

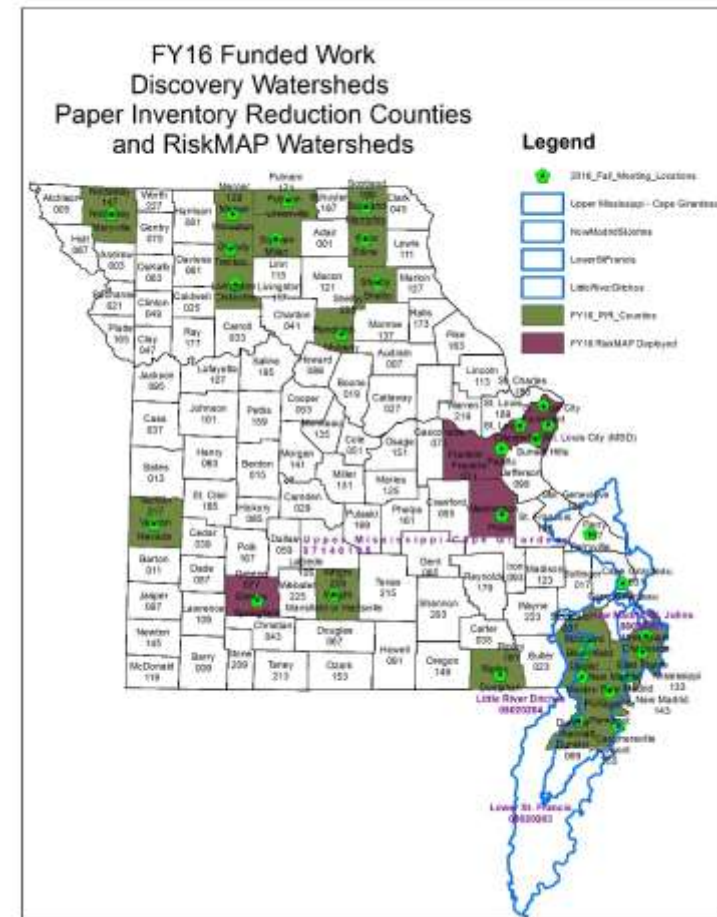
Missouri PIR Counties with Risk MAP Infusion Bootheel of Missouri

June 19, 2018

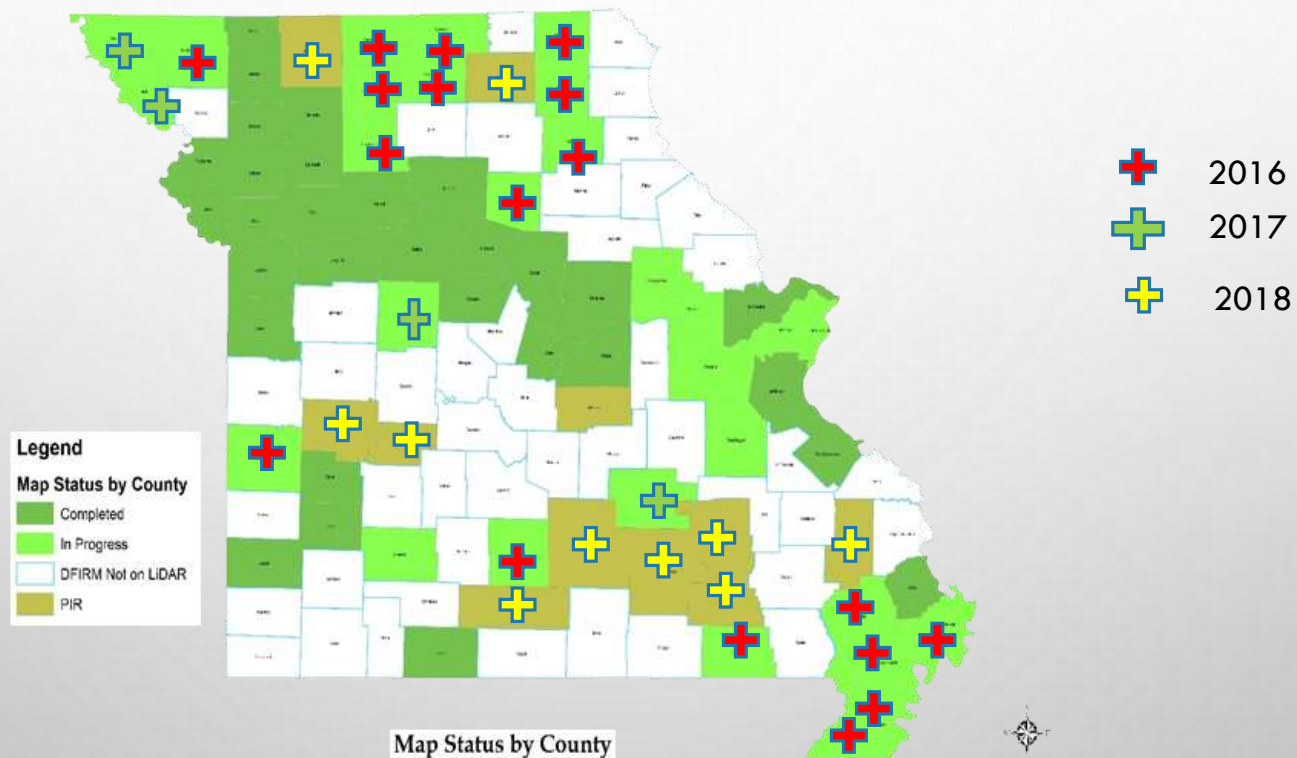
Stephen Noe, Darryl Rockfield and Patrick Bussen

Paper Inventory Reduction (PIR)

- Paper Inventory Reduction (PIR) has been a major component of the modernization philosophy of the program.
- PIR and the Modernization of paper FIRMs once again became a priority.
- These mapping projects will take 2 1/2 to 4 years to complete depending on Levees.



