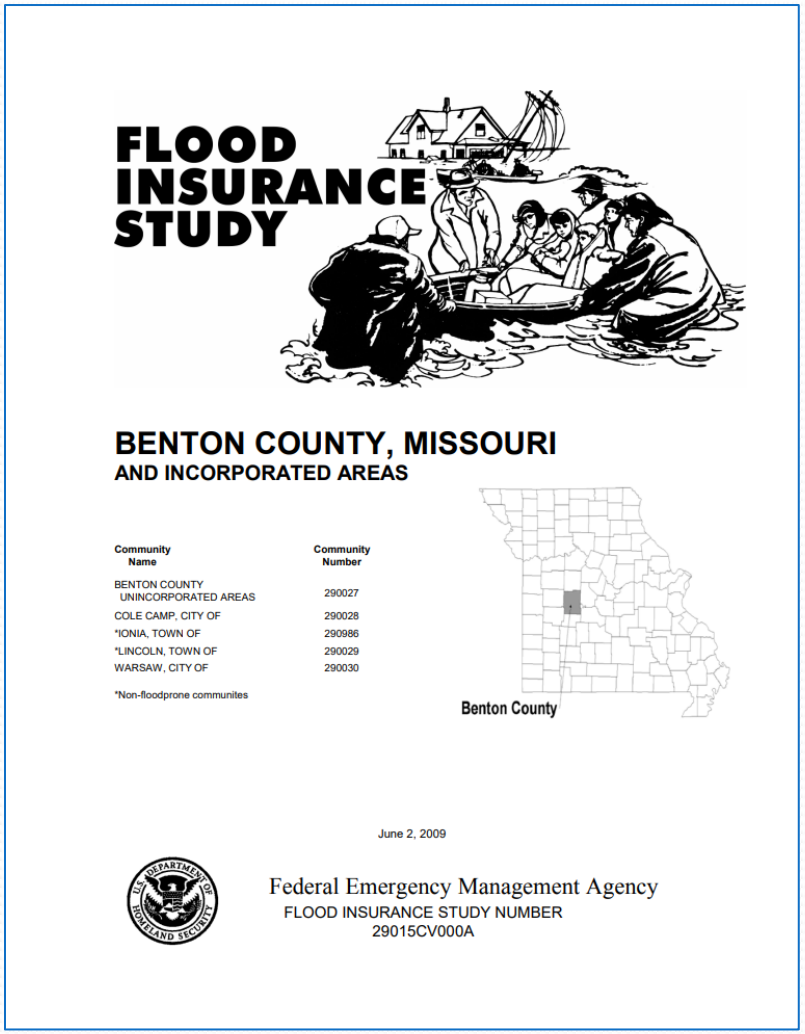
Current Effective Maps

Benton County Effective Map Date is June 2, 2009.

Benton County
Jurisdictions

- **Benton County (Unincorporated Areas)**
- **Cole Camp**
- **Ionia**
- **Lincoln**
- **Warsaw**

Blue text indicates Non-Participation in the NFIP.



FLOOD INSURANCE STUDY

BENTON COUNTY, MISSOURI
AND INCORPORATED AREAS

Community Name	Community Number
BENTON COUNTY UNINCORPORATED AREAS	290027
COLE CAMP, CITY OF	290028
*IONIA, TOWN OF	290986
*LINCOLN, TOWN OF	290029
WARSAW, CITY OF	290030

*Non-floodprone communites

Benton County

June 2, 2009

Federal Emergency Management Agency
FLOOD INSURANCE STUDY NUMBER
29015CV000A

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Project Goals: Benton County

We Are Mapping County-Wide

(1 square mile drainage area or existing mapping)

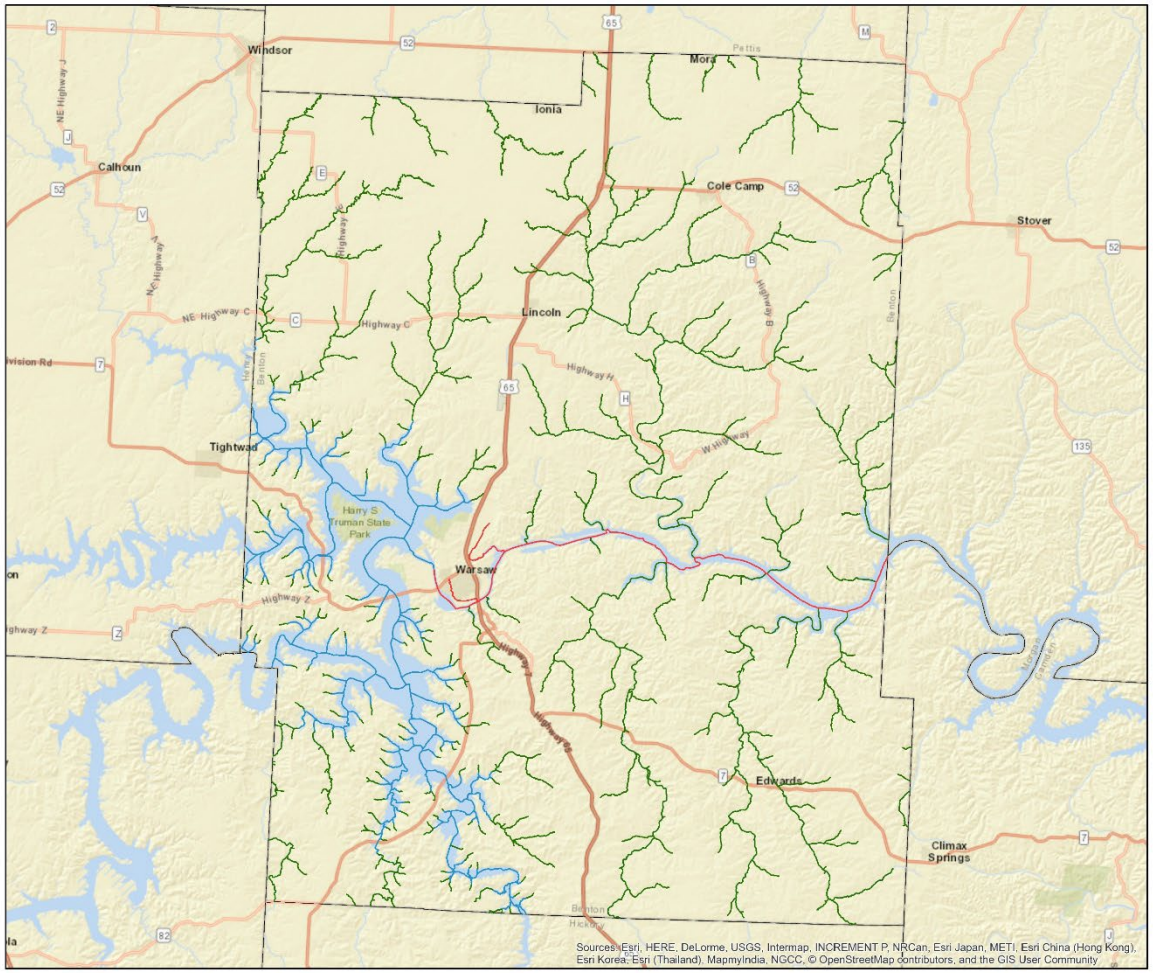
431 Miles of Streams

Benton County Project Engineering Osage Plus Watershed Discovery Modeling Methods and Extents Map

Proposed Scoped Studies

Flood Zone Type and Modeling Methods Methods

- Zone AE, Static Lake Analysis
- Zone A, 2D HEC RAS
- Zone AE, 2D HEC RAS



N

0 1.5 3 6 9 Miles

Develop LiDAR Stream Networks

- Flow Paths and Stream Lines developed from Hydro-Enforced LiDAR
- Smaller Threshold for Contributing Drainage Area
- 1 sq. Mile
- 2 sq. Mile
- 3 sq. Mile
- ½ sq. Mile
- ¼ sq. Mile

- FEMA extents
- 40-acre drainage
- 10-acre drainage
- 1-acre drainage

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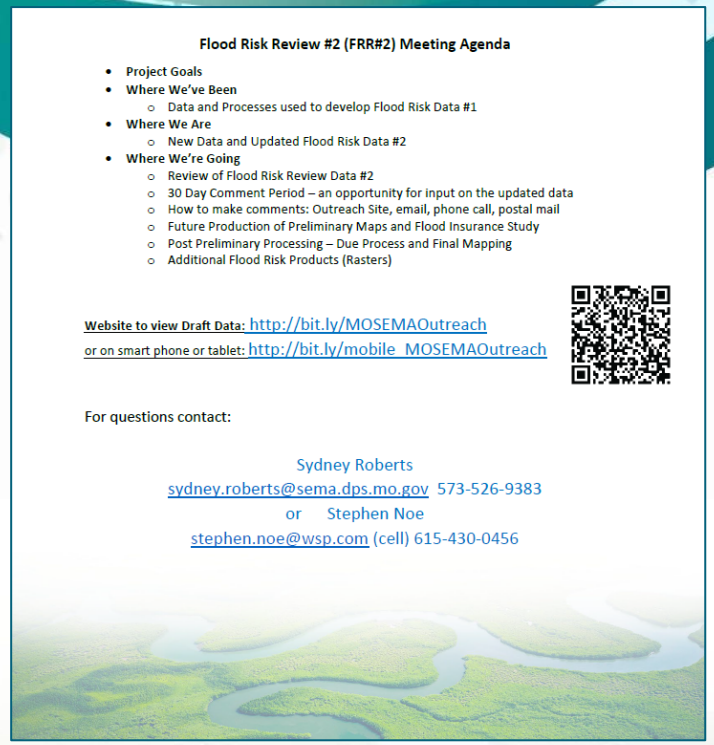

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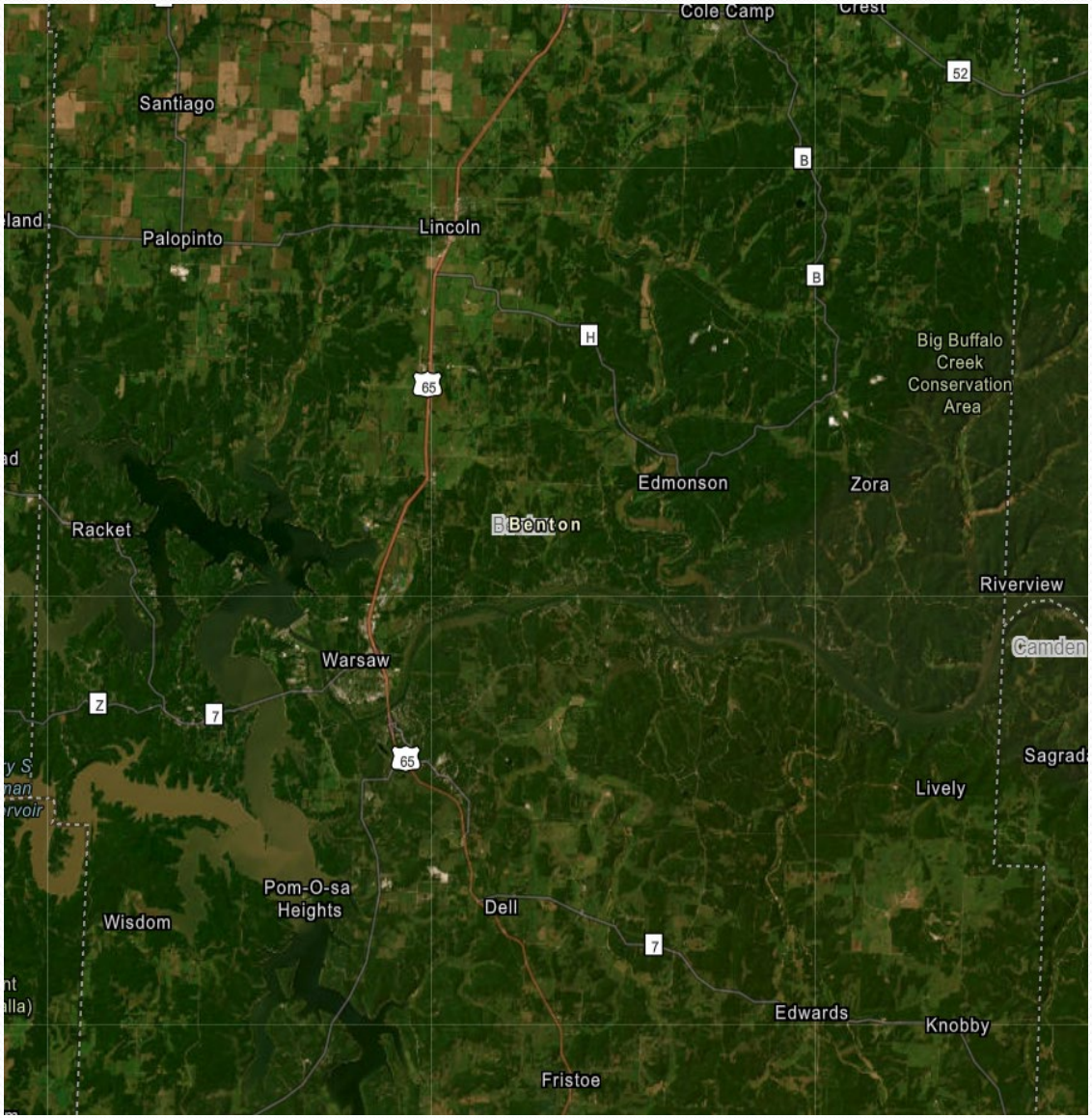
Where We've Been;

- Project Initiation Kickoff Meeting held on March 9, 2021.

- Tasks completed to date include:
  - Acquire Base Map
  - Perform Field Survey
  - Develop Topographic Data
  - Develop Hydrologic Data
  - Develop Hydraulic Data
  - Develop Floodplain Data
  - FRR#1 Meeting –March 7, 2023
  - Addressing Comments
  - FRR#2 Meeting - Today

Data Development with 2D Modeling!

Acquire Basemap Information

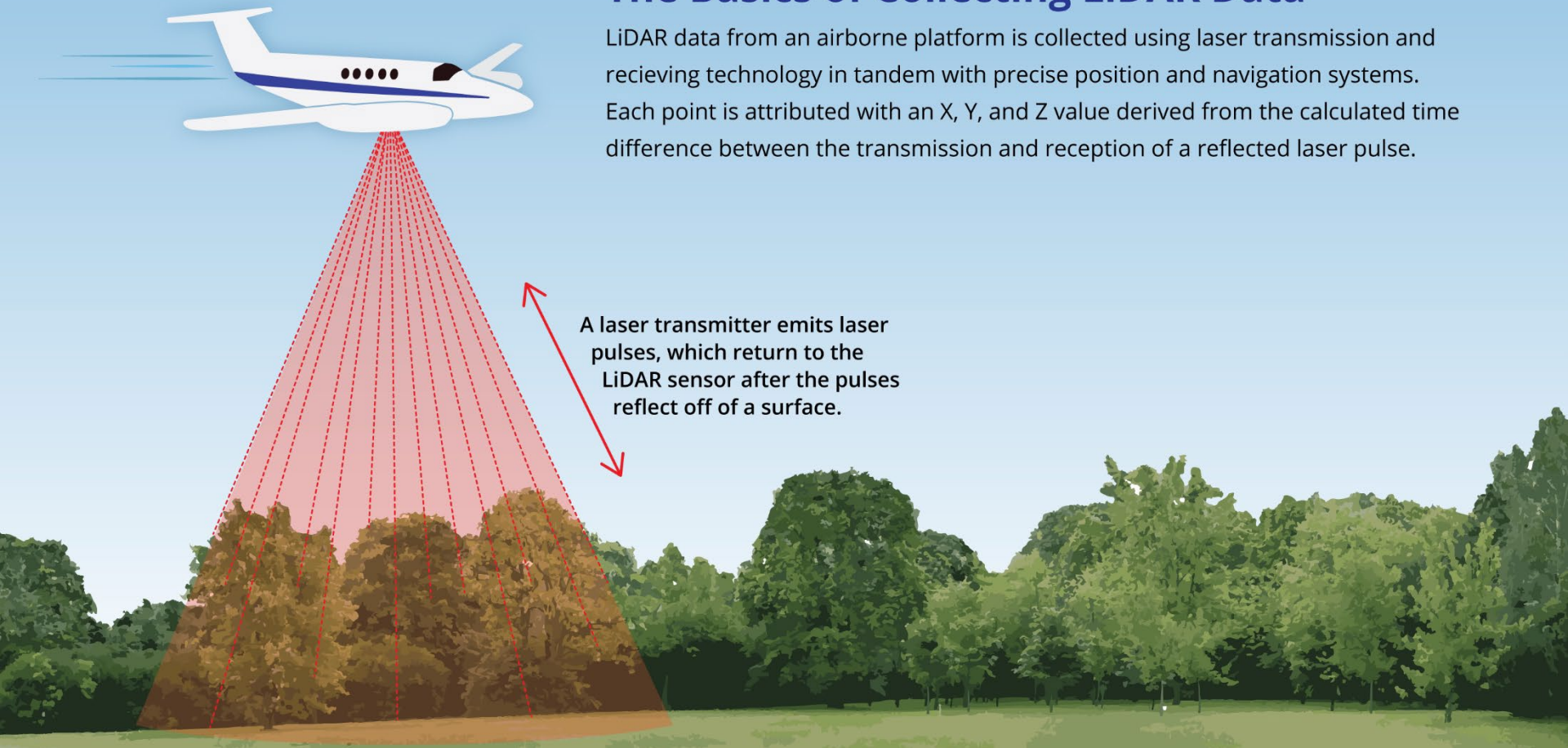


- **Aerials** by default are the USGS National Map
- **Roads** by default are MODOT and MO GIS
- **Political Boundaries** by default are MO State GIS Clearinghouse (MSDIS)

Develop Terrain

The Basics of Collecting LiDAR Data

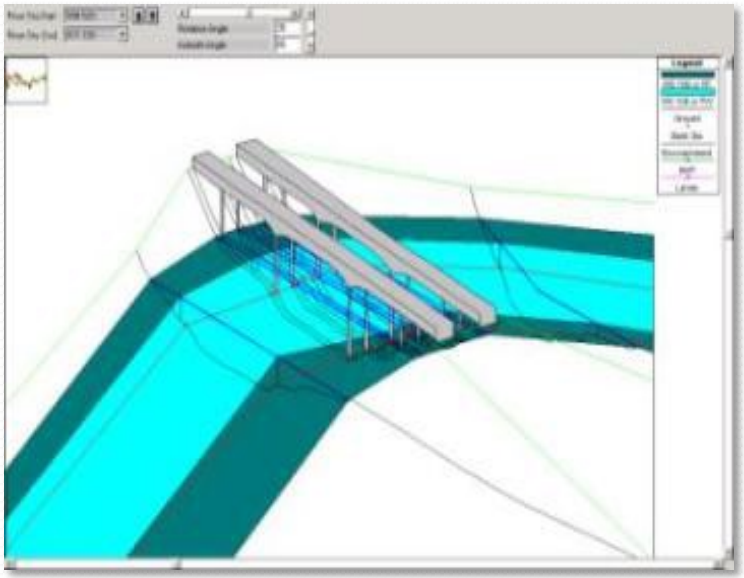
LiDAR data from an airborne platform is collected using laser transmission and recieving technology in tandem with precise position and navigation systems. Each point is attributed with an X, Y, and Z value derived from the calculated time difference between the transmission and reception of a reflected laser pulse.



Field Survey Collection

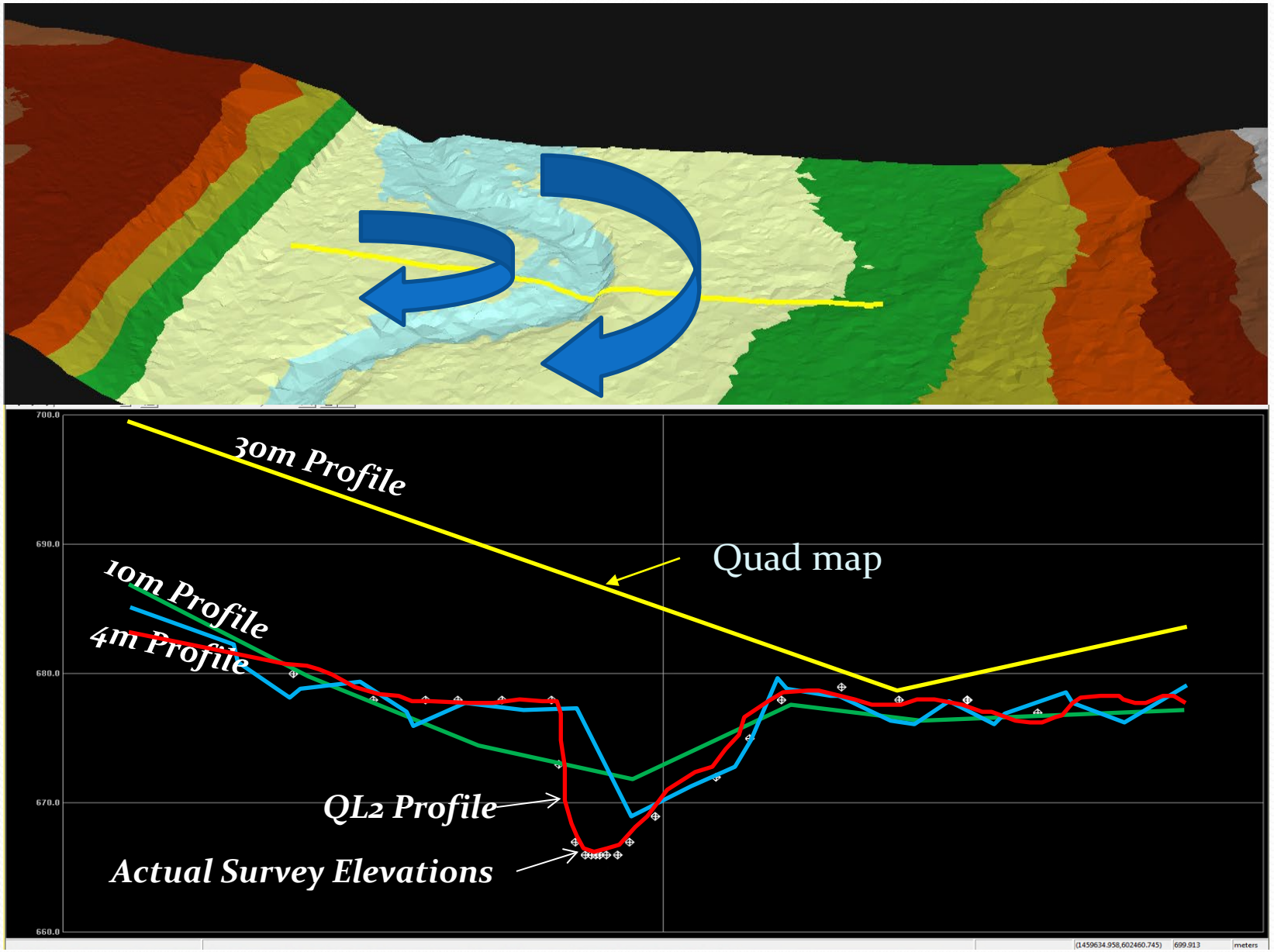
Collect survey data where natural or man-made situations are obstructing the flow of the stream.