PAPER INVENTORY REDUCTION



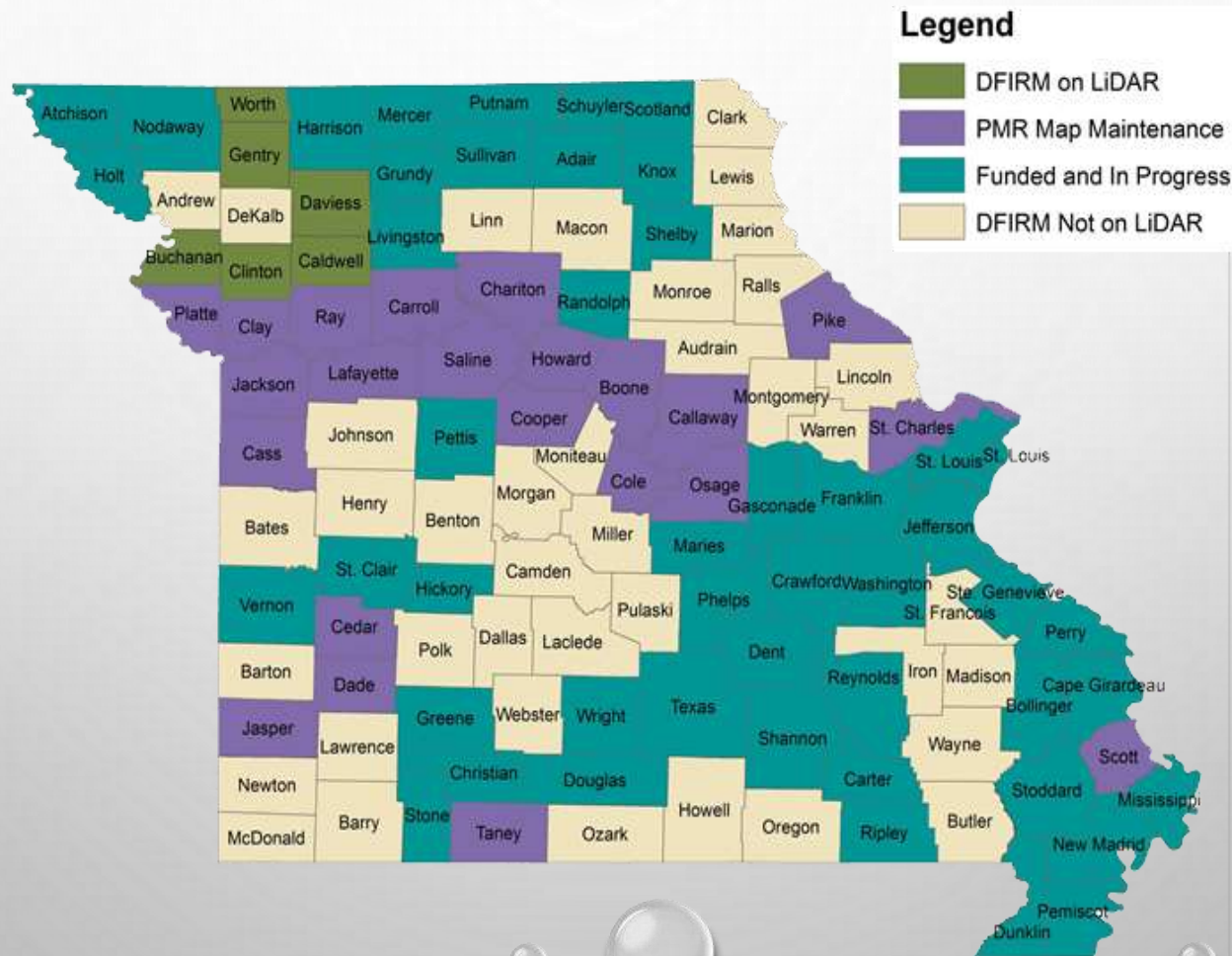
- Path to Statewide Map Maintenance
- Priority Projects
 - PIR
 - Map Modernization not on LiDAR
 - Risk MAP on LiDAR needing Map Maintenance
 - USGS 3-DEP Compliant Topography
 - Teaching Stakeholders how to “Fish” in the Risk MAP Pond