Roads and other Infrastructure Crossings



Red streams on the map

Cross-Section Accuracies



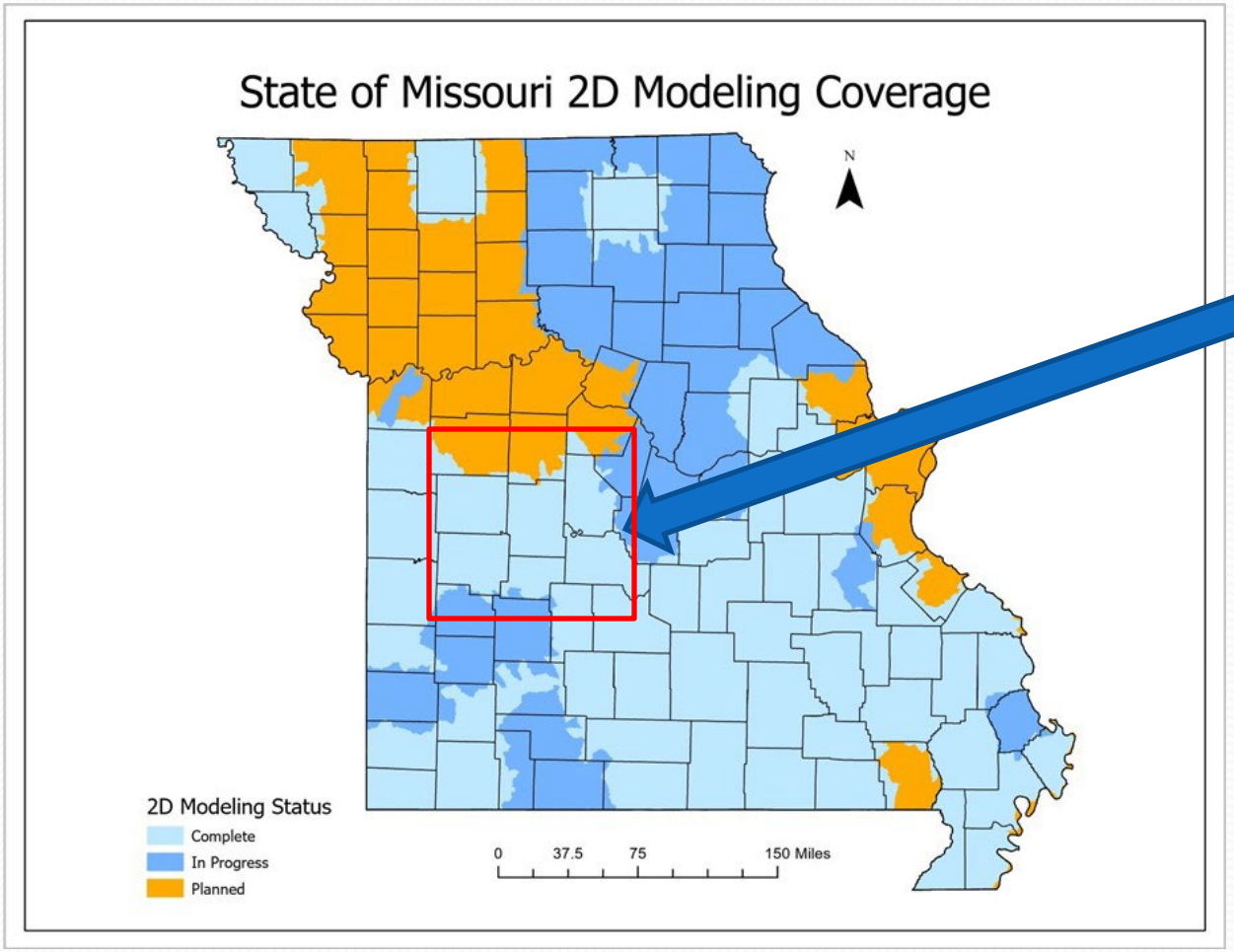
Why 2D Modeling?

- Two-Dimensional (2D) modeling is the **new industry standard** for riverine modeling.
- Advances in computer technology along with increased **accuracy** of data have driven this change.
- The goal of the hydraulic model is to accurately simulate actual flow paths, storage and depths.
- Less assumptions are made resulting in improved accuracy.
- High visual graphic output of 2D models enhances communication.
- Accurate representations for complex conditions where water does not travel directly downstream.

Benefits of 2D Hydraulic Modeling

Hydraulic Variables	One-dimensional (1D) Modelling*	Two-dimensional (2D) Modelling*	Stream Near You
Flow direction	***Assumed*** by user	***Computed***	
Flow paths	***Assumed*** by user	***Computed***	
Channel roughness	***Assumed*** constant between cross sections	***Assumed*** at each element	
Ineffective (blocked) flow areas	***Assumed*** by user	***Computed***	
Flow contraction and expansion through bridges	***Assumed*** by user	***Computed***	
Flow velocity	***Averaged*** at each cross section ***Assumed*** in one direction	Magnitude and direction ***Computed*** at each element	
Flow distribution	***Assumed*** based on conveyance	***Computed*** based on continuity	
Water surface elevation	***Assumed*** constant across cross sections	***Computed*** at each element	
Momentum	Not accounted for	***Computed*** at each element	

Statewide 2D by 2027 is the Goal!



Osage River Watershed is completed!

What's Important?

- **Volume of Runoff**
- **Timing of Runoff**
- Geometric Accuracy of Flow Paths
- Geometric Descriptions of any Restrictions
- Volume of Ponding

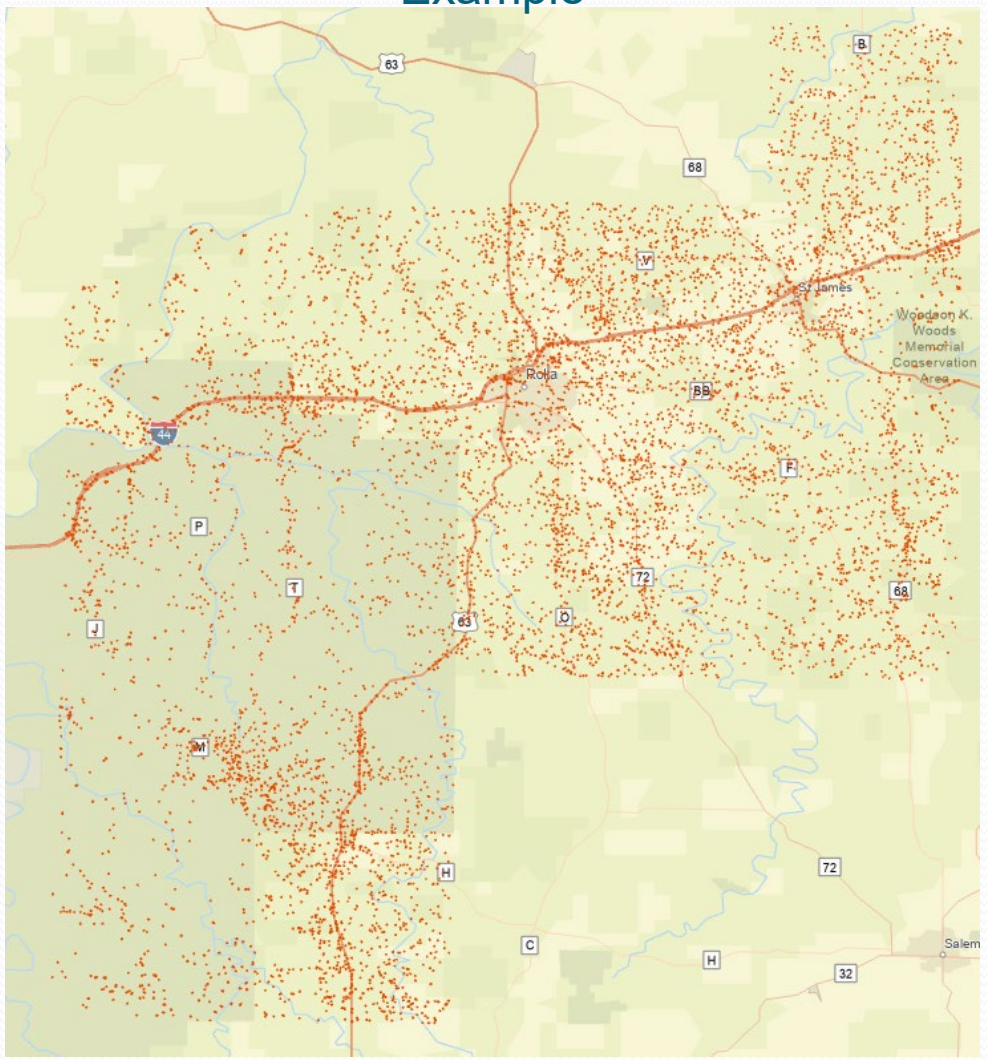
Missouri Modeling Goal: *To develop data-driven models that are easy to update as data changes.*

Two Dimensional Parameters

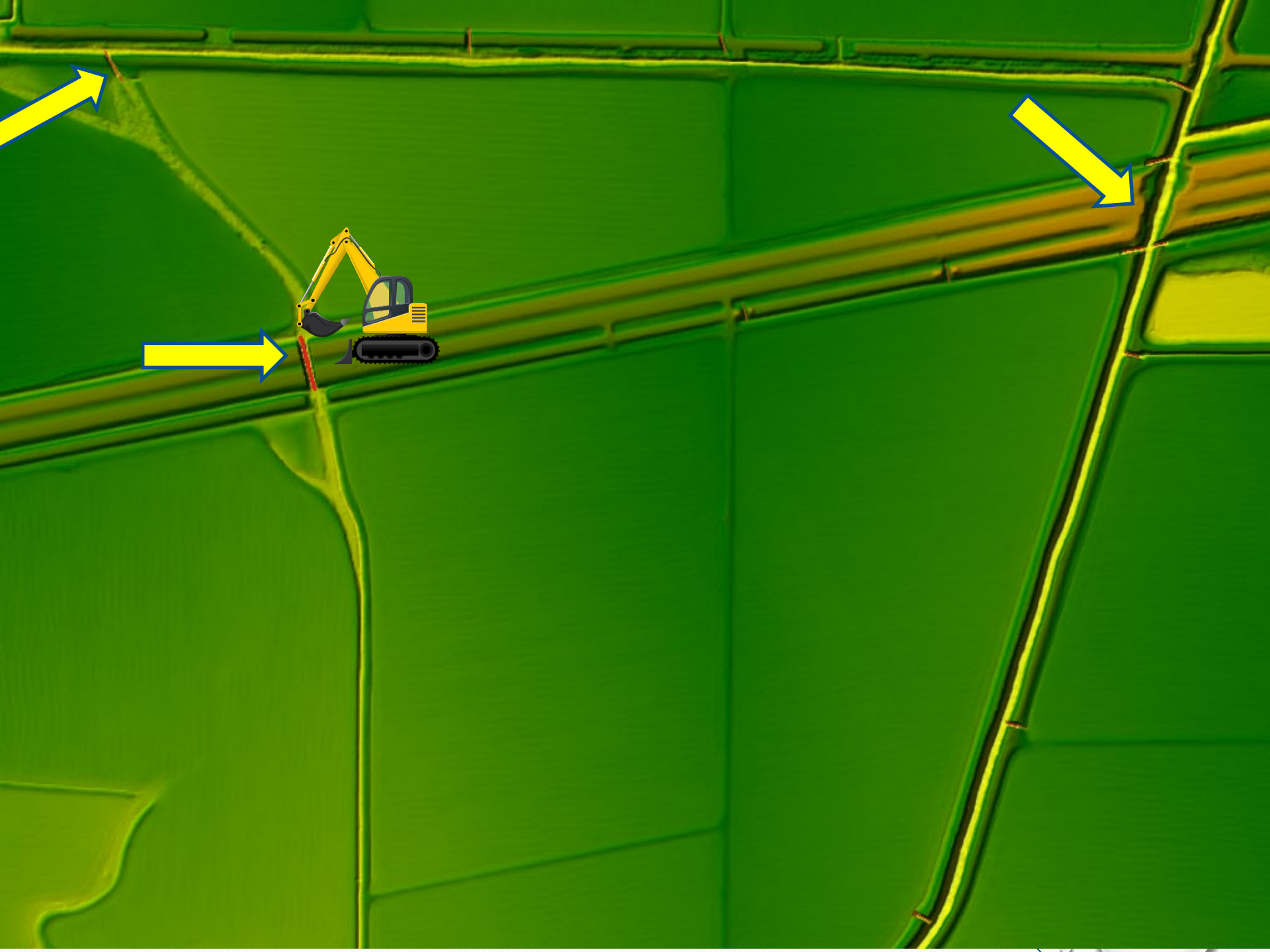
Hydro Connections

- Dams
- Berms
- Roads
- Railroads
- Any raised ground in the digital LiDAR that has a culvert or bridge

Example



Inputs

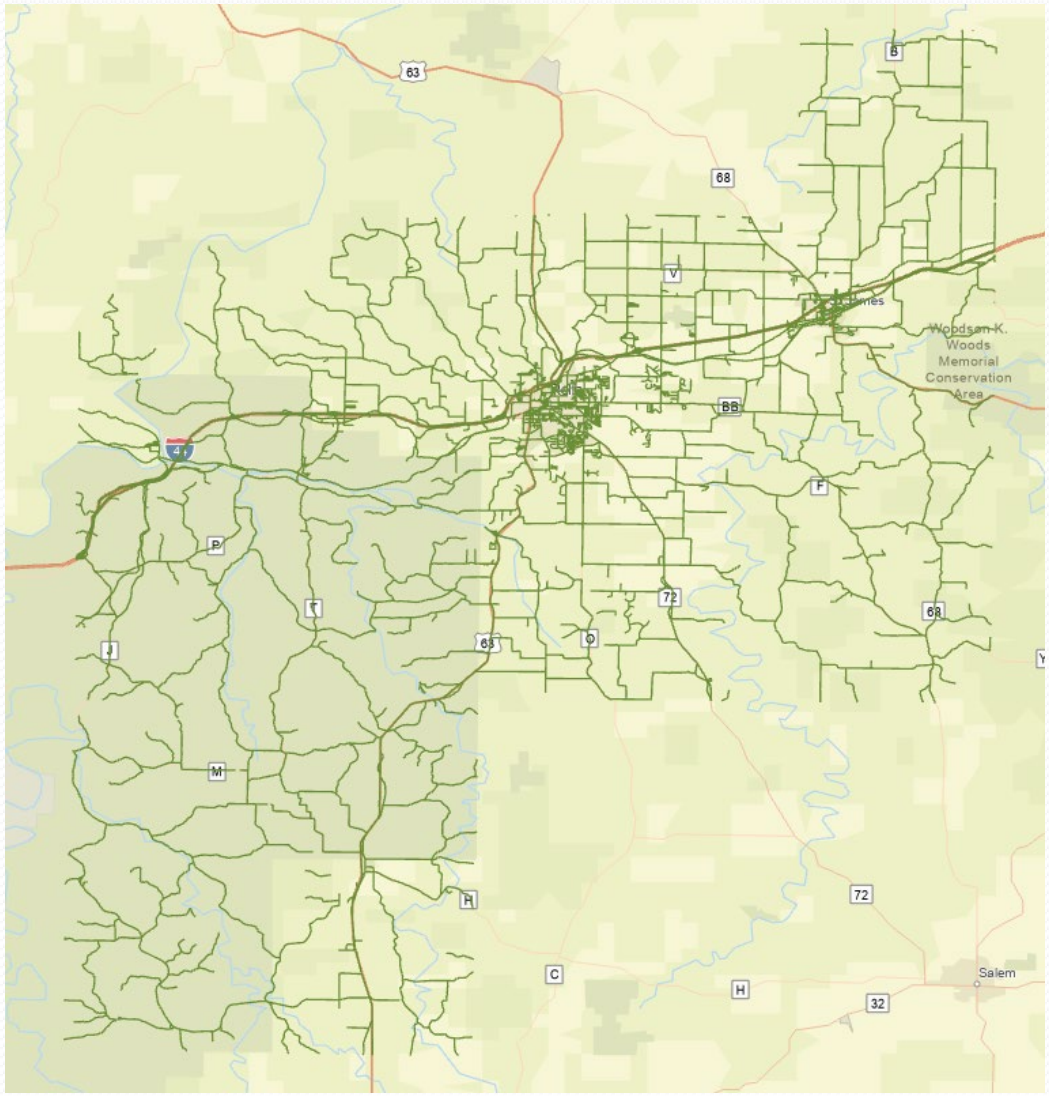


Two-Dimensional Model Parameters

Break Lines

- Railroads
- Levees
- Agricultural Berms
- Dams
- MoDOT Roads
- County Roads
- Farm Roads