RISK MAP PROGRAM
2018
COMBINED STRATEGIC COMS AND
BUSINESS PLAN

**THE MISSOURI STATE
EMERGENCY MANAGEMENT AGENCY**



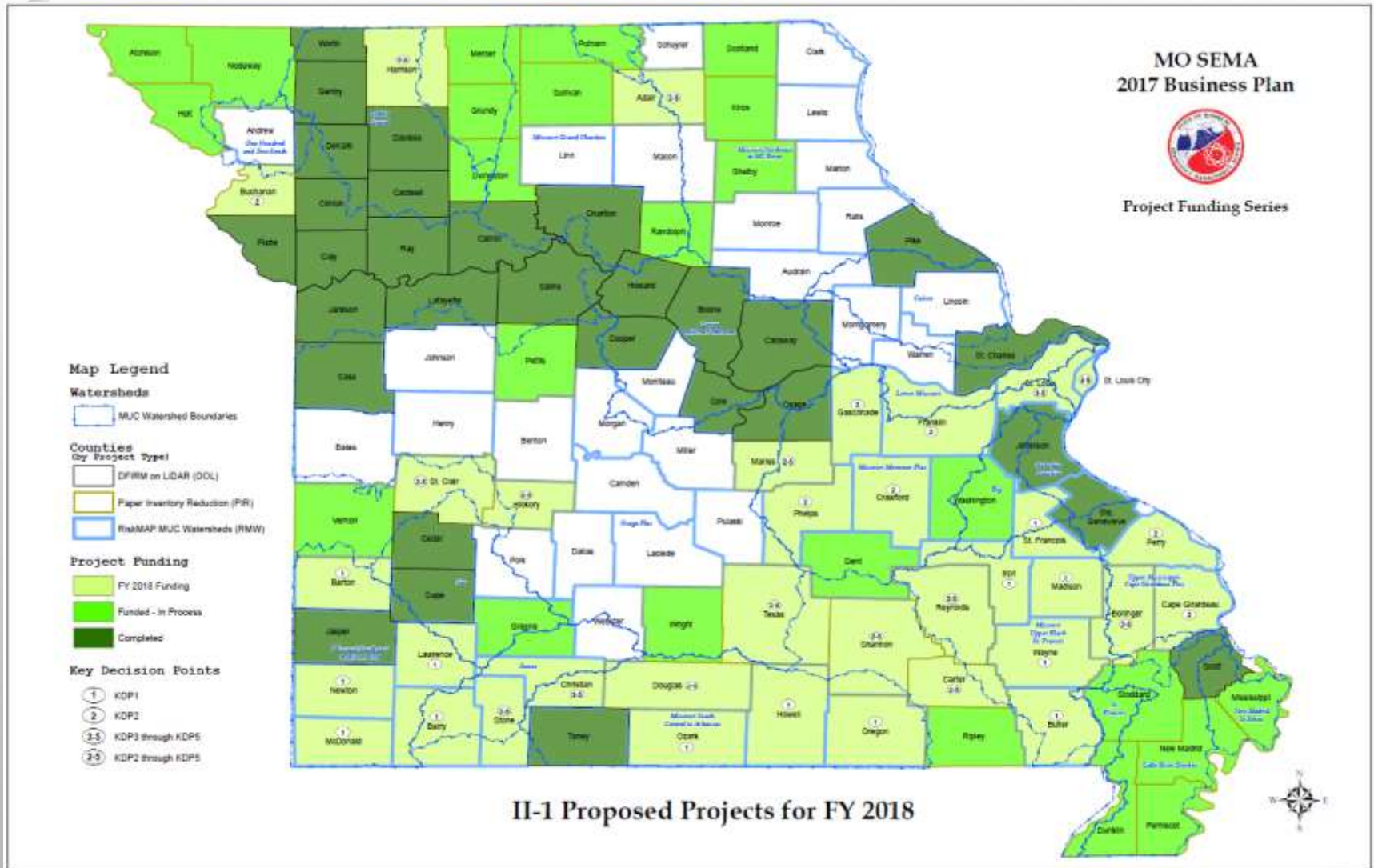
Status through requested 2018 Funding



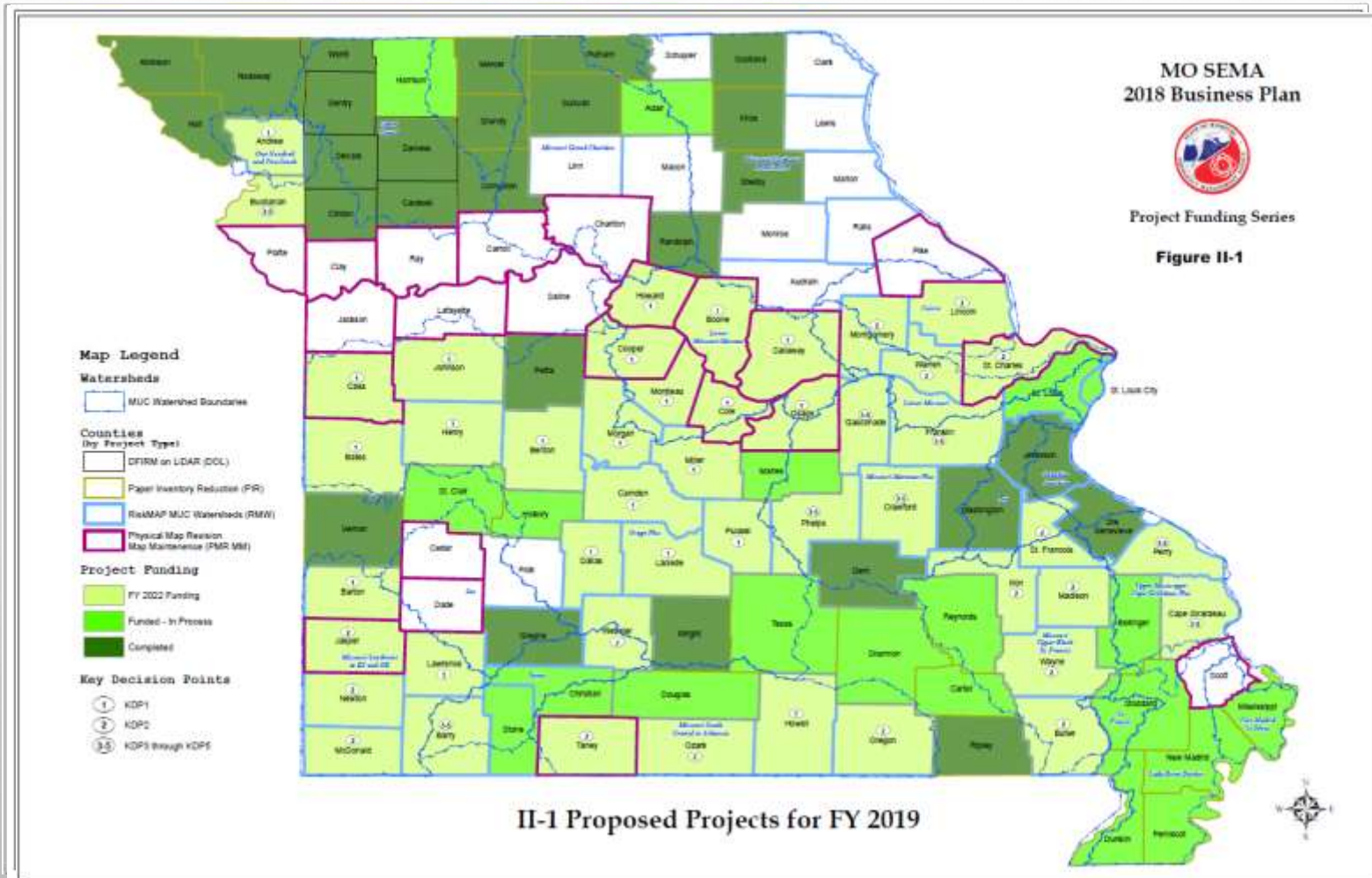
MISSOURI HYDROLOGIC UNIT CODES (MUC)



Missouri's Road to Map Maintenance




Missouri's Road to Map Maintenance




Persuasion (Beyond NFIP)

LFD and Map Adoption Period



Joining the National Flood Insurance



Joining the National Flood Insurance Program

(Unmapped Community)

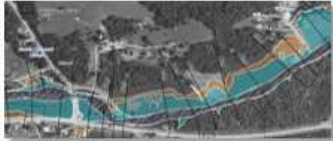
2017-2018


What is My Community's Role?

When a community chooses to join the NFIP, it must adopt and enforce minimum floodplain management standards for participation. The floodplain management requirements within the SFHA are designed to prevent new development from increasing the flood threat and to protect new and existing buildings from anticipated flood events. See Title 44 of the Code of Federal Regulations (44 CFR) section 60.3 for additional details.

A community must require permits for all development in the SFHA and ensure that construction materials and methods used will minimize future flood damage. Permit files must contain documentation to substantiate how buildings were actually constructed.

Communities must also ensure that their adopted floodplain management ordinance and enforcement procedures meet program requirements. Local regulations must be updated when additional data is provided by FEMA or when Federal or state standards are revised.





Joining the National Flood Insurance Program

(Mapped County without Planning and Zoning Regulations)

2017-2018

What is the NFIP?

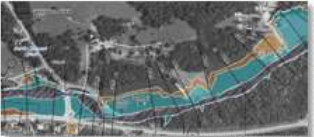
In 1968, the U.S. Congress established the National Flood Insurance Program (NFIP) to:

- Lessen future flood losses nationwide through sound, community-enforced floodplain management practices; and
- Provide access to affordable, federally backed flood insurance protection for property owners.

The NFIP is based on an agreement between local communities and the Federal Government stating that if the community will adopt and enforce a floodplain management ordinance to reduce future flood risks to new construction in Special Flood Hazard Areas (SFHAs), the Federal Government will make flood insurance available within the community.

What is a Special Flood Hazard Area?

In support of the NFIP, the Federal Emergency Management Agency (FEMA) identifies flood hazard areas throughout the United States and its territories. The SFHA is a high-risk flood hazard area defined as any land inundated by a flood having a 1-percent chance of occurring in a given year (also referred to as the base flood). Regulation within this high-risk-area constitutes a reasonable compromise between the need for building restrictions to minimize potential loss of life and property and the economic benefits to be derived from floodplain development.