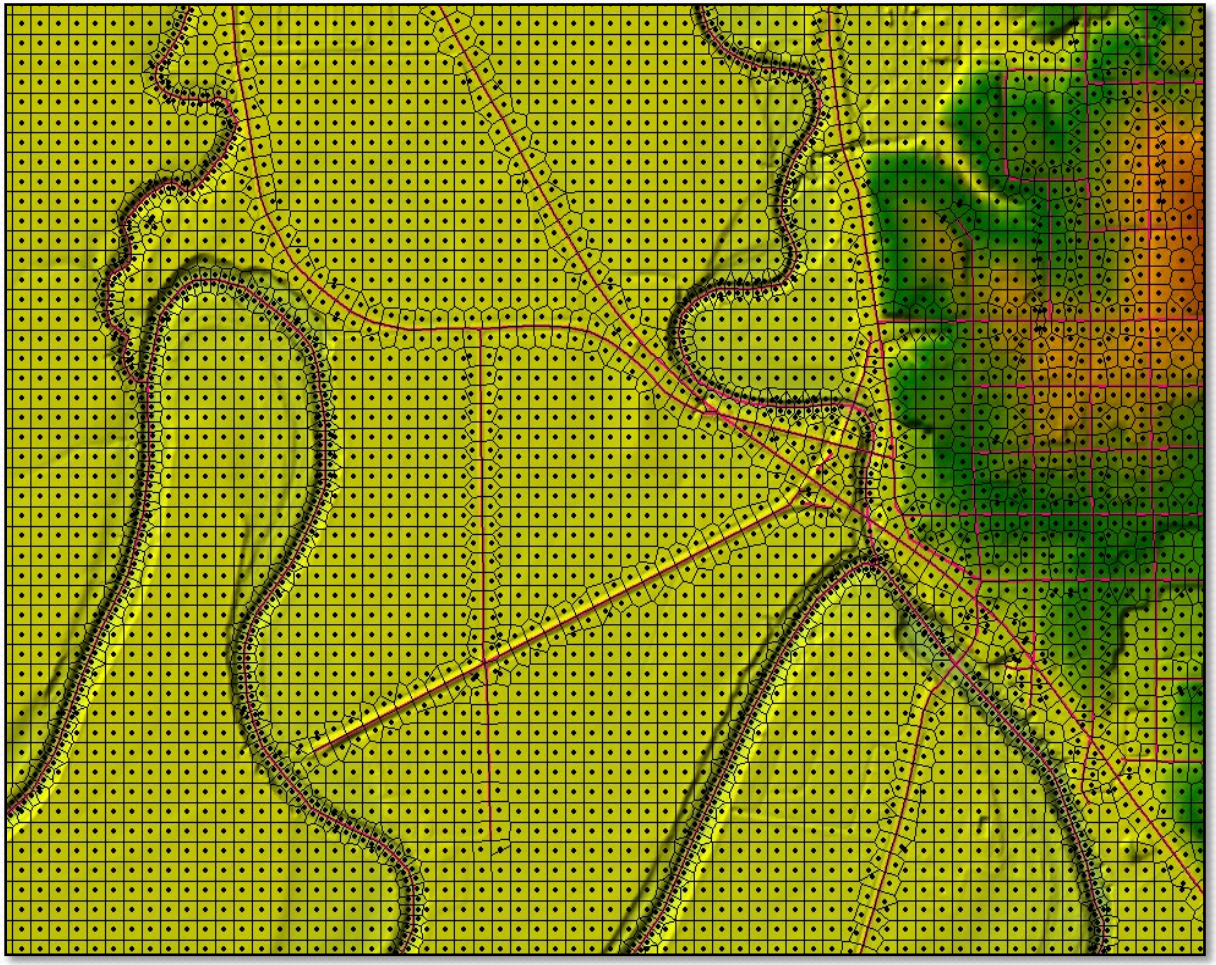
Example



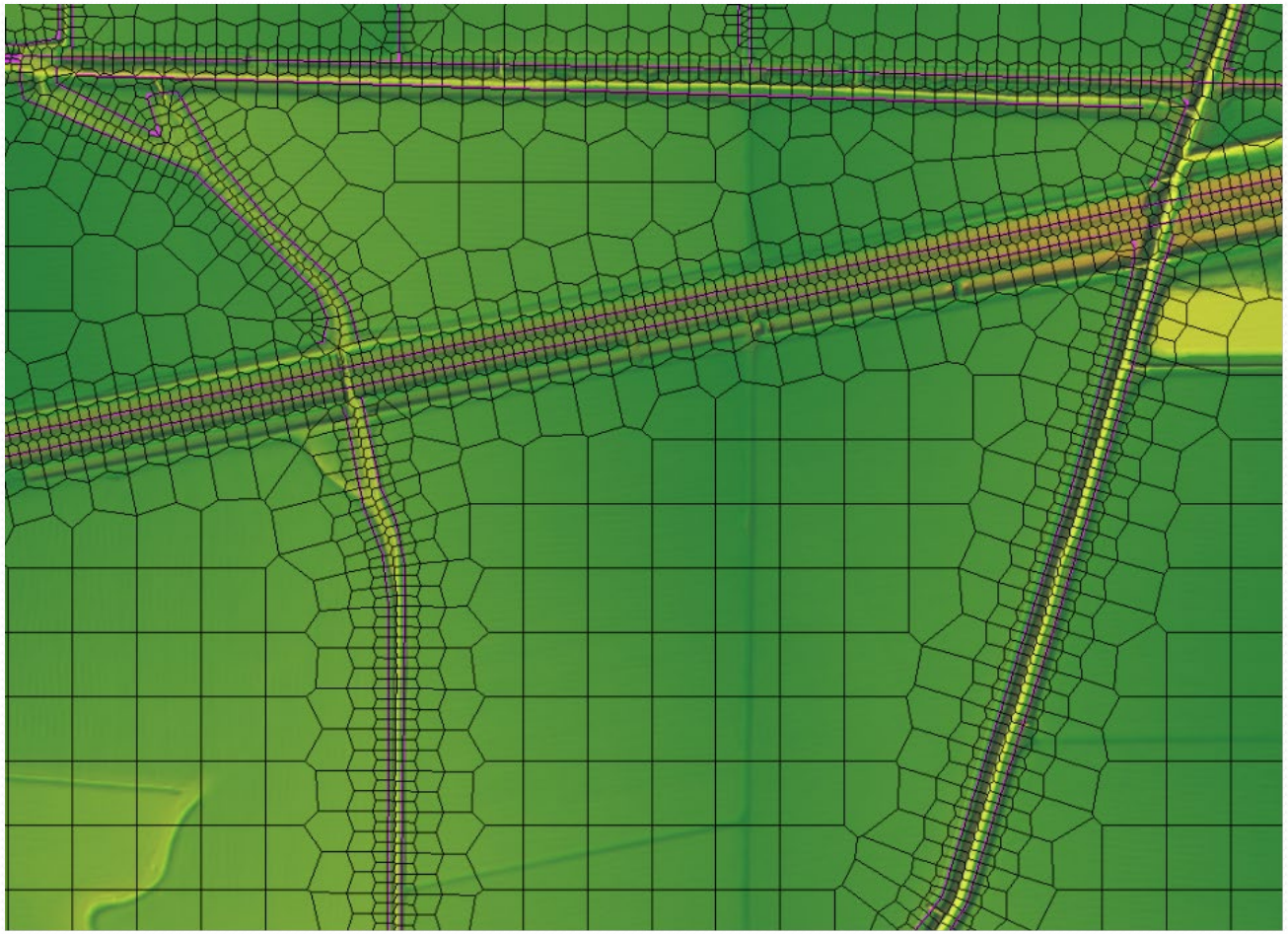
High Points – Water flows under / through.

What is a MESH?

- Railroads
- Levees
- Agricultural Berms
- Dams
- MODOT Roads
- County Roads
- Farm Roads



Two-Dimensional Model Set Up



Unstructured Computational Mesh with Detailed Terrain Data developed from LiDAR

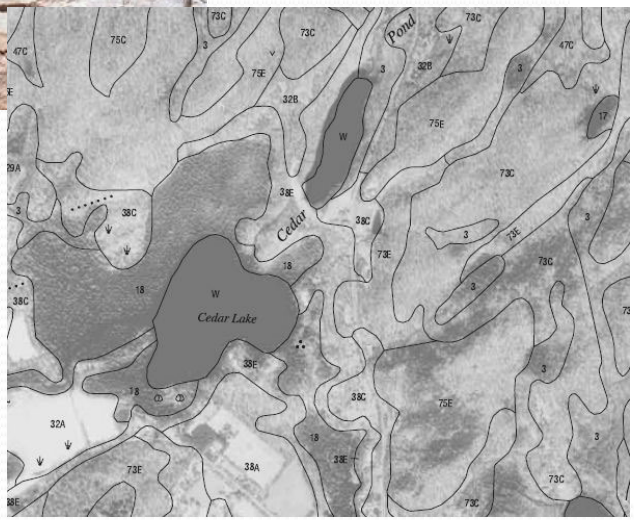
Mesh

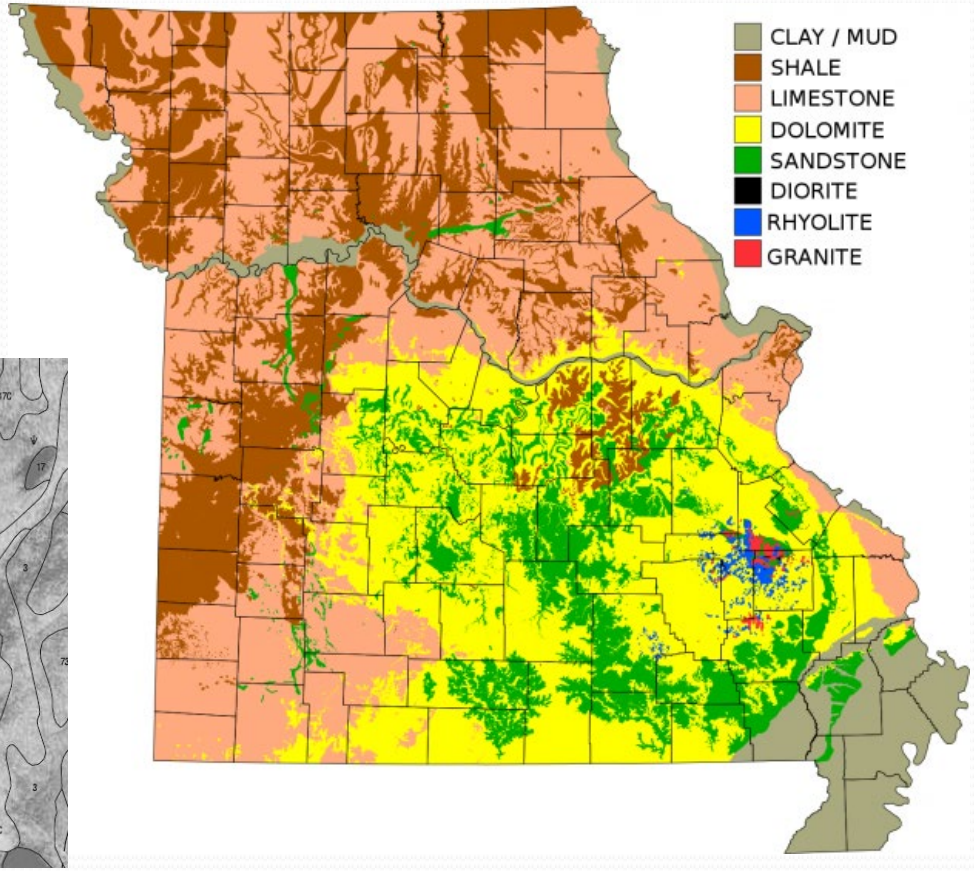
- With the input 2D area boundaries, land use data and terrain data, a 2D computational mesh can be developed.
- HEC-RAS uses a finite-volume solution scheme.
- For each cell, with 3 to 8 sides, the cross-section information is derived at the faces of the cell with storage information developed within the cell's area.

Hydrology – Volume of Runoff

- How much of the rainfall makes it to the creek, stream, or river?
- Rainfall is captured by:
  - The soil (we assume it's not too dry and not too wet)
  - The vegetation (plants and trees capture a large amount of rainfall that eventually evaporates)
  - And depressions in the ground (sinkholes too)
- What gets by all these traps goes to the channel!

Soil Classification Data

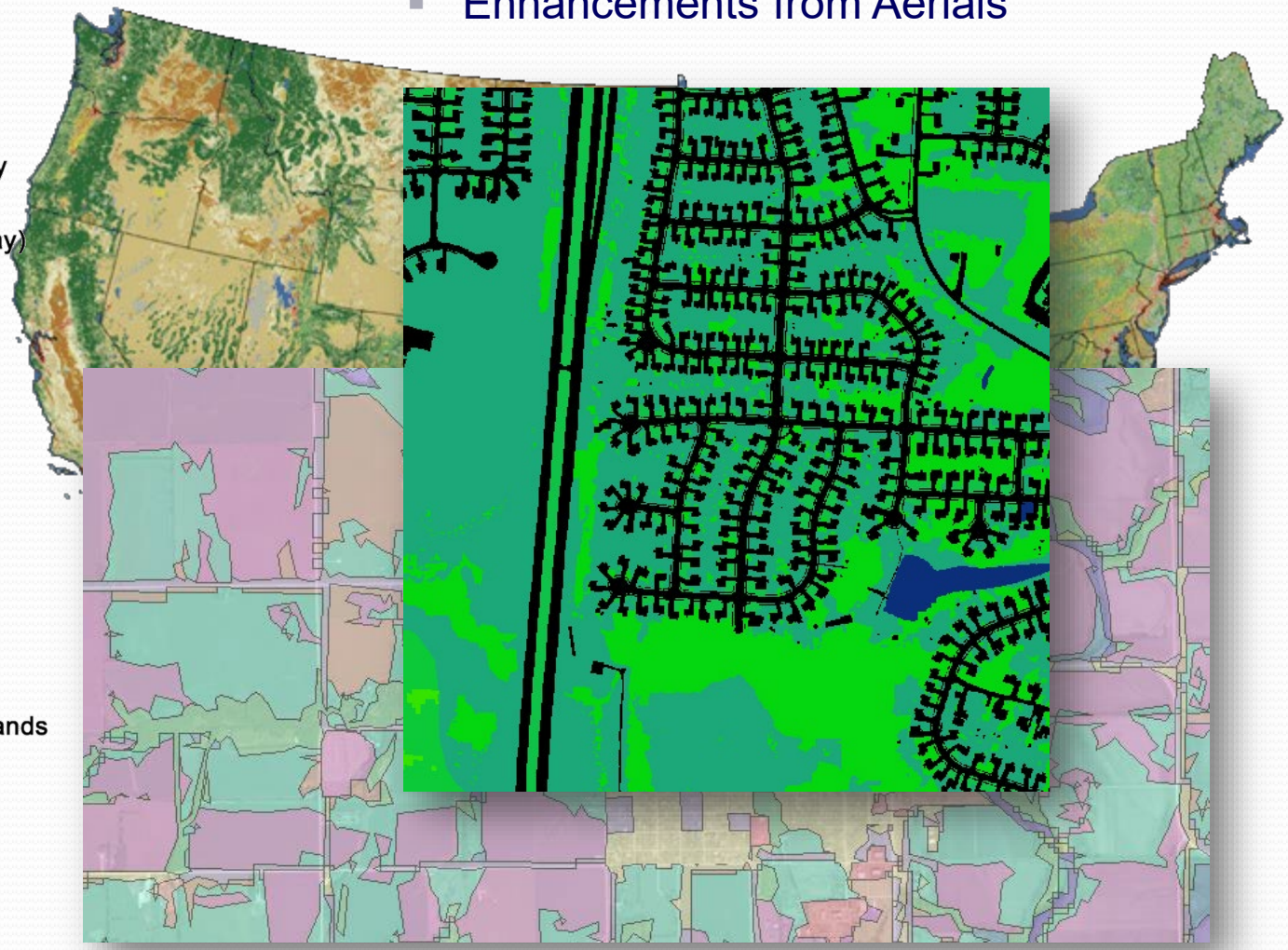




Hydrologic Soil by Groups – A, B, C and D

Land Use

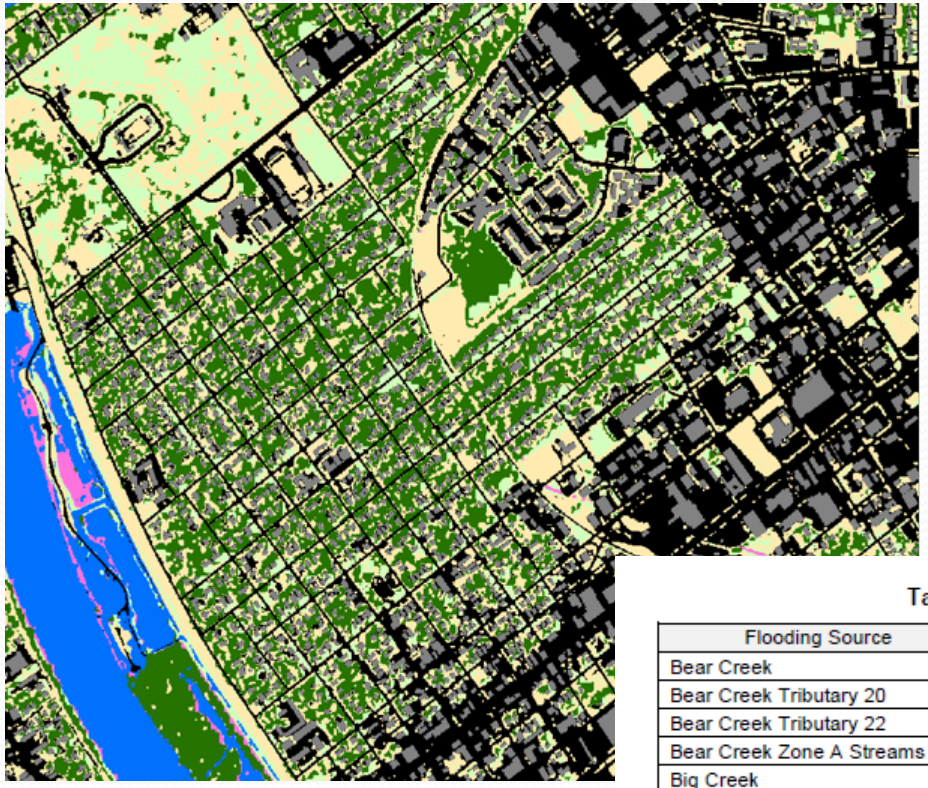
- Local Land Use Plans
- National Land Use Dataset
- Enhancements from Aerials



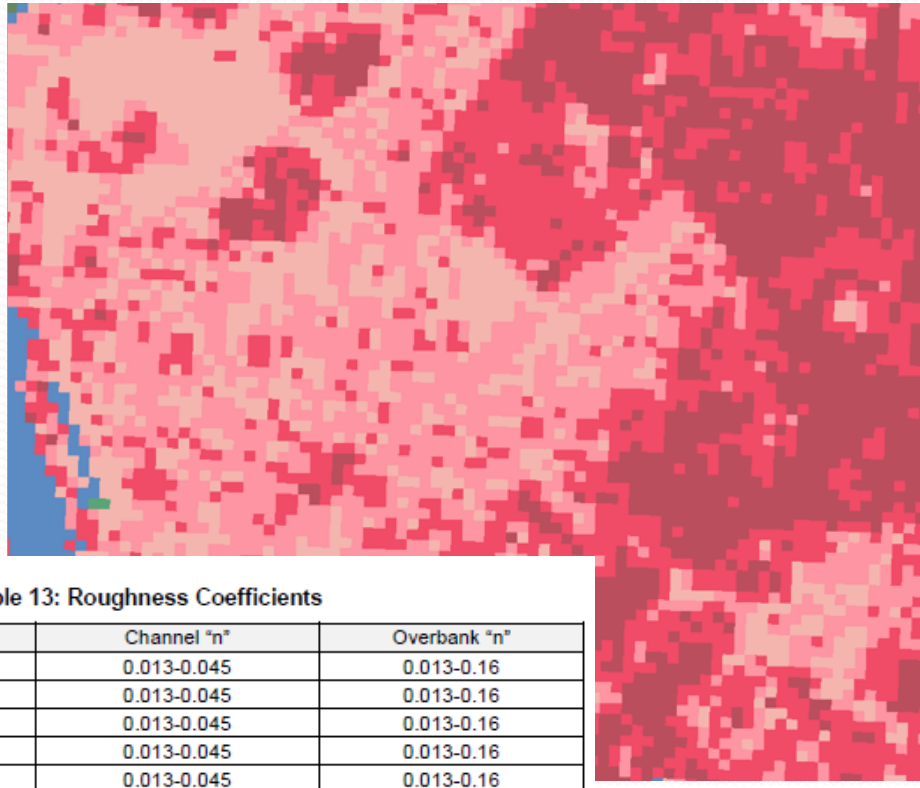
Detailed Landuse

Model Landuse Layers for CN per Mesh

Detailed per New Aerials



National Landuse Layer

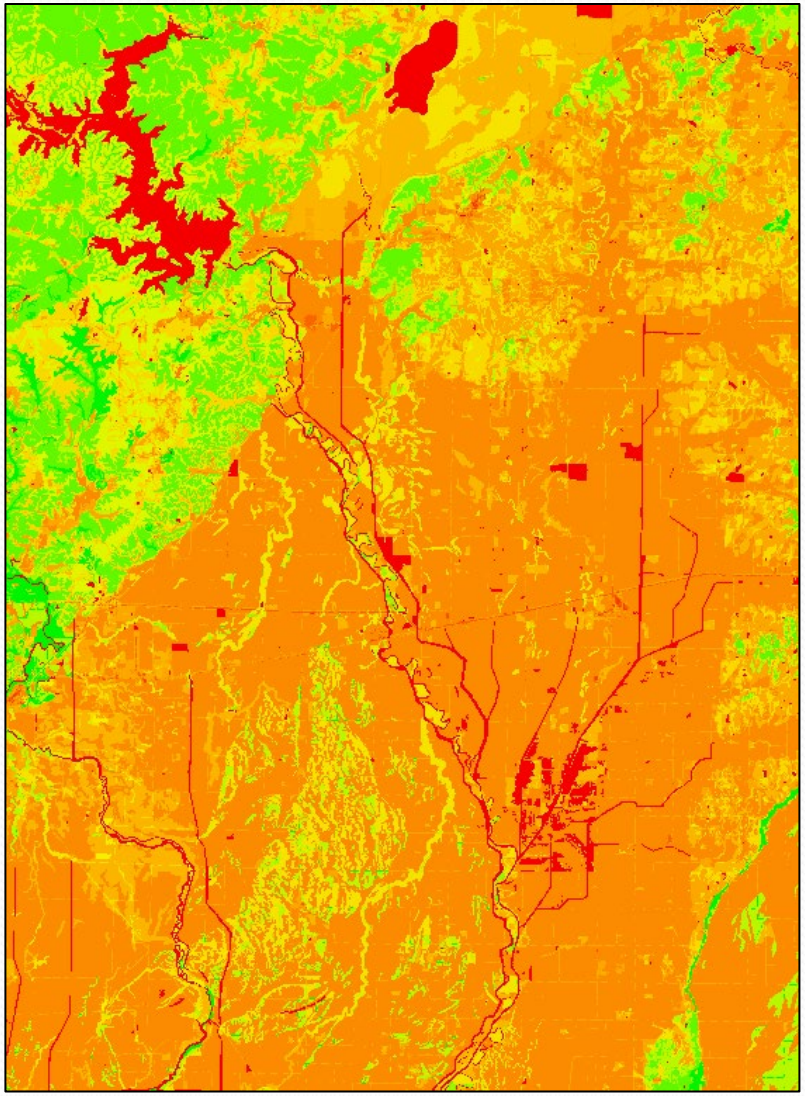


Examples

Table 13: Roughness Coefficients

Flooding Source	Channel "n"	Overbank "n"
Bear Creek	0.013-0.045	0.013-0.16
Bear Creek Tributary 20	0.013-0.045	0.013-0.16
Bear Creek Tributary 22	0.013-0.045	0.013-0.16
Bear Creek Zone A Streams	0.013-0.045	0.013-0.16
Big Creek	0.013-0.045	0.013-0.16
Davis Branch	0.013-0.045	0.013-0.16
East Middle Chariton Watershed Zone A Streams	0.013-0.045	0.013-0.16
Fabius Watershed Zone A Streams	0.013-0.045	0.013-0.16