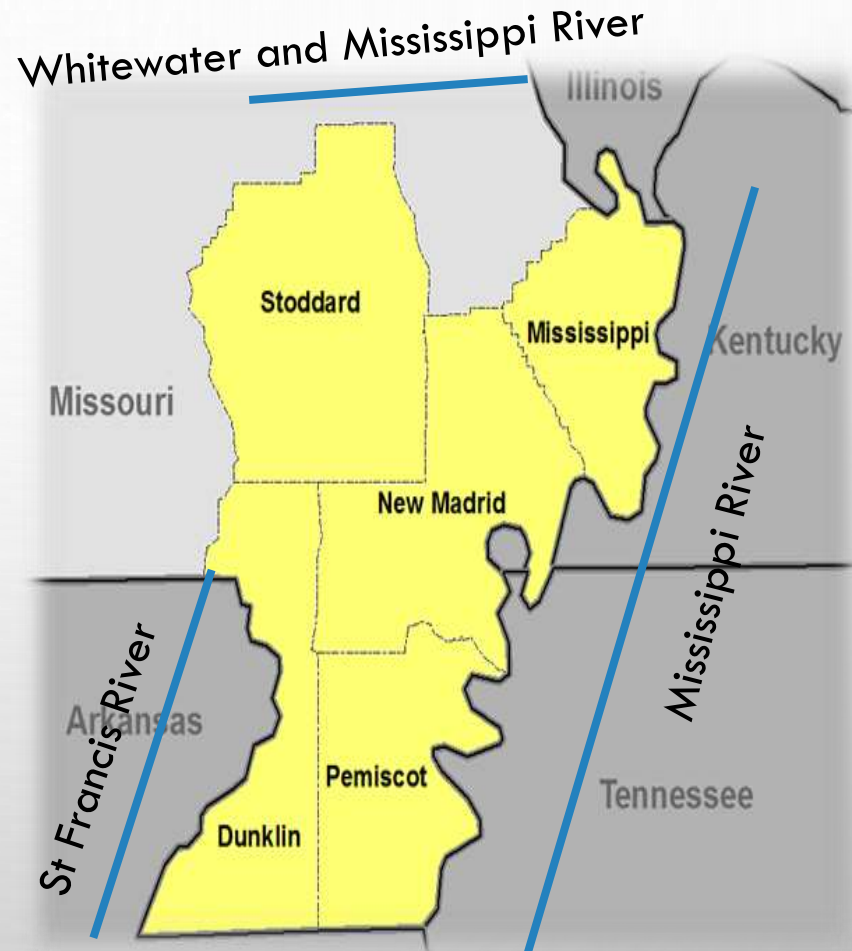


Joining the NFIP

- SEMA has developed brochures for you that address where the community is in the Adoption Process:
 - Participating
 - Joining Mapped
 - Joining Never Mapped
 - Joining No Planning and Zoning
- SEMA Staff helps them though each part of the process

BOOTHEEL AREA

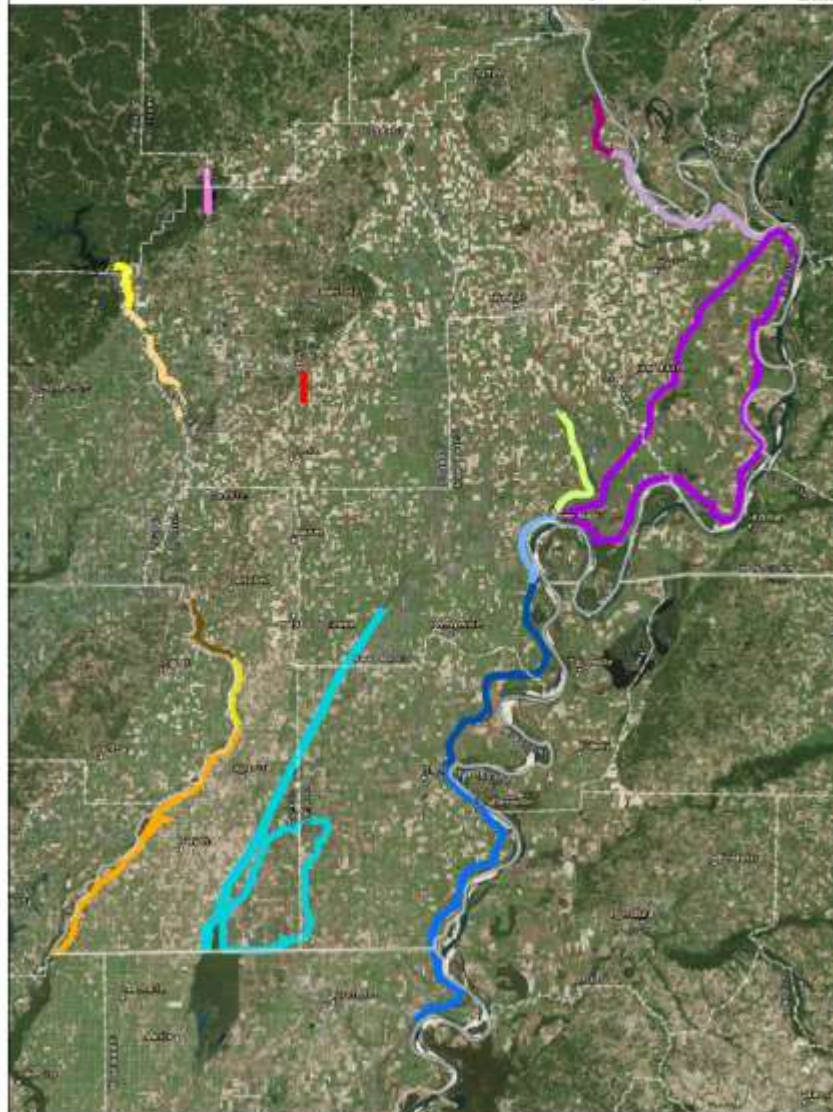
- **Bordered by the Mississippi River on the east**
- **Bordered by the St. Francis River on the west**
- **Bordered by the Little River Headwater Diversion Levee to the north**
- **Covering approximately 3,014 square miles plus another 900 Square Miles draining to the area**