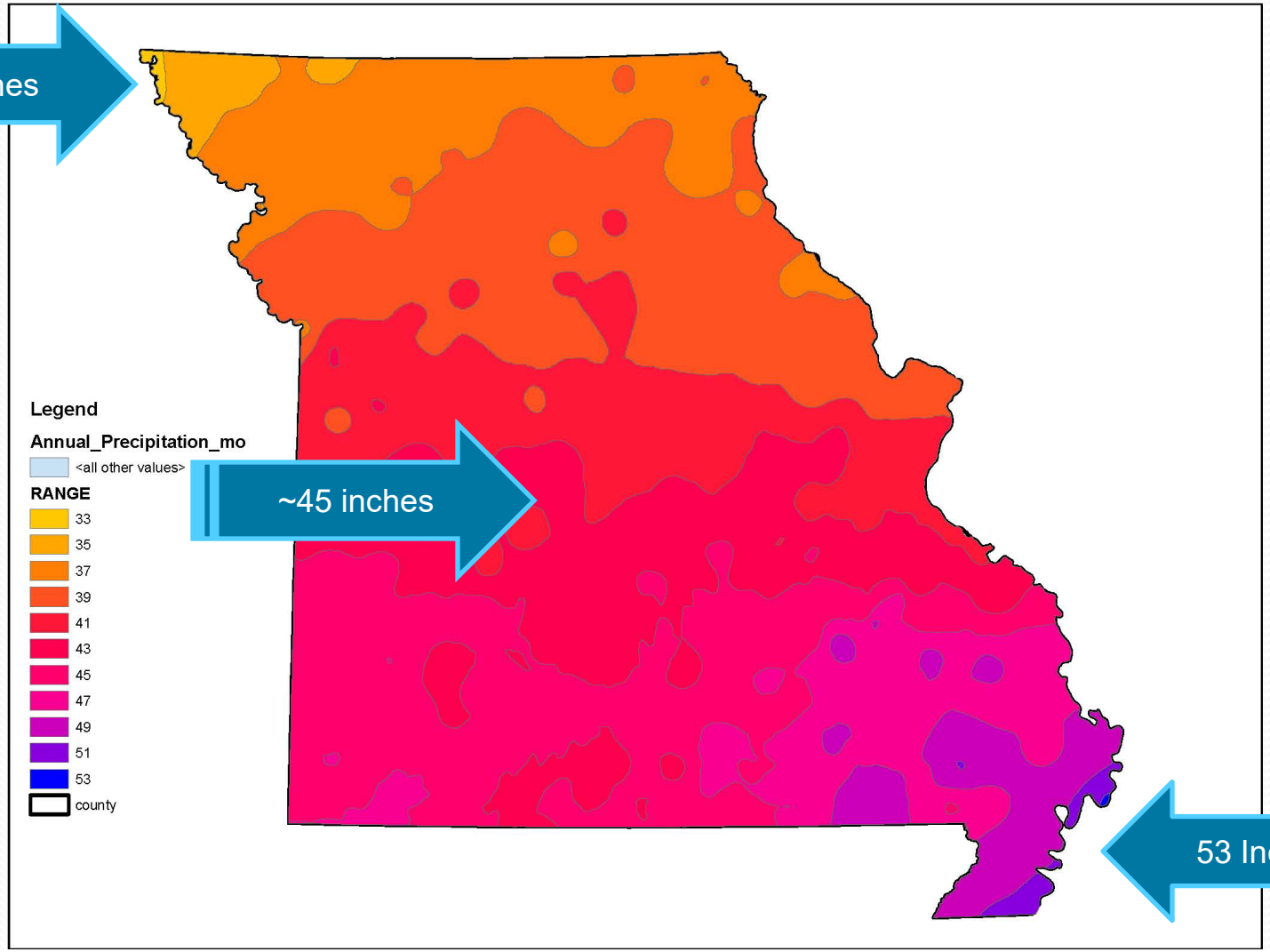
Compute Curve Numbers



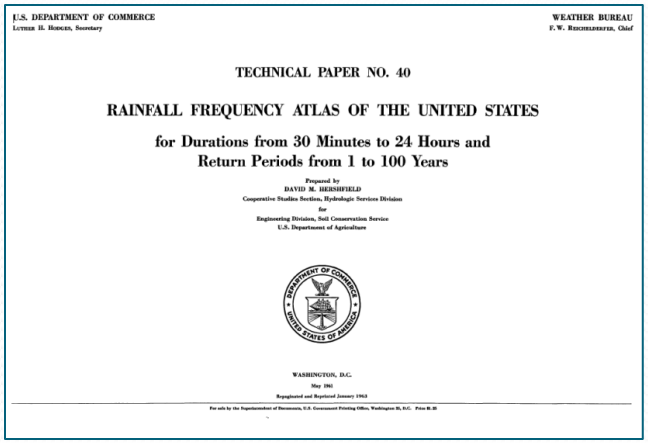
Summary of Curve Number Values with the Associated Land Use and Soil Data

Landuse Description	Hydrologic Soil Group			
	A	B	C	D
Developed, Open Space	51	68	79	84
Developed, Low Intensity	57	72	81	86
Developed, Medium Intensity	77	85	90	92
Developed, High Intensity	89	92	94	95
Deciduous Forest	30	55	70	77
Shrub/Scrub	43	65	76	82
Herbaceous	43	65	76	82
Hay/Pasture	49	69	79	84
Cultivated Crops	65	75	82	86
Woody Wetlands	36	60	73	79
Emergent Herbaceous Wetlands	36	60	73	79
Open Water	98	98	98	98

Annual Precipitation



Rainfall Frequency and Amounts



U.S. DEPARTMENT OF COMMERCE
LUTHER H. HODGES, Secretary

WEATHER BUREAU
F. W. REICHELDERFER, Chief

TECHNICAL PAPER NO. 40

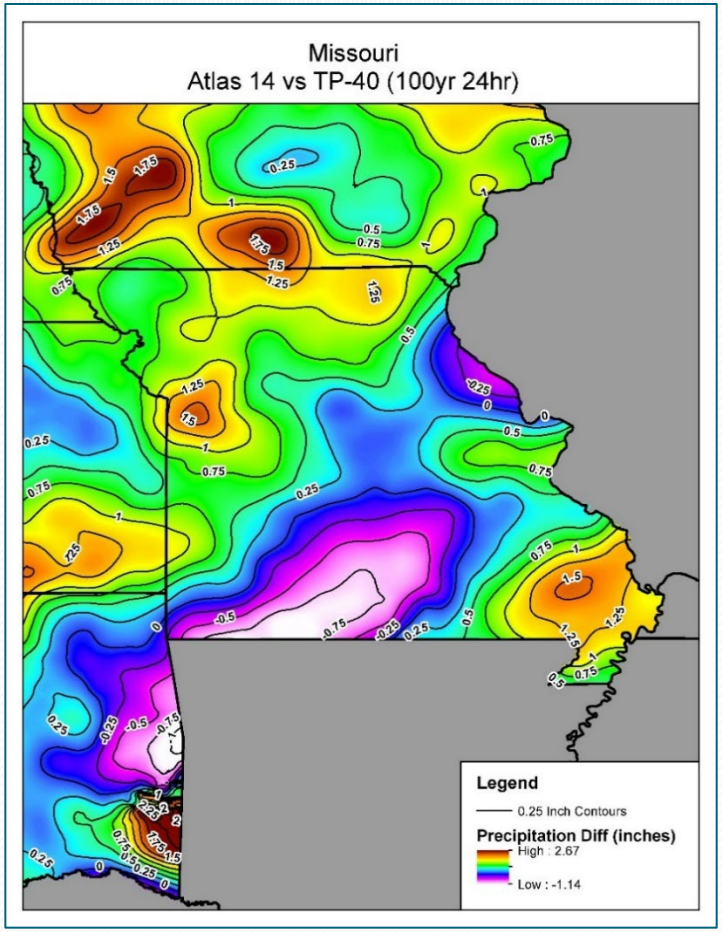
RAINFALL FREQUENCY ATLAS OF THE UNITED STATES

for Durations from 30 Minutes to 24 Hours and
Return Periods from 1 to 100 Years

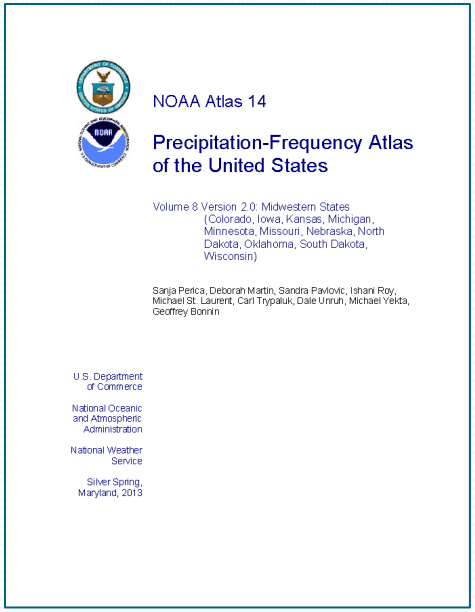
Prepared by
DAVID M. HERSHFIELD
Cooperative Studies Section, Hydrologic Services Division
for
Engineering Division, Soil Conservation Service
U.S. Department of Agriculture

WASHINGTON, D.C.
May 1961
Reprinted and Replaced January 1963

(1% 24hr event)



Varies from -0.5 inches to +1.0 inches



NOAA Atlas 14

Precipitation-Frequency Atlas of the United States

Volume 8 Version 2.0: Midwestern States
(Colorado, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Oklahoma, South Dakota, Wisconsin)

Sanja Perica, Deborah Martin, Sandra Pavlovic, Ishani Roy, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Michael Yekta, Geoffrey Bonnin

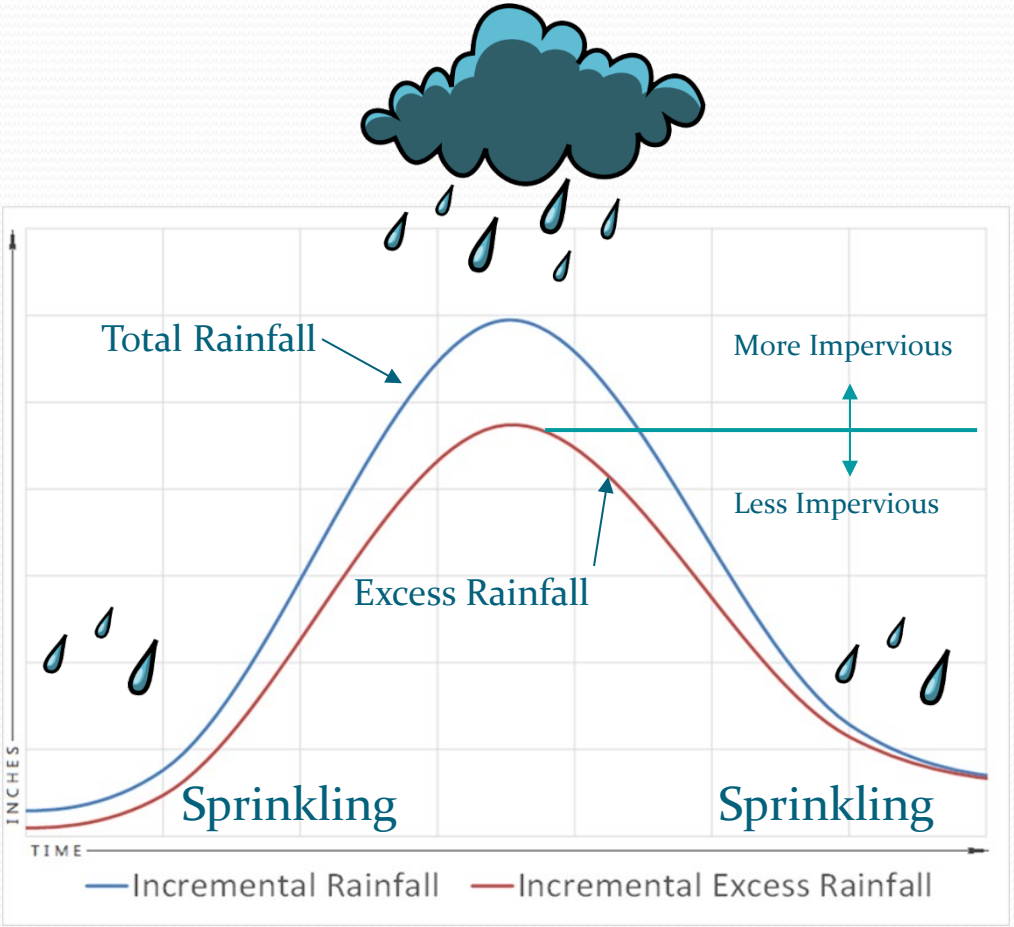
U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
Silver Spring, Maryland, 2013

2D Hydrology

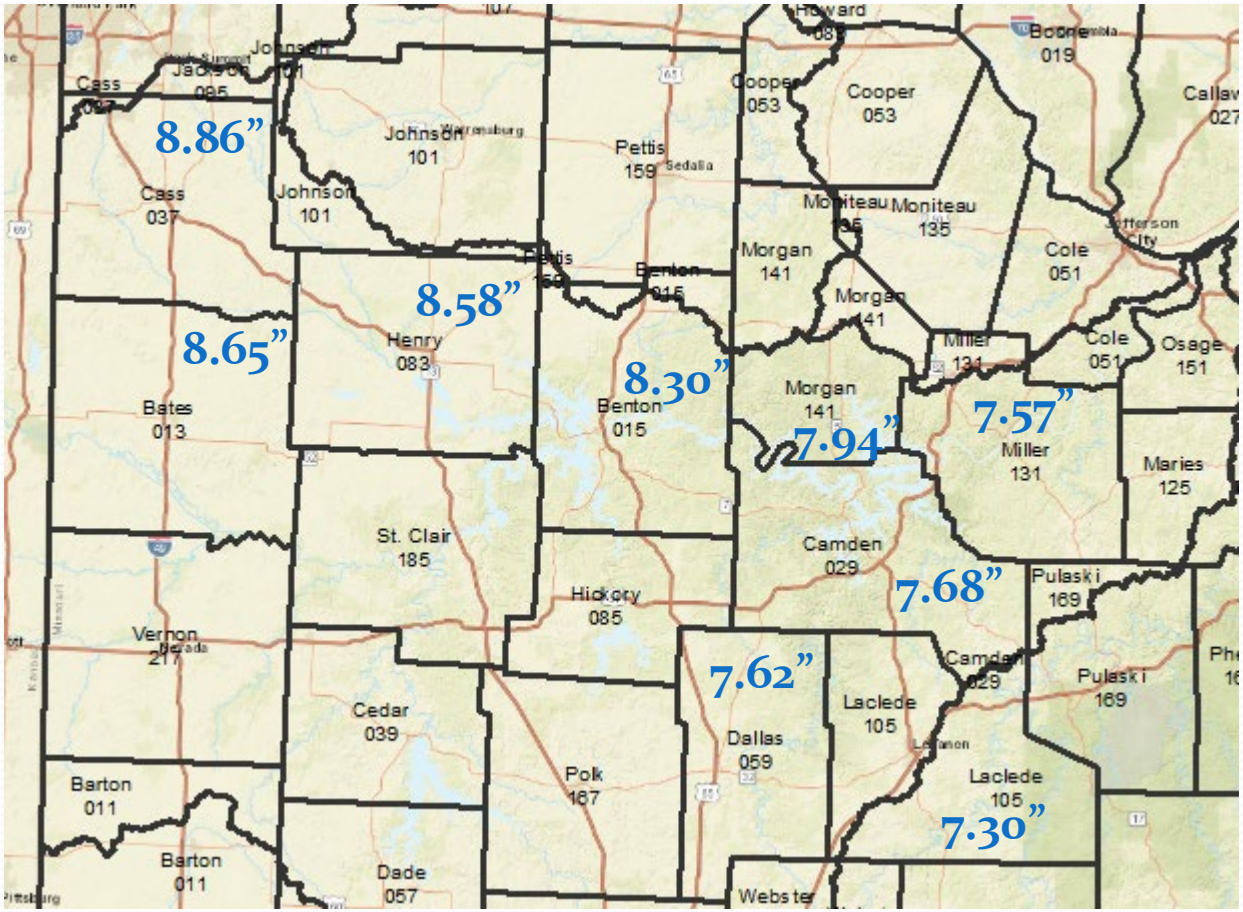
Excess Rainfall

- A Type II distribution was selected for the rainfall hyetograph
- The excess rainfall is the amount that leaves the mesh cell.

Excess Rainfall Hyetograph, Plotted with the Rainfall Hyetograph, developed with SCS methodology