TURNING THE MS RIVER LOOSE

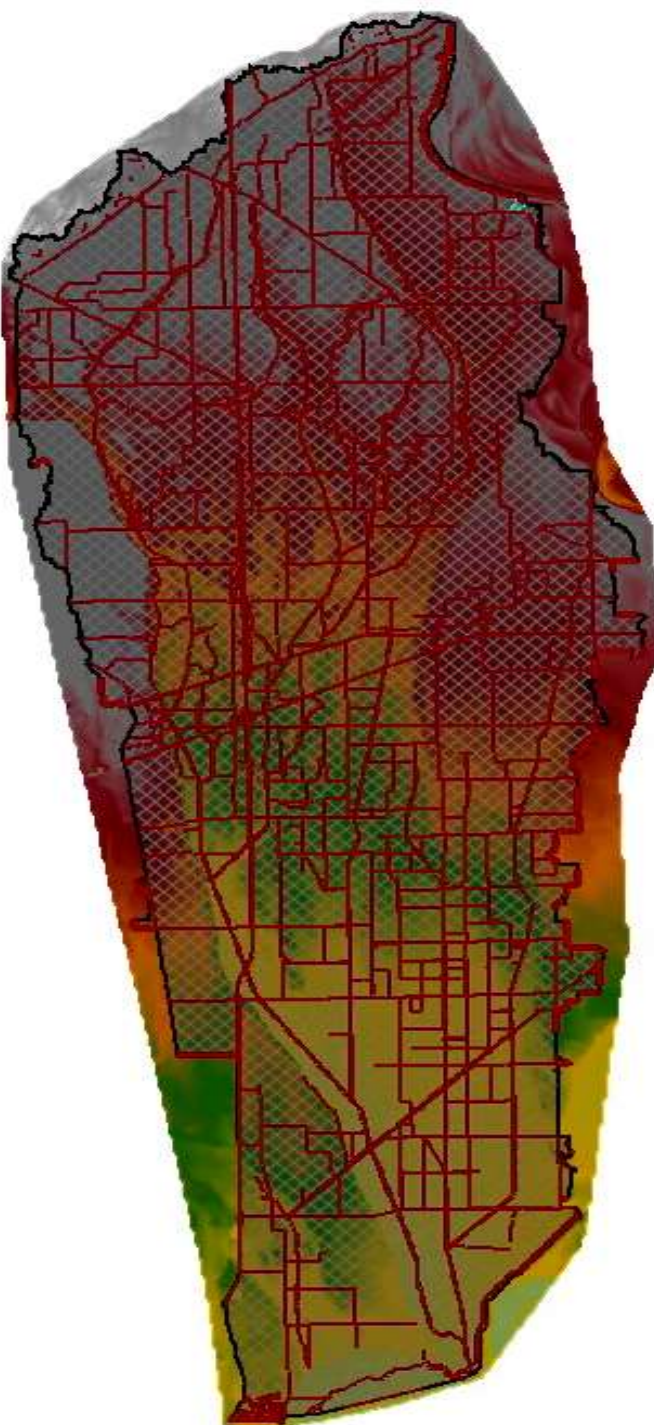
Bootheel, Missouri - No-Levee Scenario Breakouts

- | | | |
|------------------------------|------------------------------|-----------------------------------|
| Mississippi River No-Levee 1 | Mississippi River No-Levee 6 | St. Francis River No-Levee 5 |
| Mississippi River No-Levee 2 | St. Francis River No-Levee 1 | Elk Chute / Little River No-Levee |
| Mississippi River No-Levee 3 | St. Francis River No-Levee 2 | New Madrid No-Levee |
| Mississippi River No-Levee 4 | St. Francis River No-Levee 3 | Hill Diversion No-Levee |
| Mississippi River No-Levee 5 | St. Francis River No-Levee 4 | Dexter Airport No-Levee |