Atlas 14 24-Hour 1% Rainfall Depths

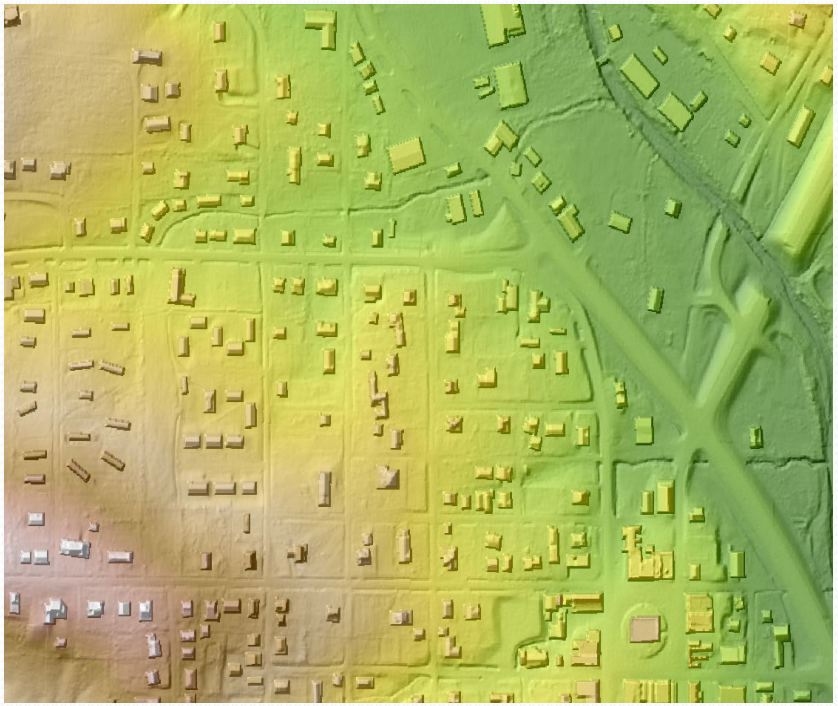


The rainfall depths data for each county is leverage data obtained from NOAA

https://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html

Building Footprint Extraction from LiDAR – 3D Features

Aerial View

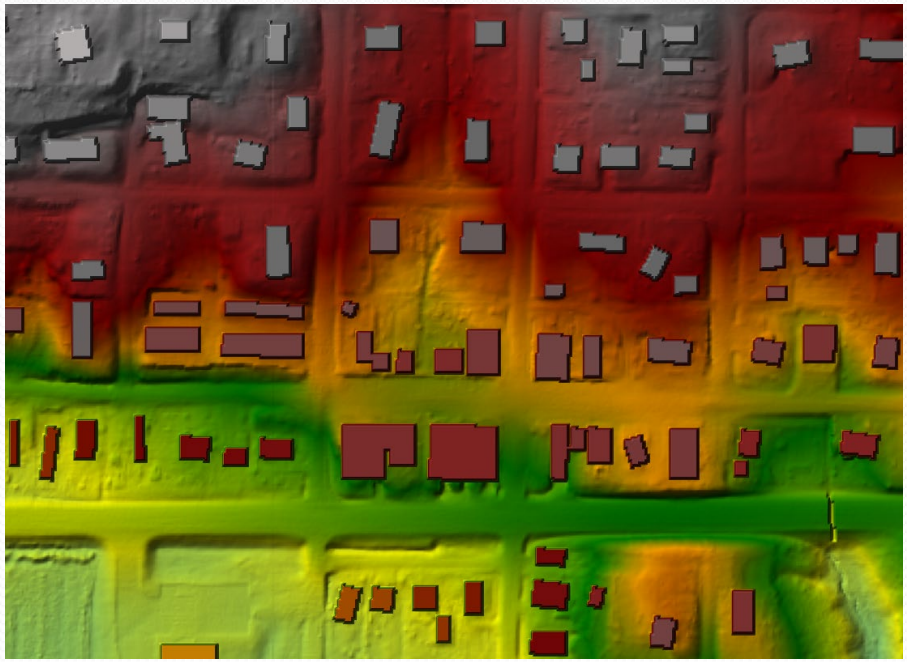


Terrain View

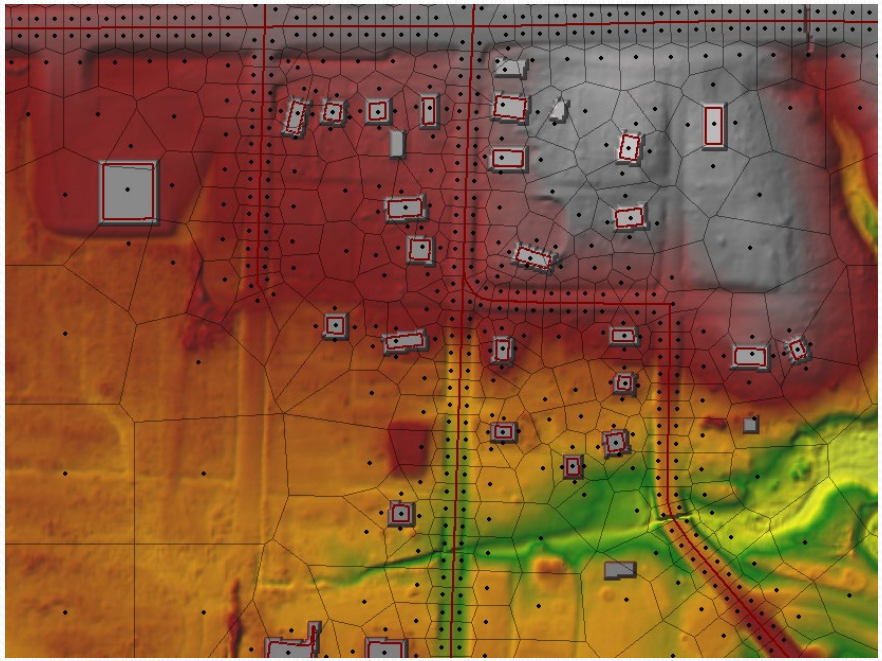
Building Footprints in the Model

- View of the 3D Buildings in the model

Without the mesh

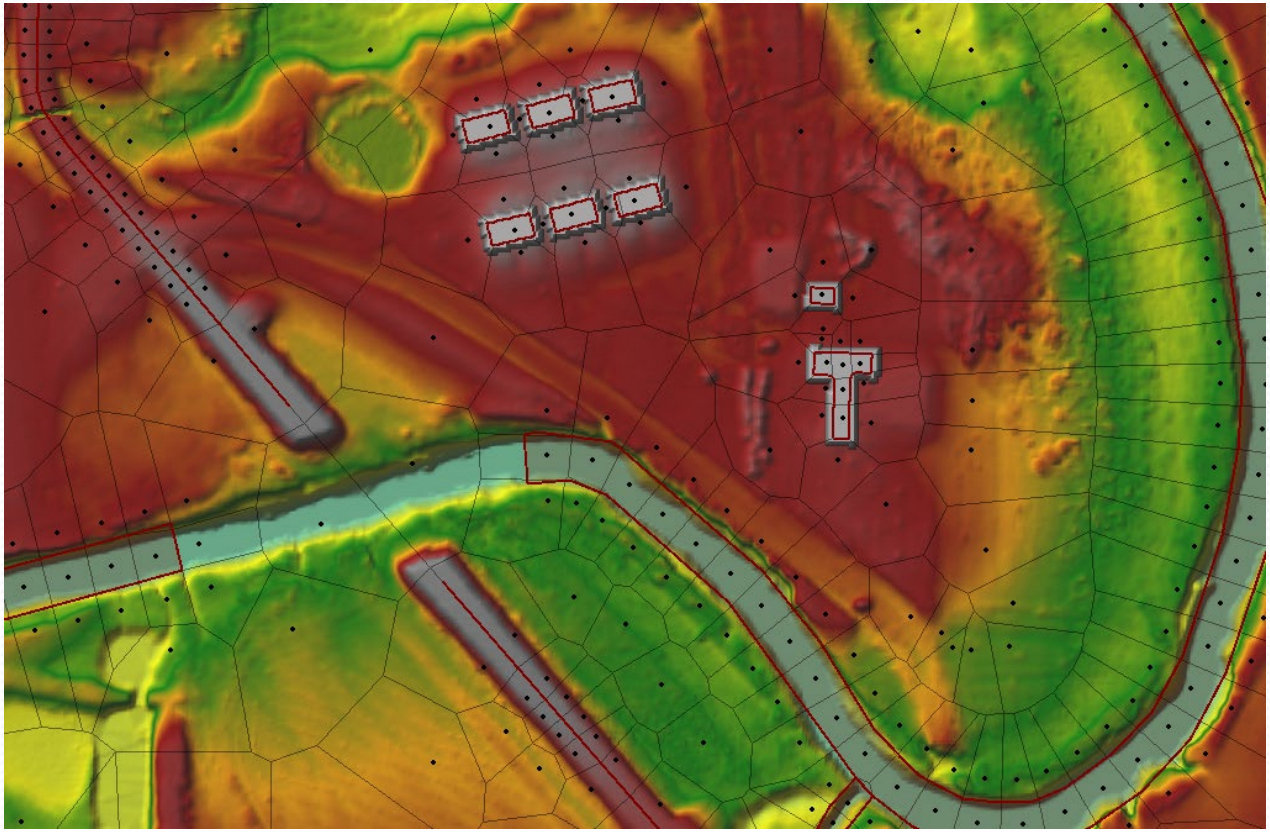


With the mesh



3D Building Footprint within Floodplain

- Showing the road

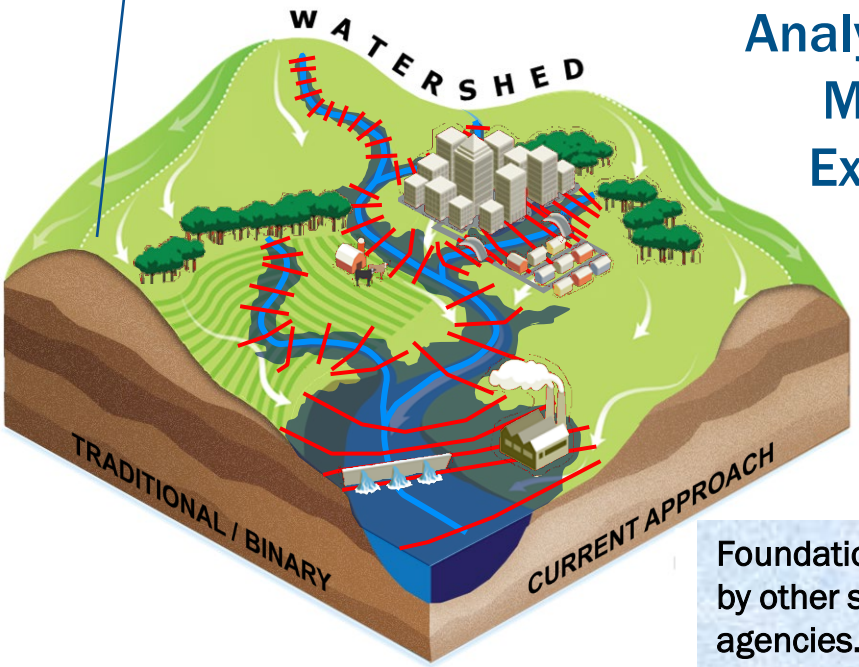


Hydraulics – Timing of Runoff

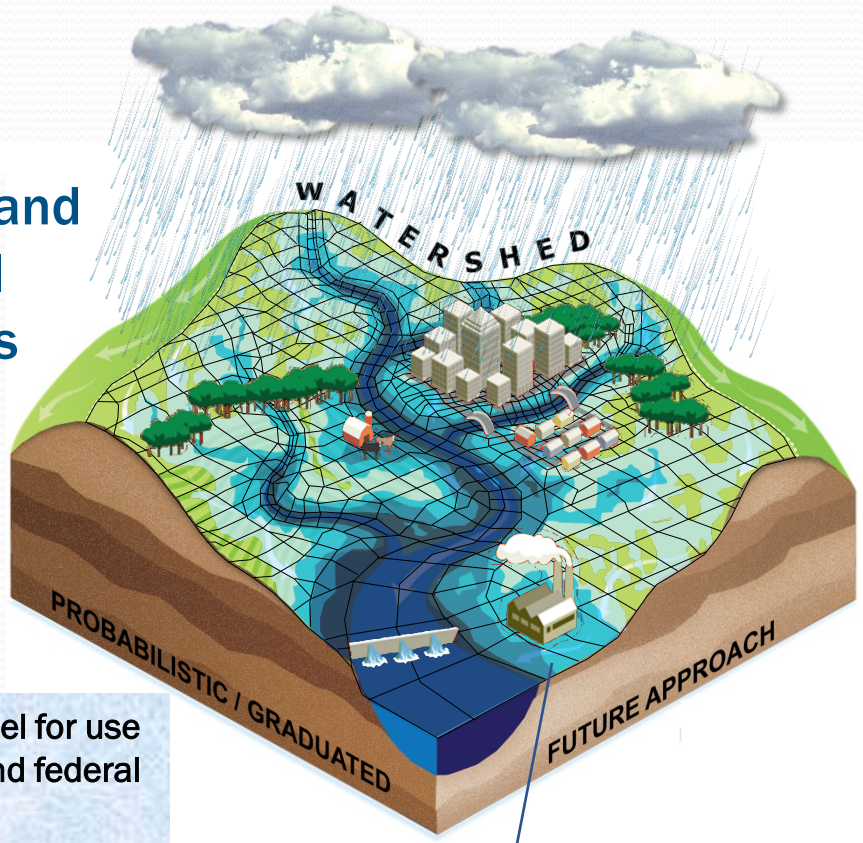
- How high will all that water get once it gets to the creek, river, stream, bridge, culvert, or road?
- The height of the water surface is determined by:
  - The slope of the ground (how steep or flat is the stream?)
  - The vegetation (plants and trees provide obstructions that slow down the water which makes it go higher)
  - How confined is the channel? (Is it wide or narrow?)
  - Infrastructure obstacles (How many road crossings?)

Digital description of ground for water to flow from one place to another that determines the direction and path, accounts for roughness, volume of attenuation, time to travel with a result of the predicted WSEL at a point of interest.

- Fluvial flooding only.
- Data along studied streams.
- Event-based analyses.



Analysis and Model Extents



Foundation model for use by other state and federal agencies.

- Fluvial and pluvial flooding.
- Data for entire watershed.
- Probabilistic analyses.

Developments

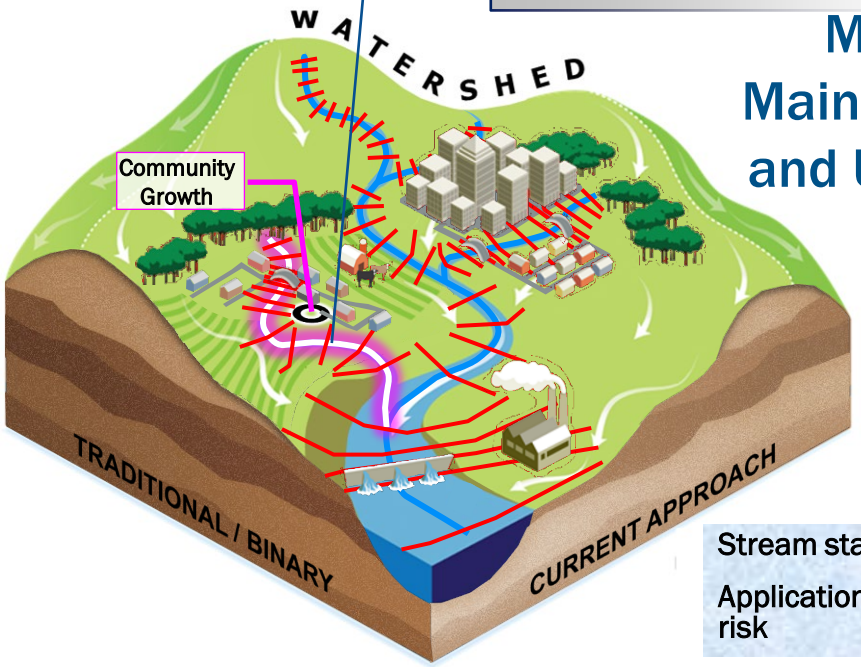
Flood reduction solutions

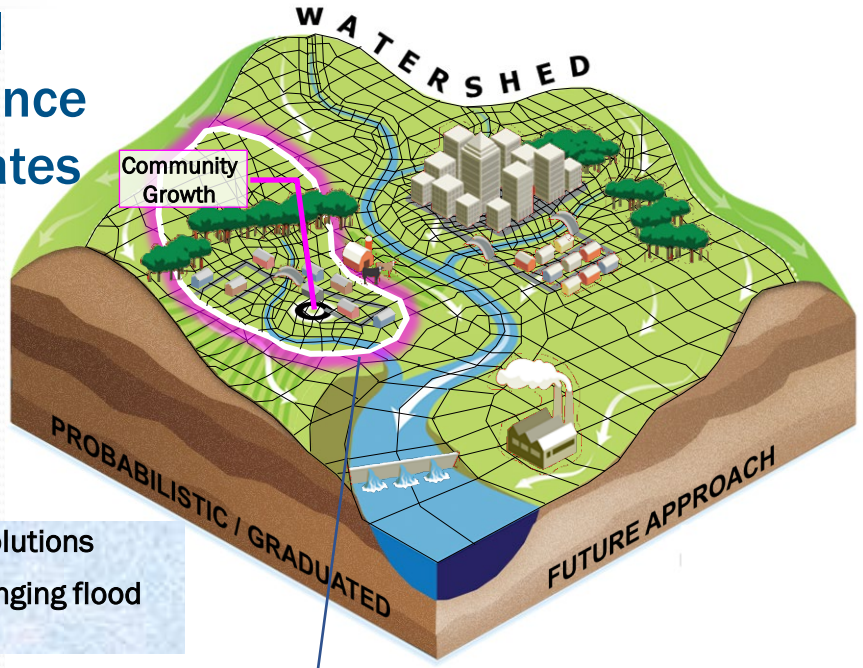
- Model enhancements stream-by-stream.
- Multiple models per watershed.

Bridge/culvert replacements

Stream conveyance modifications

Model Maintenance and Updates





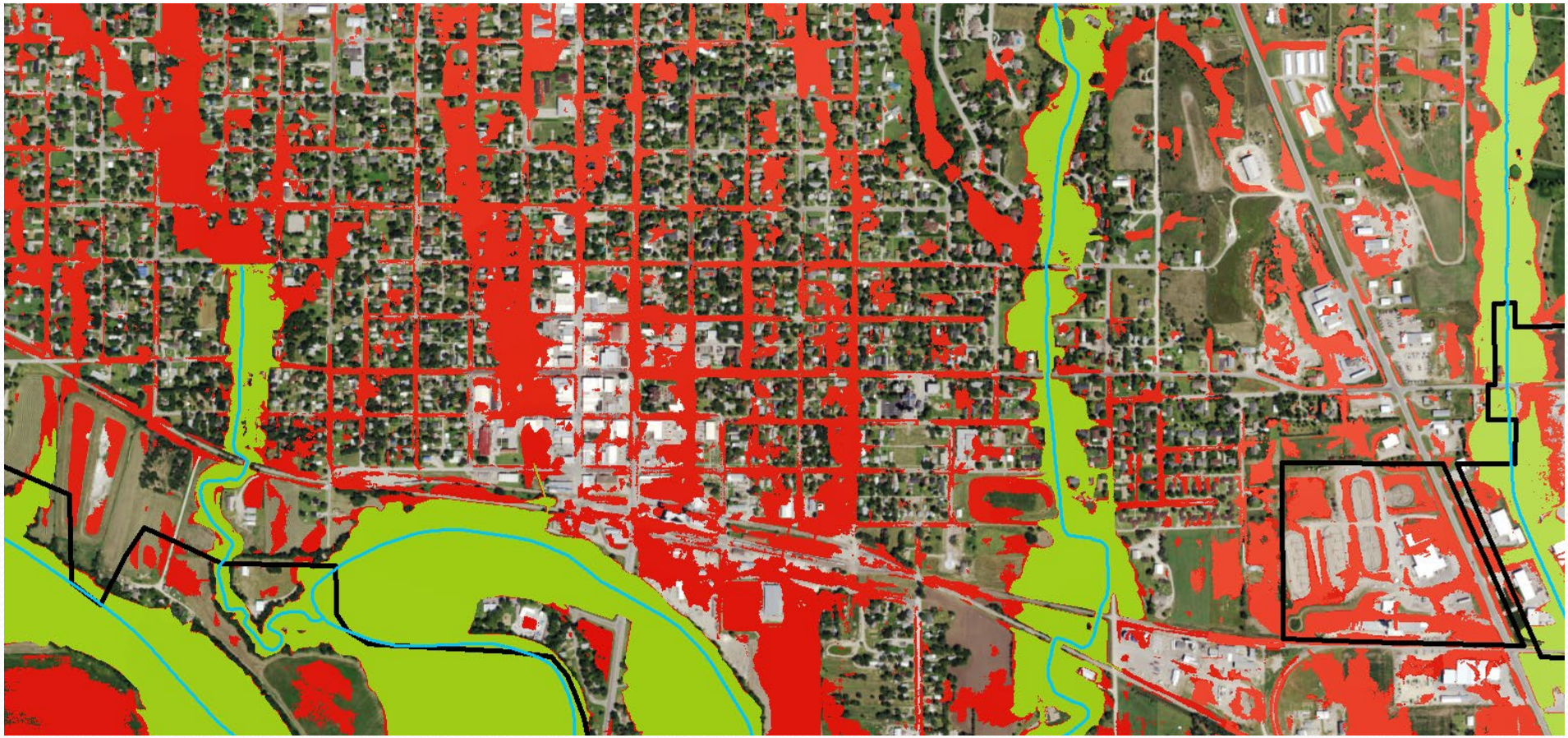
Stream stability solutions

Application of changing flood risk

- Enhancements integrated into overall watershed model.
- One model per watershed.

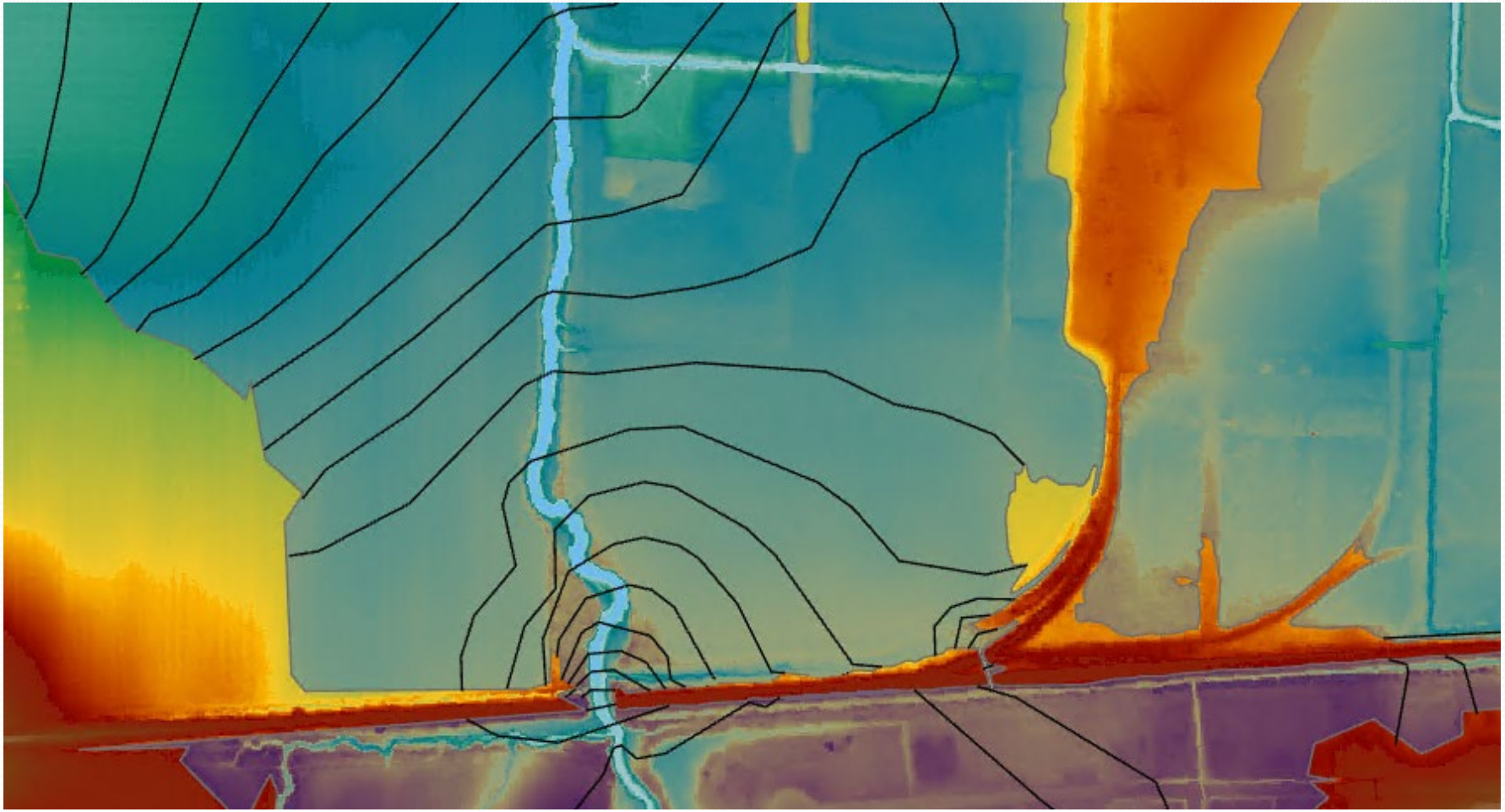
Question ?

Why is my regulatory floodplain different from the model results?

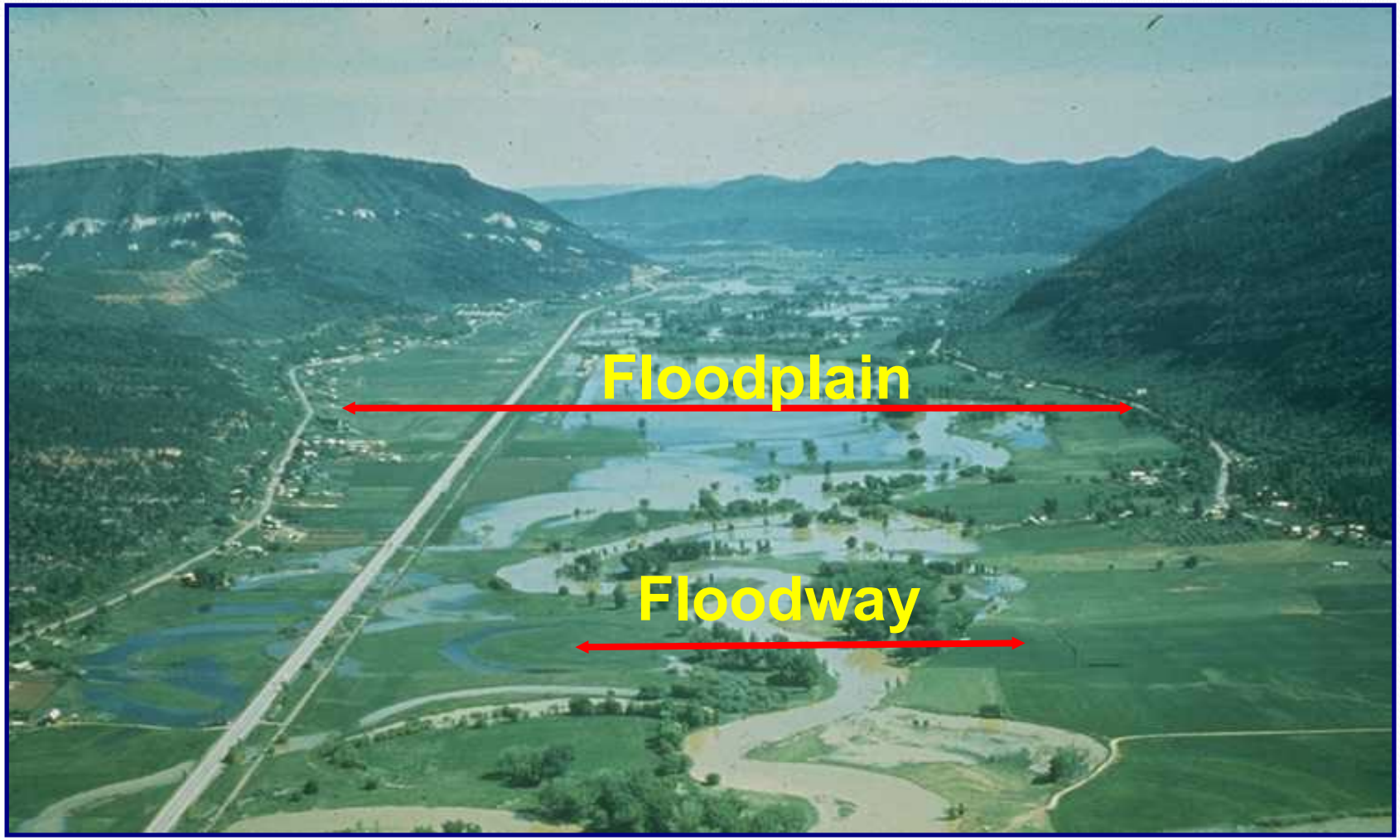


Why are the BFE lines curved?

We will have **Evaluation Lines** (cross-sections) going forward….



Floodplain vs. Floodway



Red streams will have a Floodway

Our Agenda

Project Goals;

Where We've Been;

Where We Are;

Where We're Going;

Flood Risk Review #2 (FRR#2) Meeting Agenda

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  - Additional Flood Risk Products (Rasters)

Website to view Draft Data: http://bit.ly/MOSEMAOutreach
or on smart phone or tablet: http://bit.ly/mobile_MOSEMAOutreach

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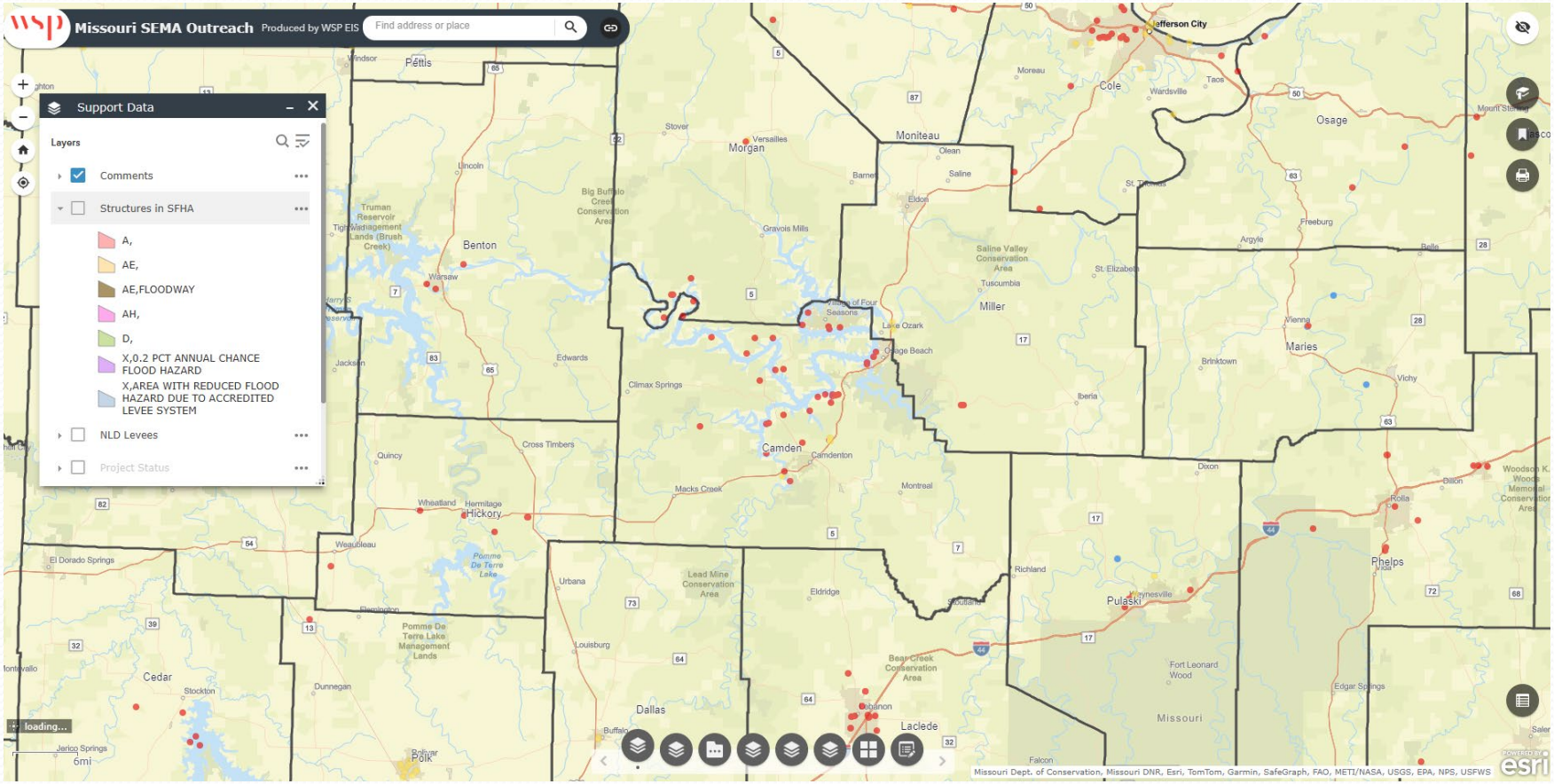
Where We Are;

Flood Risk Review Meeting #2 - Today

- Reviewing the working-set of Flood Risk Data and providing comments!

- Your comments are welcome now and you are encouraged to provide input!

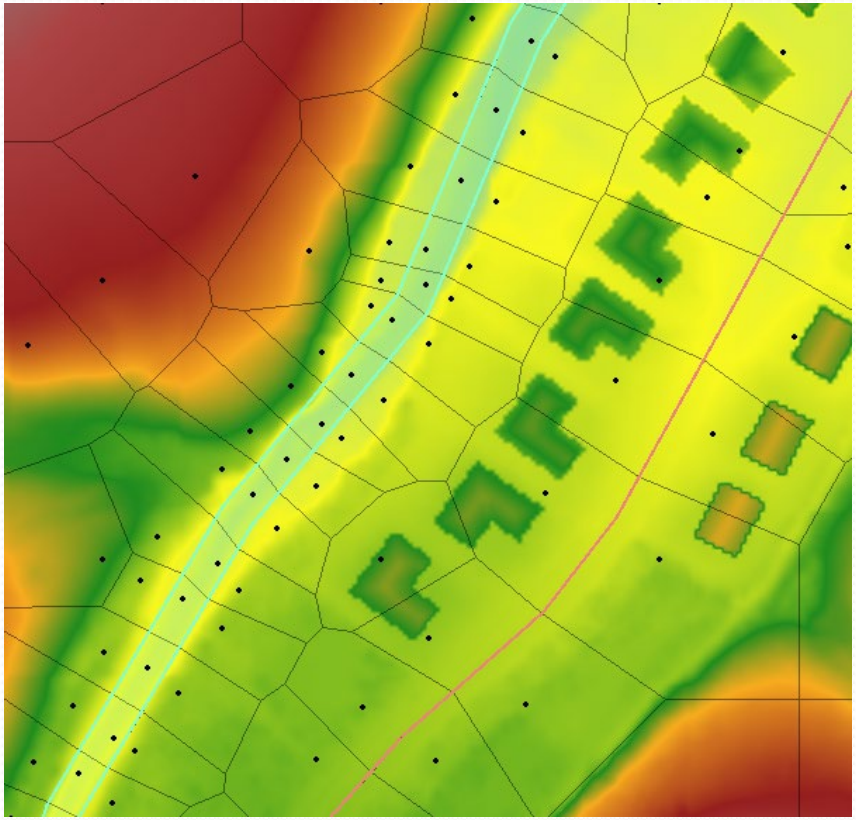
Comments Received

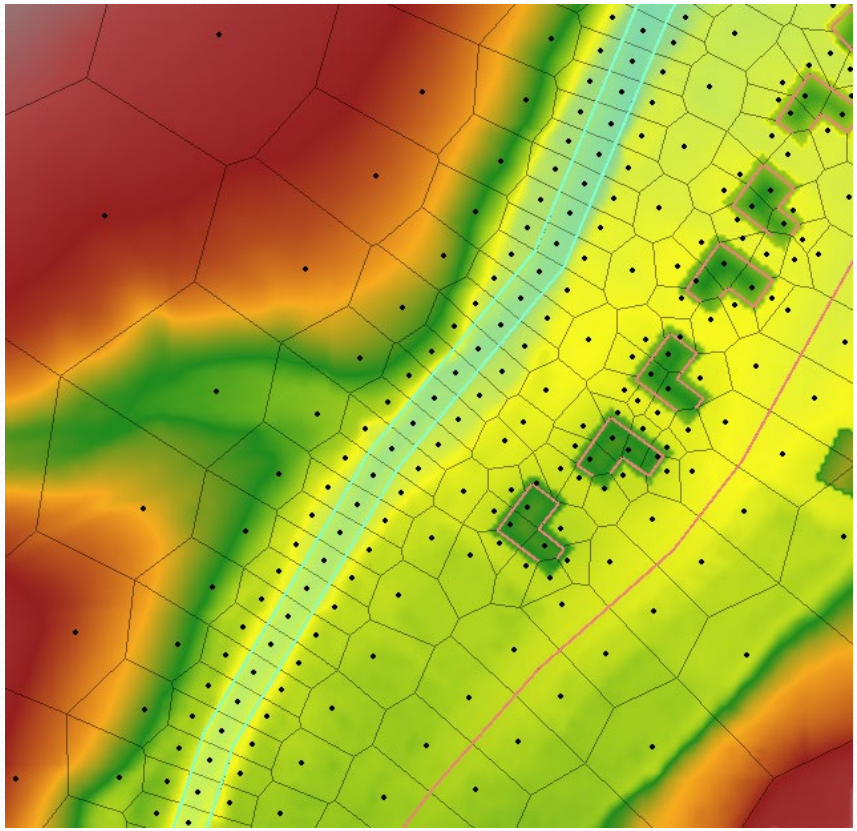


Example of addressing comments

“Check cell size for street overflow”.

Cell size decreased and breaklines added for overflow area.

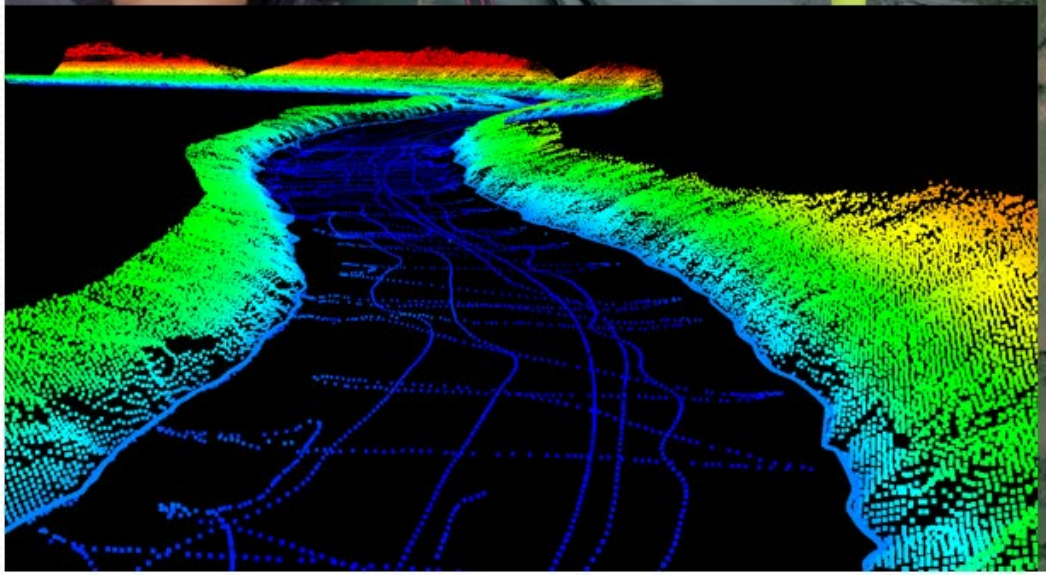




This example is in Pulaski County

USACE Bathymetry Data received

Riverine bathymetry refers to the measurement and mapping of the depth of rivers and lakes



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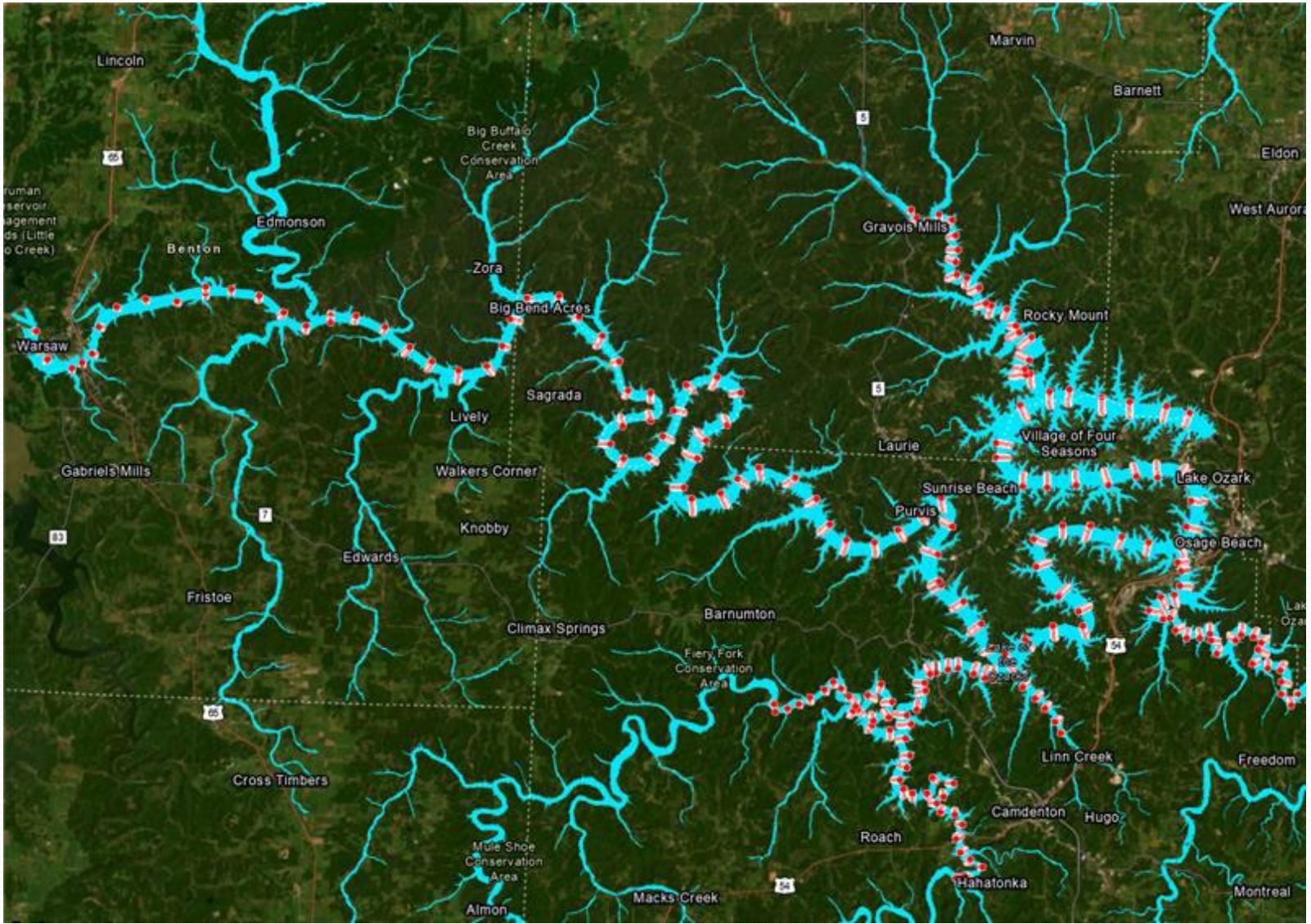
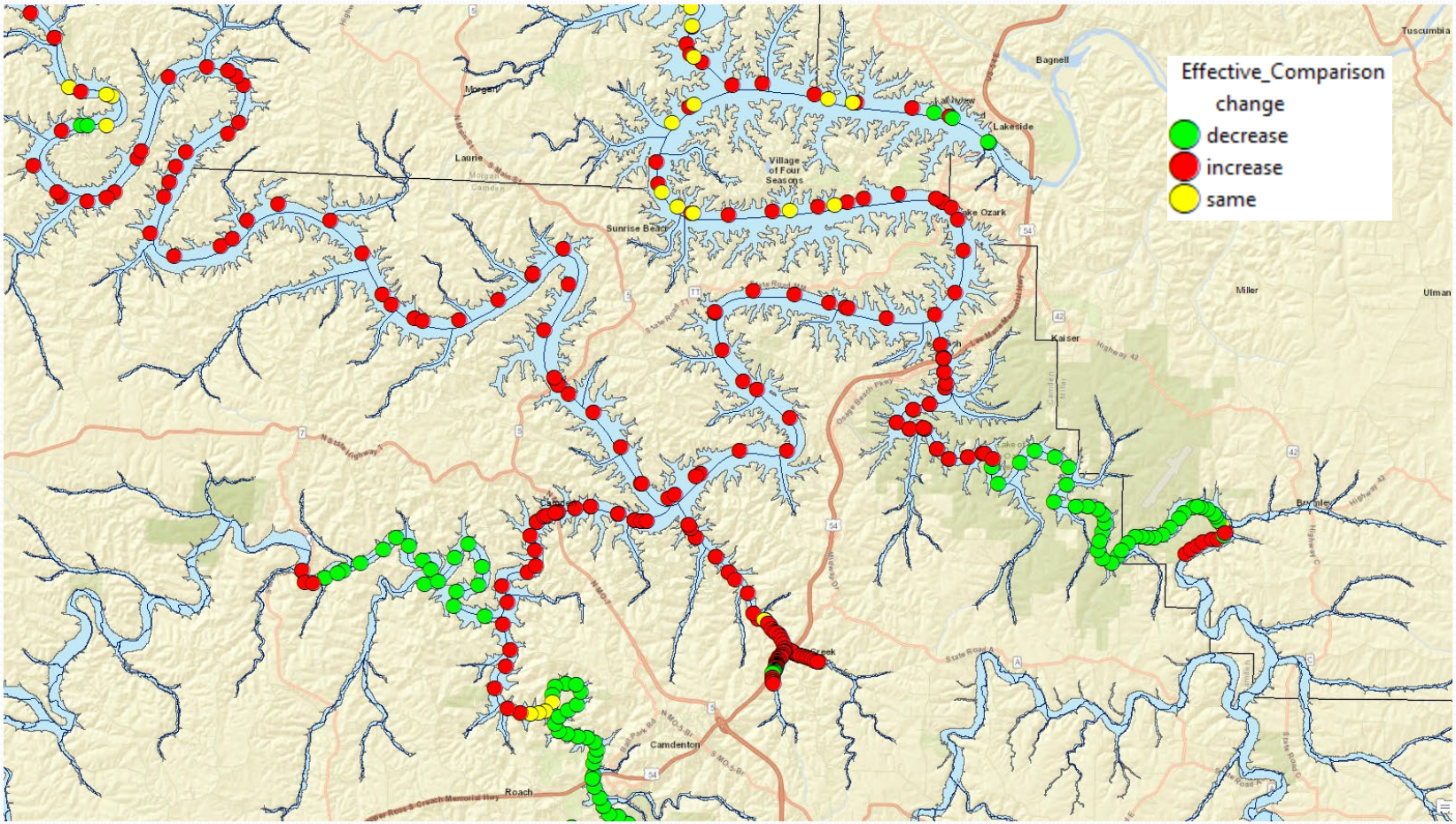
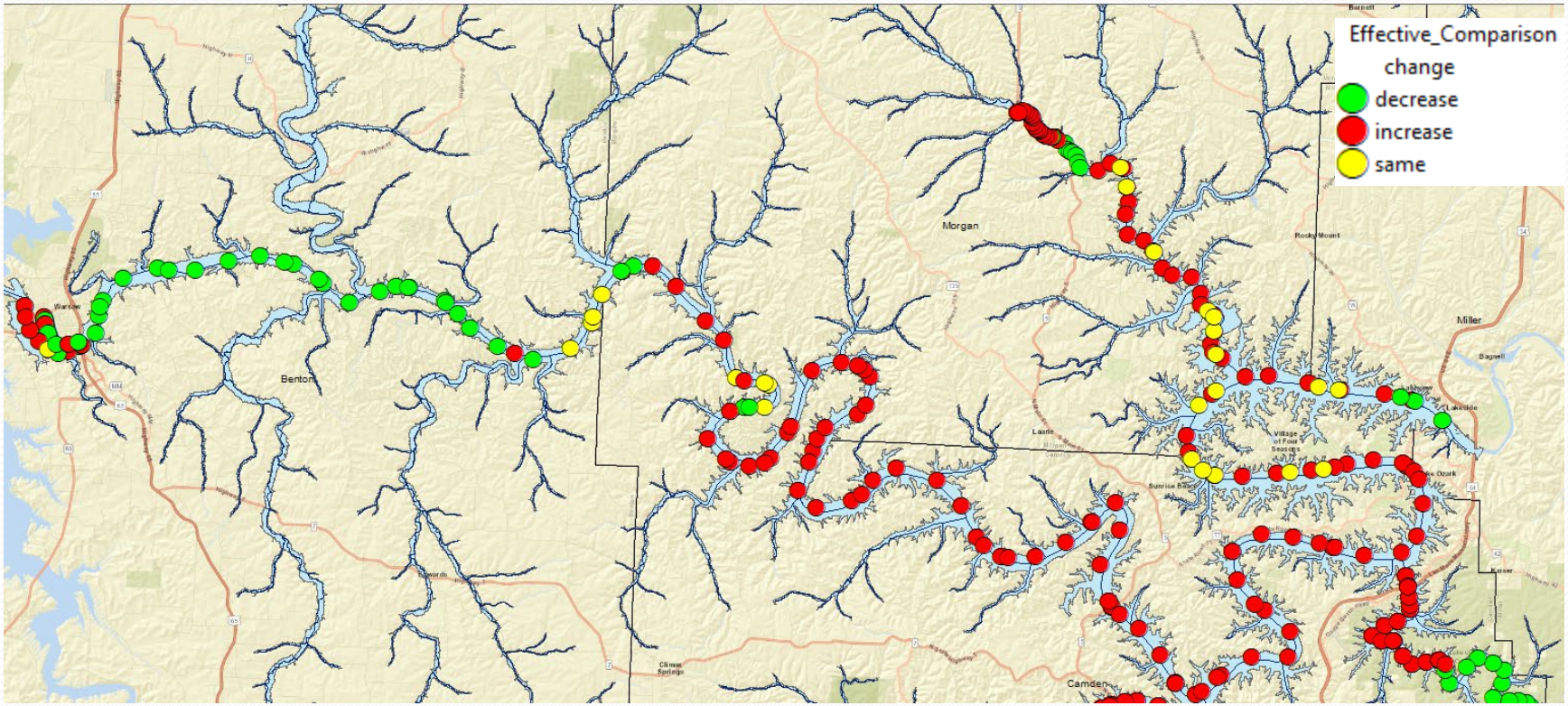


Changes in Lake Elevation



Changes in Lake Elevation



Flood Risk Review Meeting

What is the purpose of a Flood Risk Review Meeting?