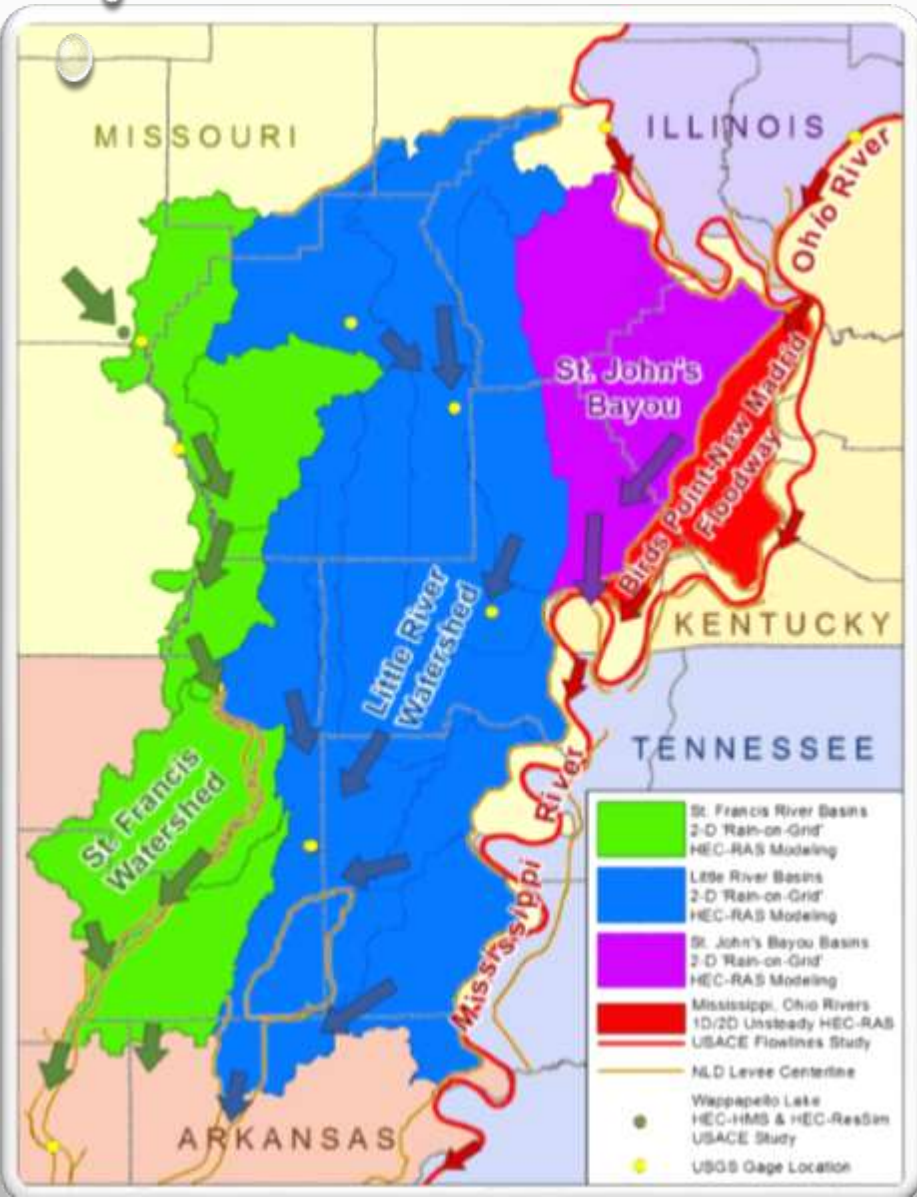


wood.