- Why do we do this work?
  - It is so we can update your communities' flood risk and assessment data.
- Why has this County been selected?
  - Many of the communities previously mapped by the National Flood Insurance Program (NFIP) have information on their DFIRM maps that are over 30 years old.
  - Better data and science is available to produce more accurate flood data, and provide better data to communicate risk..
- Why are you important to this process?
  - You understand the flood risk across the county
  - Your experience and knowledge increases the value of the data

30-Day Comment Period

30-Day Comment Period Flood Risk Review Meeting

- We want your input on these maps.
  - This is your opportunity to have a say in what the end results look like and the best opportunity to achieve those changes by front porch conversations
  - <u>If you provide us feedback at this stage, we can and will work with you to address your concerns and incorporate them into the models.</u>
  - The 30-day comment period begins today.

Some Items to Review

- Hydroconnectors
- Breaklines
- Areas that flood that are not within flood risk plotted areas.
- Areas plotted within flood risk areas that do not flood.
- Points of highwater for a particular previous flood event.

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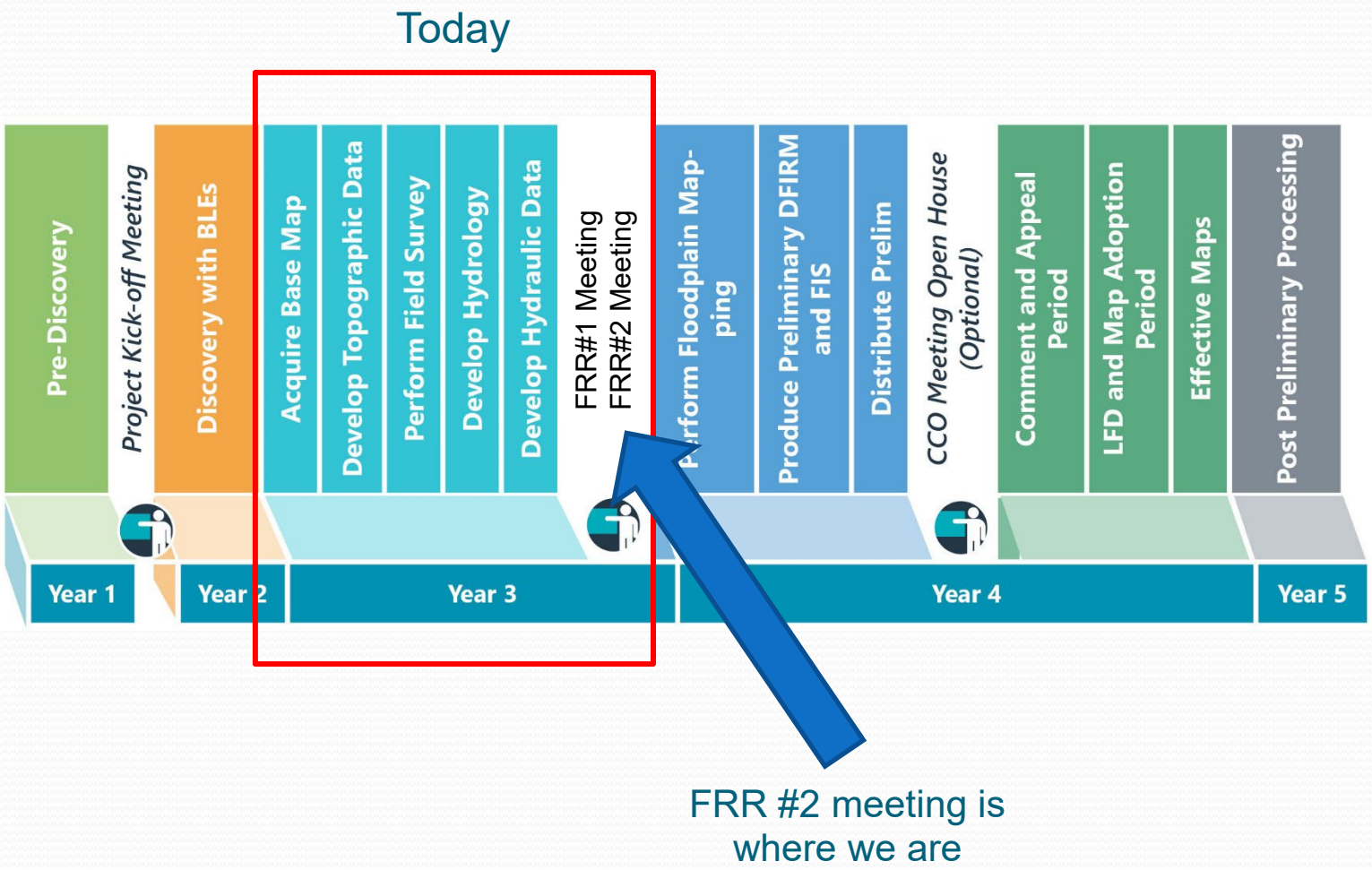
Where We're Going!

Future tasks to complete the project:

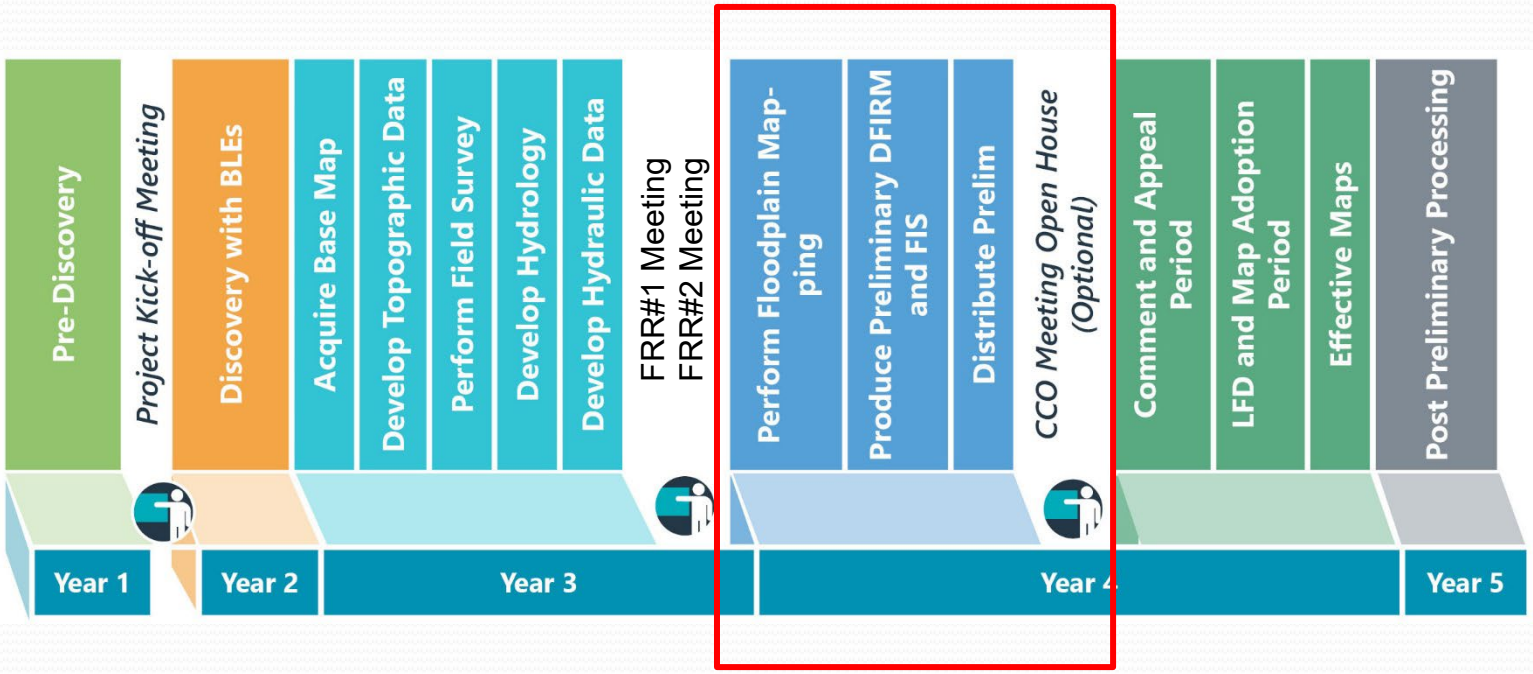
- Develop the draft FIRM database (*Summer 2025*)
- Preliminary Flood Insurance Rate Map (FIRM) and Flood Insurance Study (FIS) Production (*Fall 2025/Winter 2026*)
- Hold CCO Meeting *(**front porch opportunities closing**) (Spring 2026)*
- Begin Formal Appeal Process (**front porch over**) (*Summer 2026*)
- Letter of Final Determination (LFD) issued and formal ordinance and map adoption begins (*Winter 2026*)

Still lots of opportunities to change the data….

Life Cycle of a Floodplain Mapping Project

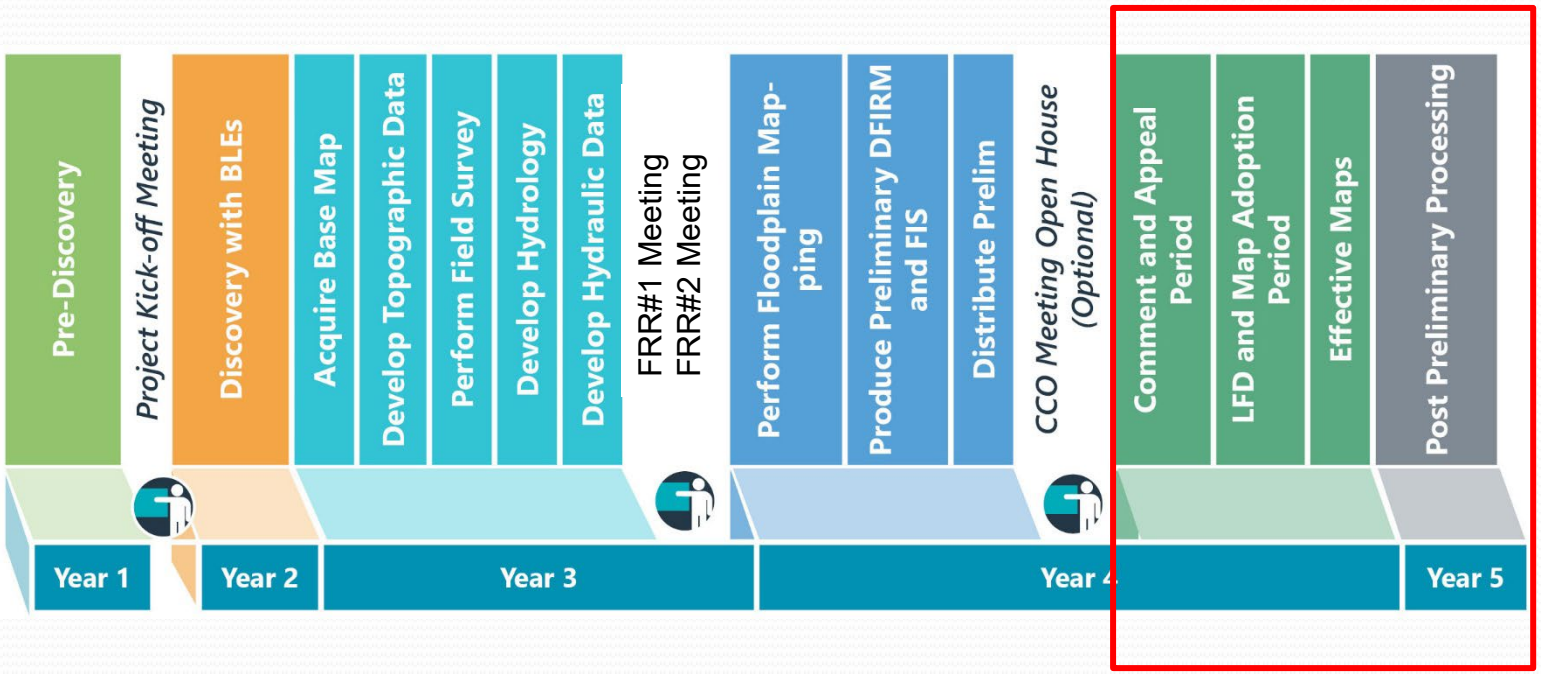


Preliminary Map Products and Communications



Fall 2025 and Winter 2025/2026

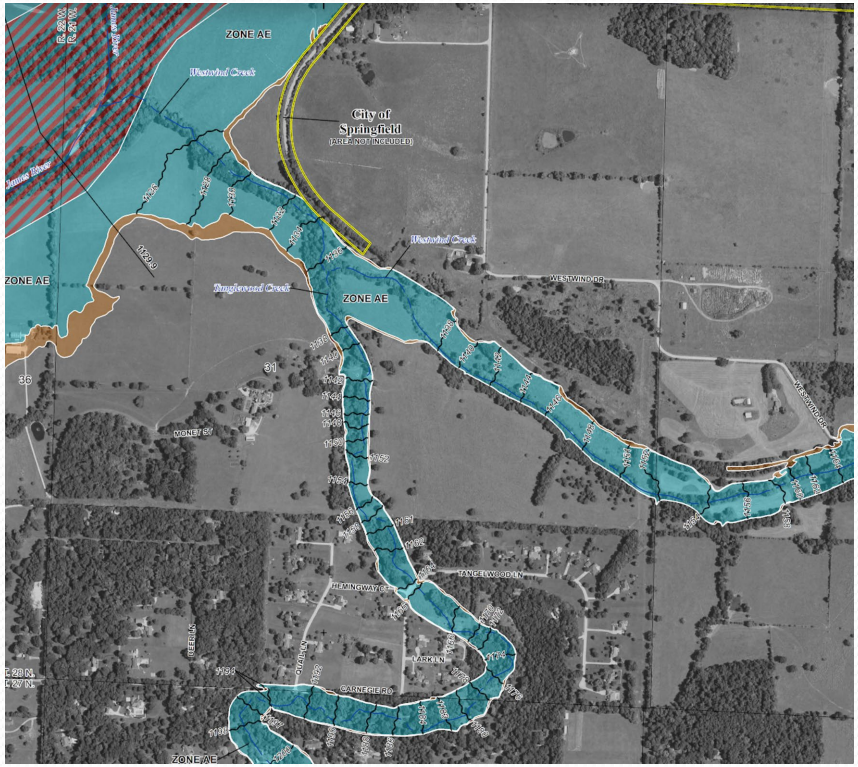
Post Preliminary Process Meetings and Communications



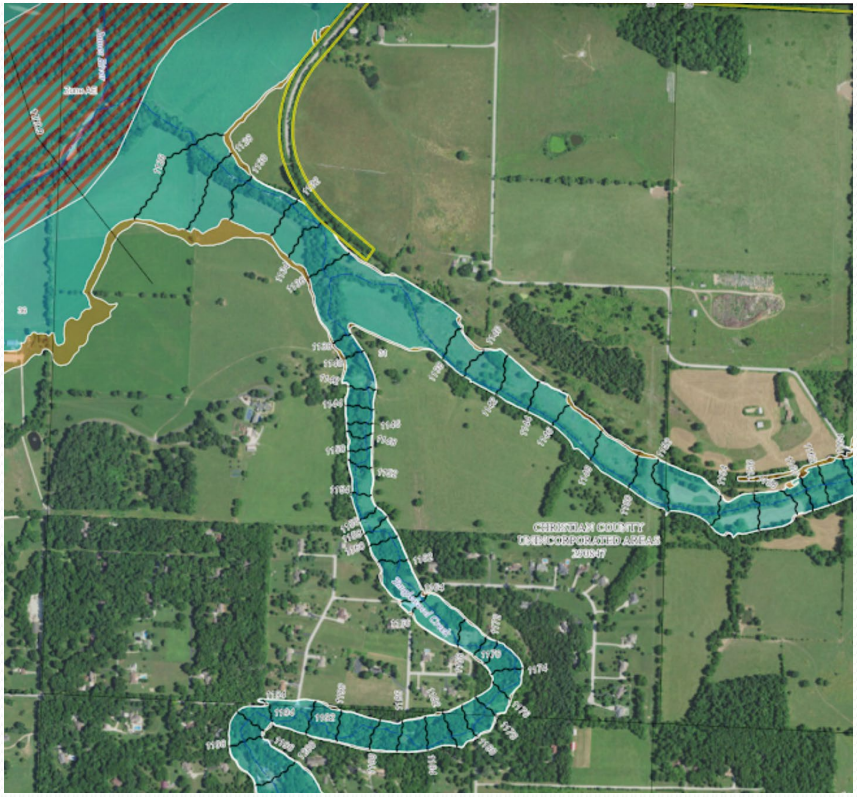
Summer 2026

Automated Map Production (AMP)

Traditional Example



AMP Example



Cross Sections or No Cross Sections?

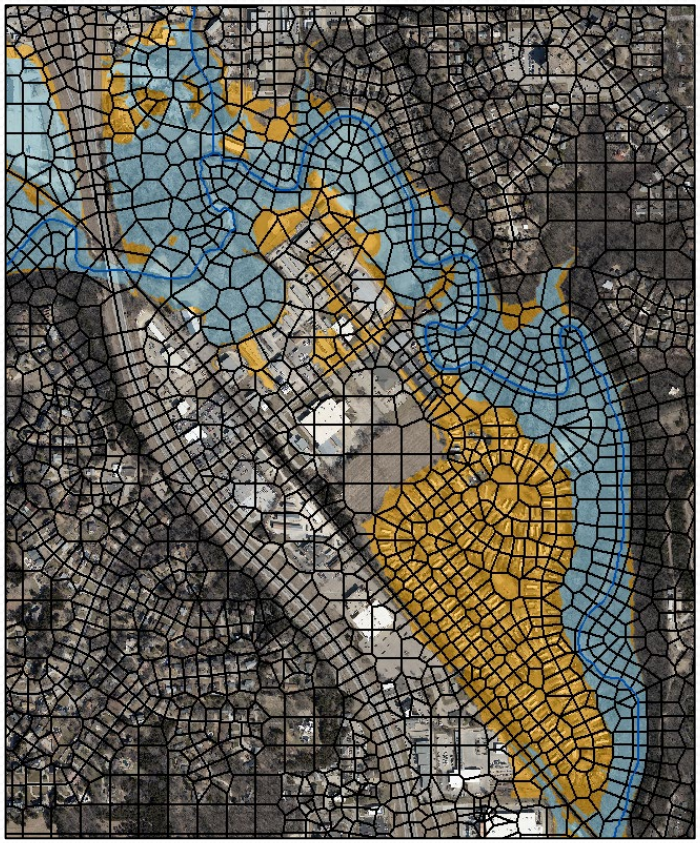
Evaluation Lines are the new Cross Sections

- WSEL Contours of shorelined SFHA
- Density depends on slope of WSEL and mapping standards.
- Minimum is to have an evaluation line no further apart than 1” of map scale (500 to 1000 ft).

Evaluation Lines

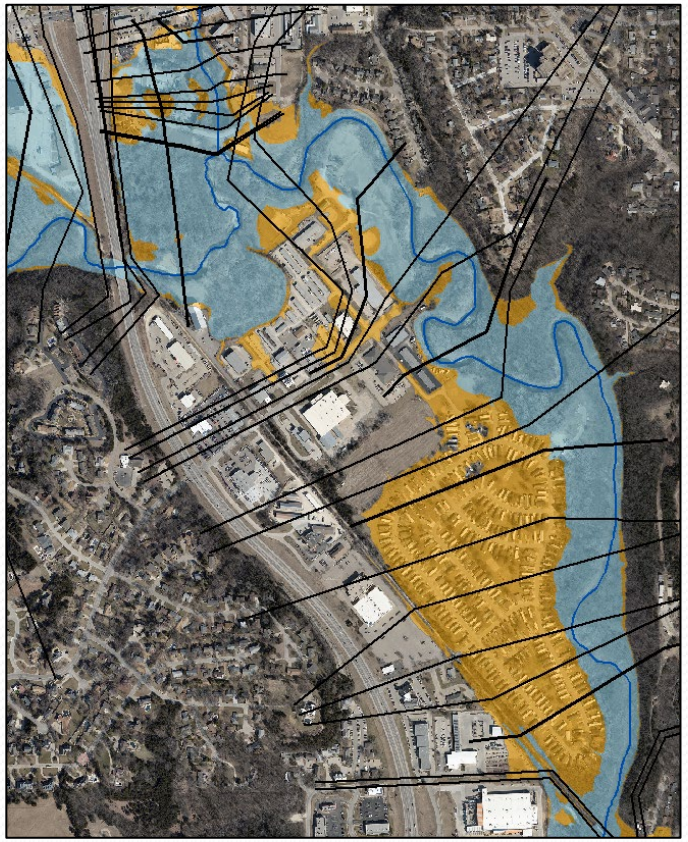
2D to Regulatory

No cross-sections like we have in 1D
Interconnected Cells and Cell Faces



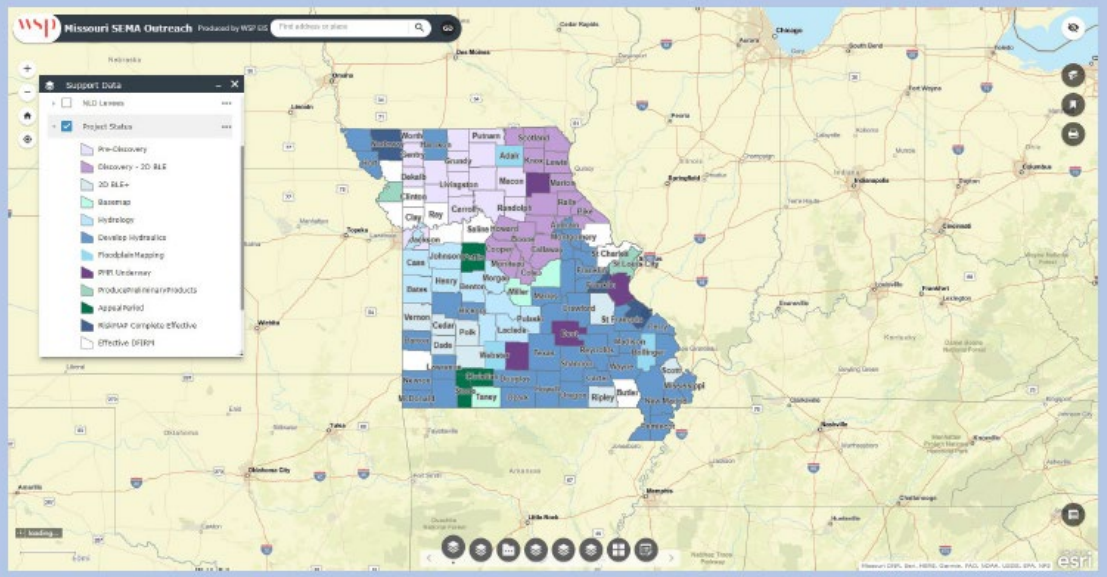
Vs.

Cross-sections are the modeling base unit.
Can be incorporated directly into the regulatory maps



Reviewing the Updates

User Guide:
Missouri SEMA Outreach Site



We're sending this user guide to help navigate how to review your updated data…..

Flood Risk Data Review Process

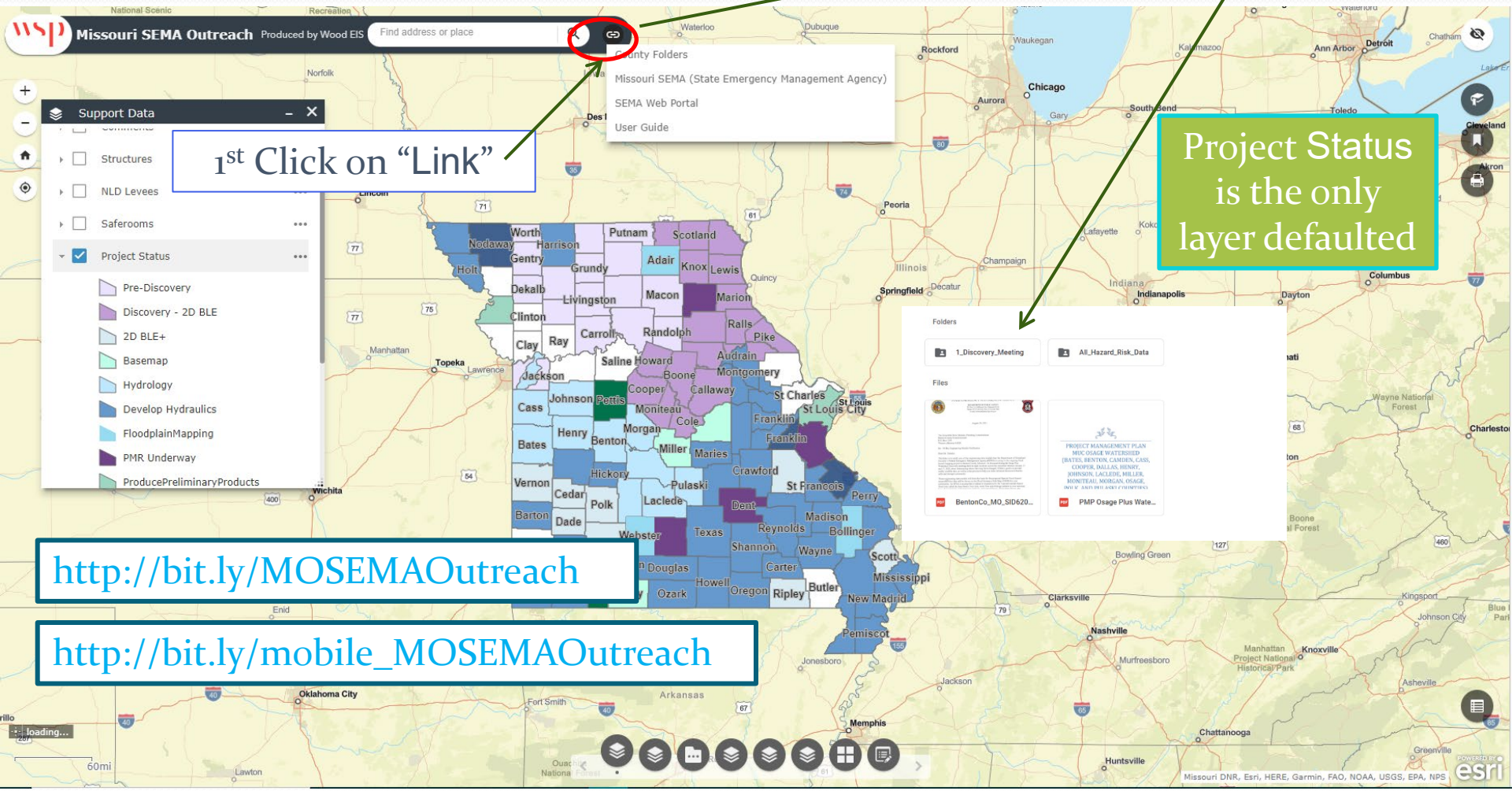
- We want your input on these maps.
  - This is your opportunity to have a say in what the end results look like and the best opportunity to achieve those changes by front porch conversations
  - If you provide us feedback at this stage, we can and will work with you to address your concerns and incorporate them into the draft flood risk data!
  - The 30-day comment period begins today.
  - You'll receive a SID 621 letter stating the actual ending date for comments, which should be in April.

Some Items to Review

- Hydroconnectors
- Breaklines
- Areas that flood that are not within flood risk plotted areas.
- Areas plotted within flood risk areas that do not flood.
- Points of highwater for a particular previous flood event.
- Changes that occurred with the 6.0 model updates.

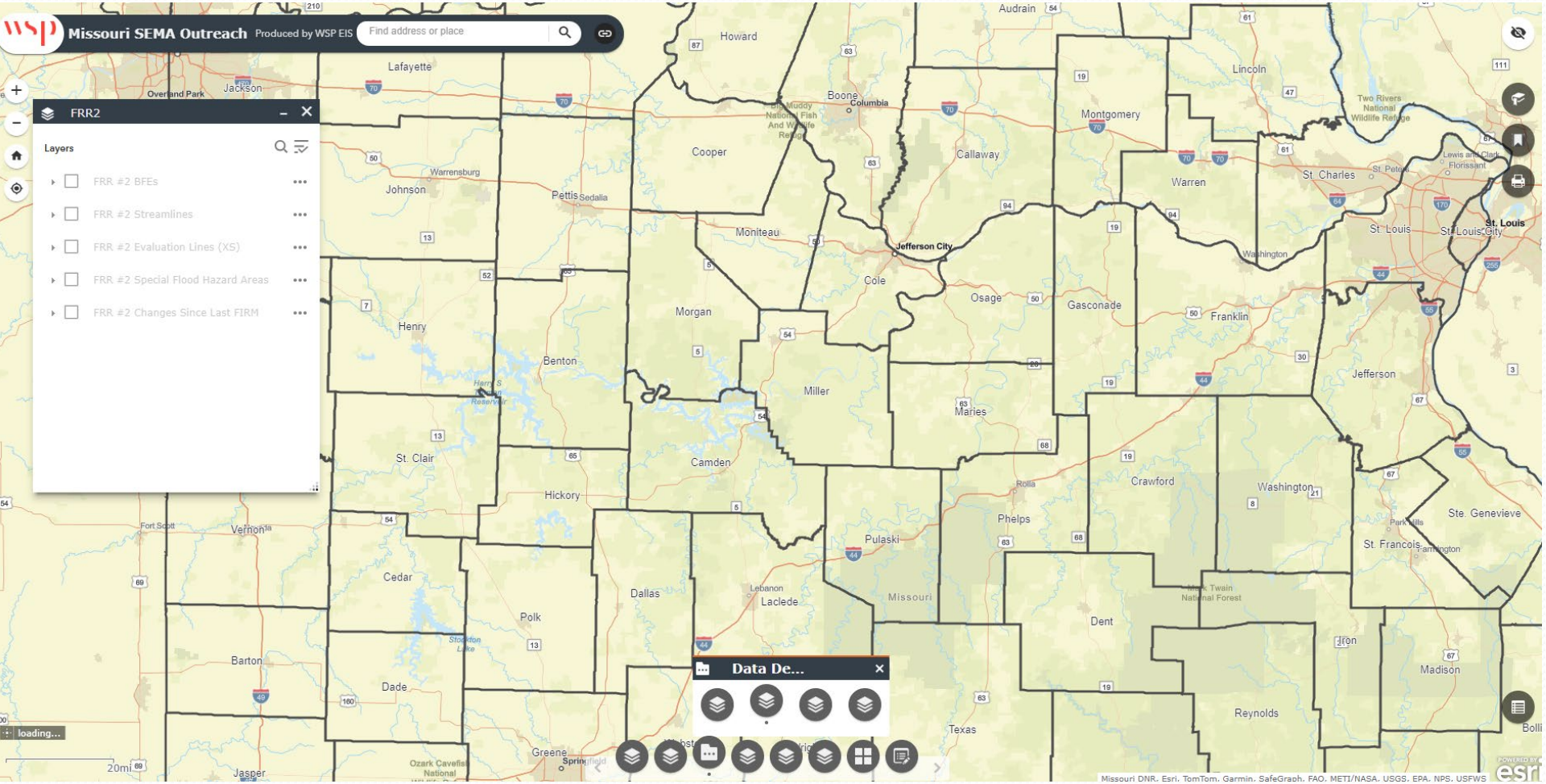
Some Tools to Assist with Communications

Outreach Website



FRR#2 Data

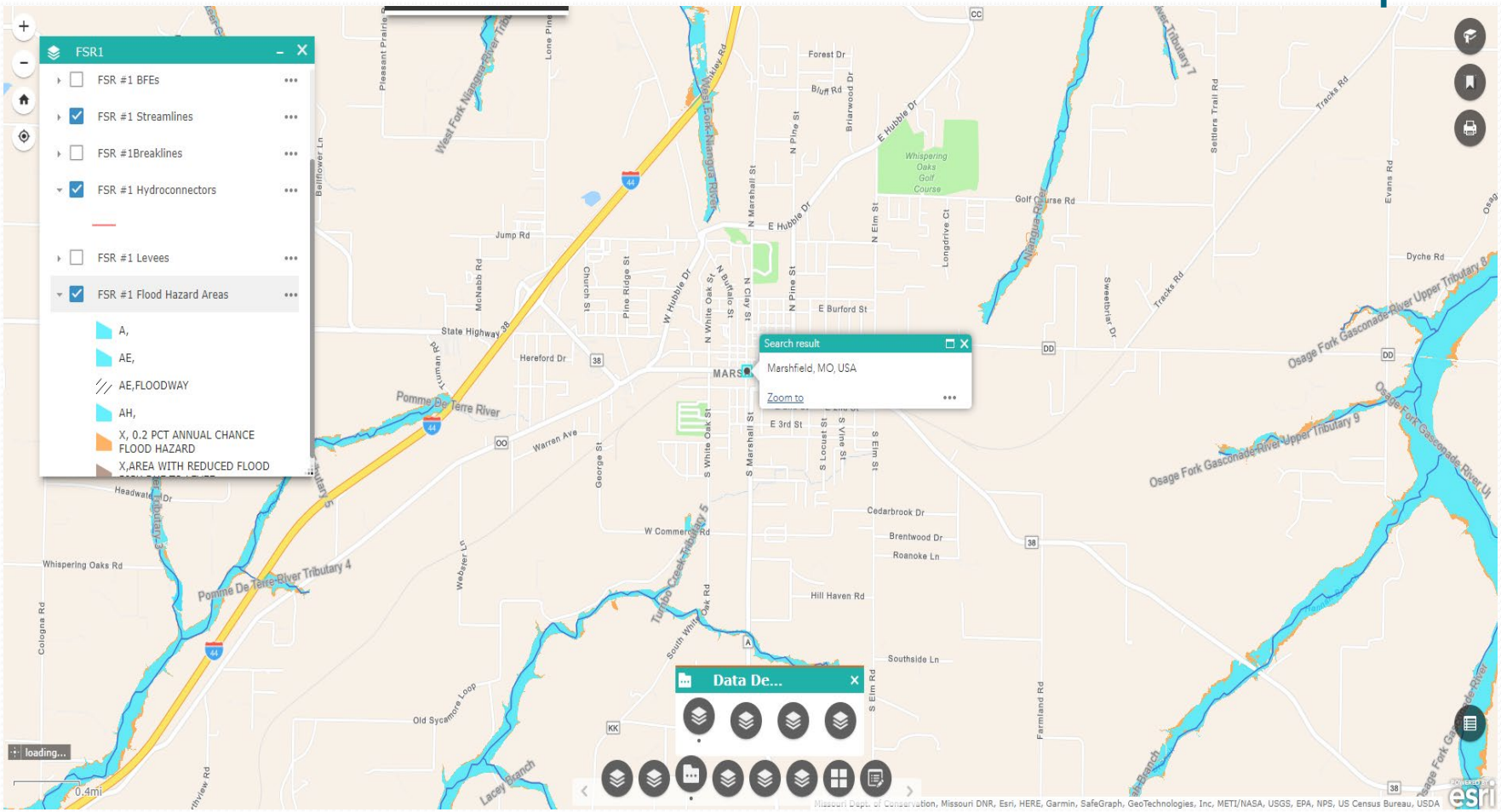
We'll demonstrate this live!



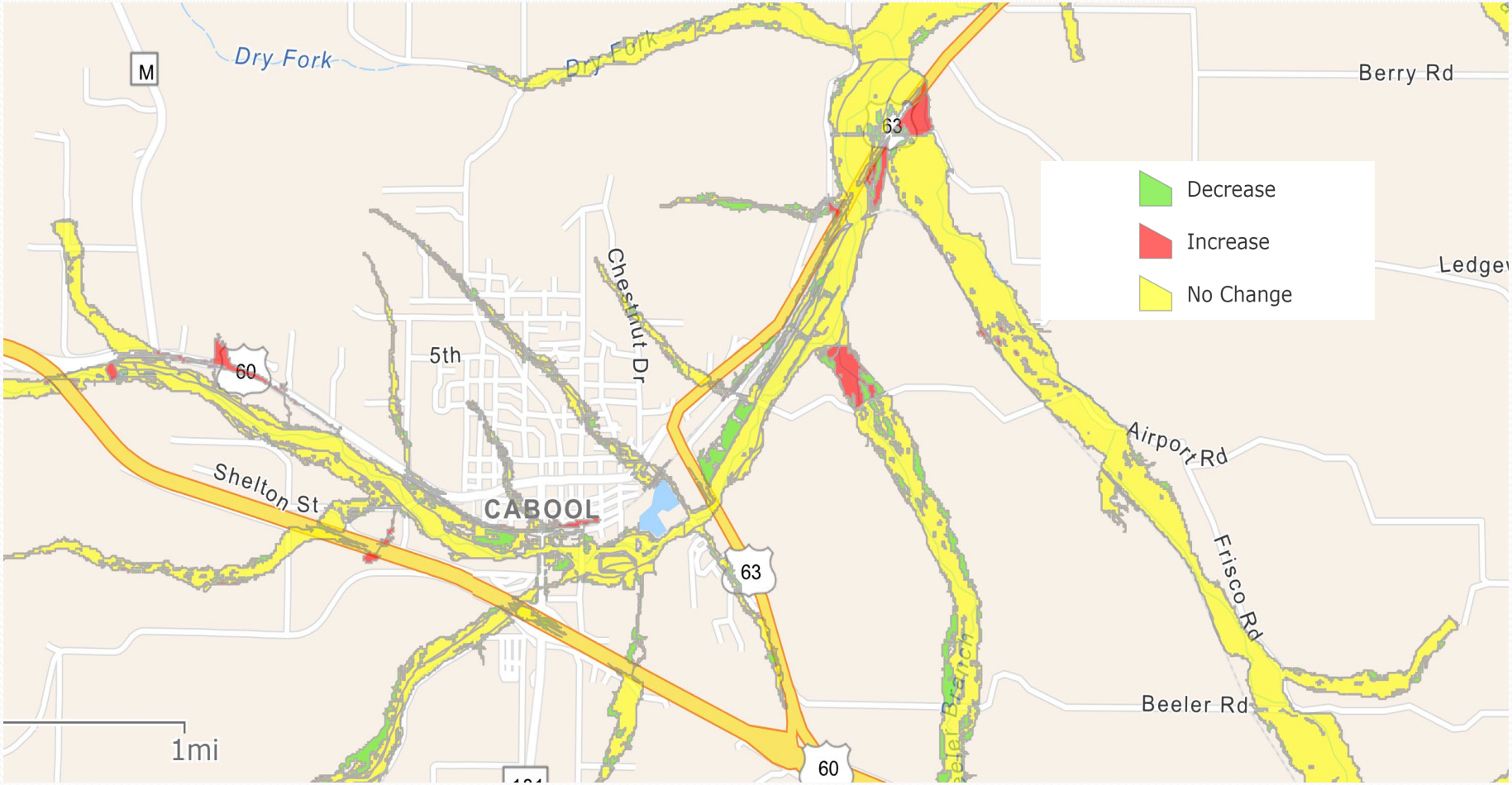
Updated Proposed SFHA

Effective Flood Risk Data to Updated Flood Risk Data

Example



Changes Since Last FIRM (CSLF)



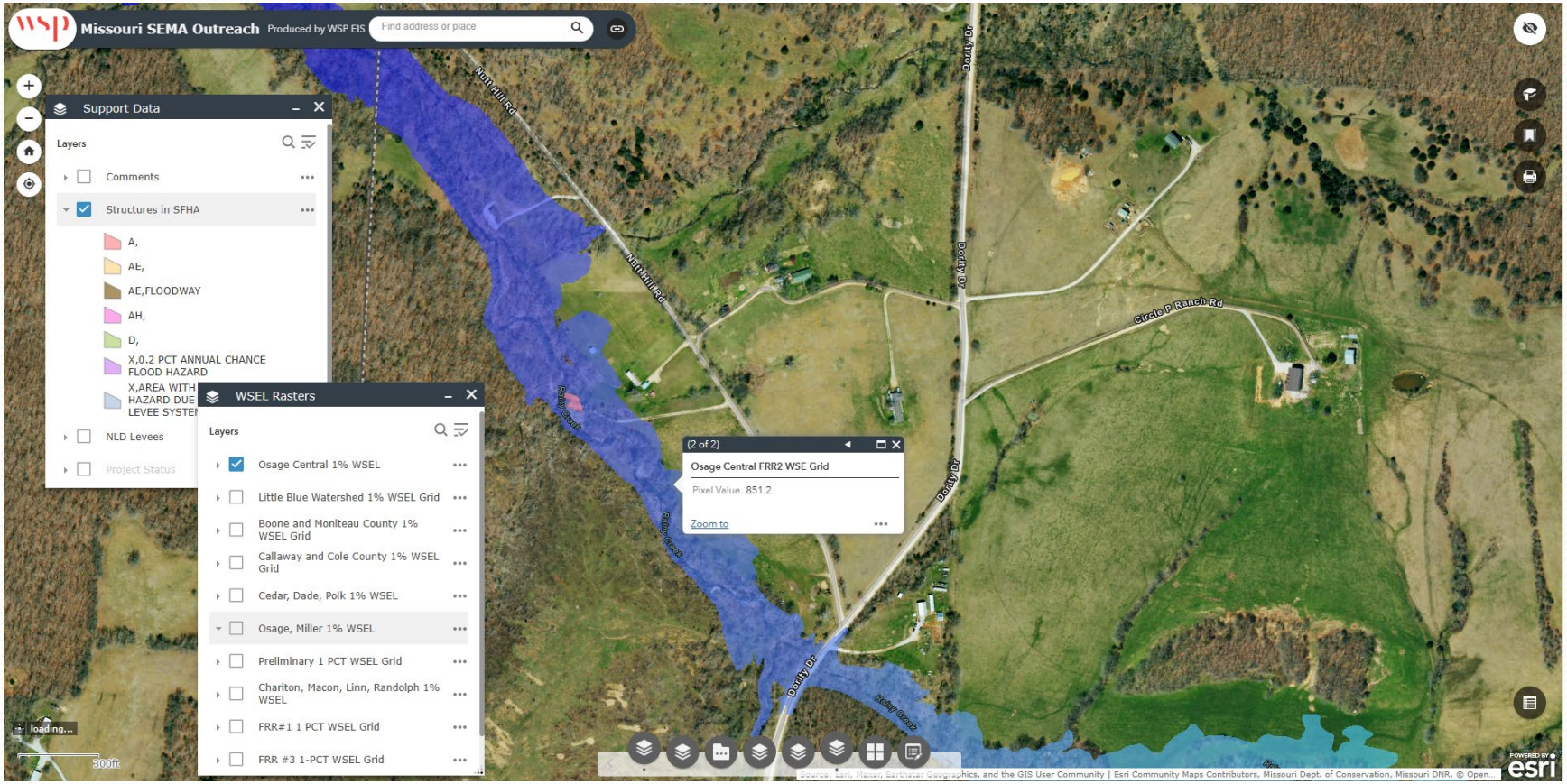
Example

Water Surface Elevations (WSELs)

Point and Click

Example

Using the WSELs



If you need assistance…..

If you need help navigating these maps via the website, please call:

Sydney Roberts at 573-526-9383,

or

Stephen Noe at 615-430-0456


QUESTIONS?
WHEN?
WHERE?
WHAT?
WHO?
HOW?
Where?
When?
Why?
What?