WITHOUT 1 SECTION OF LEVEE

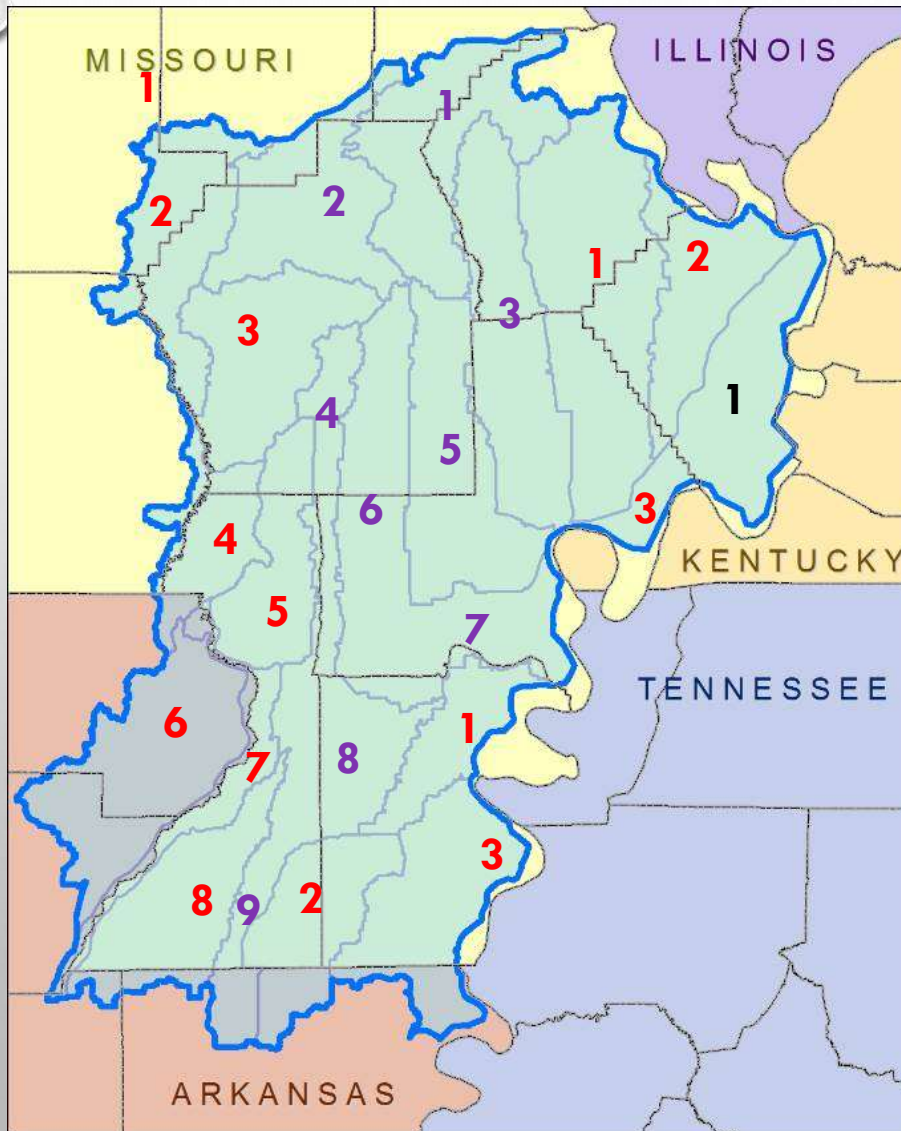


MULTIPLE WATERSHEDS



- **More dredging than in Panama Canal**
- **100's of Drainage Districts**
- **15 plus Levee Districts**
- **5 States**
- **4 FEMA Regions**
- **3 USACE Districts**

MODELS MODELS AND MODELS



- OVER LAPPING
- BACKWATER TO BACKWATER
- CROSS JURISDICTIONAL BNDYS
- ALL MODELS MOVING FORWARD TOGETHER

OUR PROJECT GOAL

We Are Mapping the Entire County!

**New Madrid County
Paper Inventory Reduction
Project Engineering
Modeling/Methods Map**

Scoped Studies

Enhanced Studies

- **Zone AE - HEC-HMS/HEC-RAS 2D**
Studies will be developed as part of this project utilizing HEC-HMS and HEC-RAS
- **Zone AH - SCS Grid Tool/HEC-RAS 2D**
Zone AH studies will be developed as part of this project using SCS Grid Tool and HEC-RAS 2D.
- **Leverage Zone AE - Gage/HEC-RAS 2D**
USACE 2017 Flowline Study will be updated for Flood Frequency Flows and incorporated into this project mapping.






















Basic Studies

- **Zone A - SCS Grid Tool / HEC-RAS 2D**
Studies will be developed as part of this project using SCS Grid Tool and HEC-RAS 2D.
- **Levee**



0 1.5 3 6 9 Miles

MAP LEGEND - MODEL/METHODS SUMMARY TABLE

Enhanced Studies – Results in an Zone AE or AH Flood Zone – Includes Bridges and Culverts				
Map Symbol	Hydrologic Model/ Method Proposed	Hydraulic Model/ Method Proposed	Rationale for Models Selected	
	Gage Analysis 	1-D Steady-State Riverine Analysis 	Hydrology -	Gage station with sufficient records to establish flood frequency flows which is the preferred method when data is available.
			Hydraulics -	Well defined riverine streams with uniform flow directions.
	Rainfall Runoff Analysis 	1-D Steady-State Riverine Analysis 	Hydrology -	Rainfall runoff model is required to account for soil infiltration, varied landuses, timing of rainfall runoff and various storage features within the area draining to the
			Hydraulics -	Well defined riverine streams with uniform flow directions.
	Regression Analysis 	1-D Steady-State Riverine Analysis 	Hydrology -	Regional regression equations are applicable to the streams being studied. The drainage features are similar to those throughout the region.
			Hydraulics -	Well defined riverine streams with uniform flow directions.
	SCS Type II Grid Hydrology	2-D Riverine Analysis 	Hydrology -	Flat areas with minimal slope for drainage with various depressions
			Hydraulics -	Interconnected channels/ditches with Top of Bank berms of varying heights above natural ground.
Basic Studies - Studies – Results in a Zone A Flood Zones – Without Bridges and Culverts				
Map Symbol	Hydrologic Model/ Method Proposed	Hydraulic Model/ Method Proposed	Rationale for Models Selected	
	Gage Analysis 	1-D Steady-State Riverine Analysis 	Hydrology -	Gage station with sufficient records to establish flood frequency flows which is the preferred method when data is available.
			Hydraulics -	Well defined riverine streams with uniform flow directions.
	Rainfall Runoff Analysis 	1-D Steady-State Riverine Analysis 	Hydrology -	Rainfall runoff model is required to account for soil infiltration, varied landuses, timing of rainfall runoff and various storage features within the area draining to the
			Hydraulics -	Well defined riverine streams with uniform flow directions.
	Regression Analysis 	1-D Steady-State Riverine Analysis 	Hydrology -	Regional regression equations are applicable to the streams being studied. The drainage features are similar to those throughout the region.
			Hydraulics -	Well defined riverine streams with uniform flow directions.
Static Elevations for Lakes				
Map Symbol	Hydrologic Model/ Method Proposed	Hydraulic Model/ Method Proposed	Rationale for Models Selected	
	Existing Analysis from DNR or NRCS	Existing Analysis from DNR or NRCS	Static 1% flood elevations on lakes are useful if and when any construction or development occurs around the lake. These elevations will be applied to the maps if they were established during the design process and assessable in DNR or NRCS records.	

LIFE OF THE PROJECT STATUS GRAPHIC

You are here

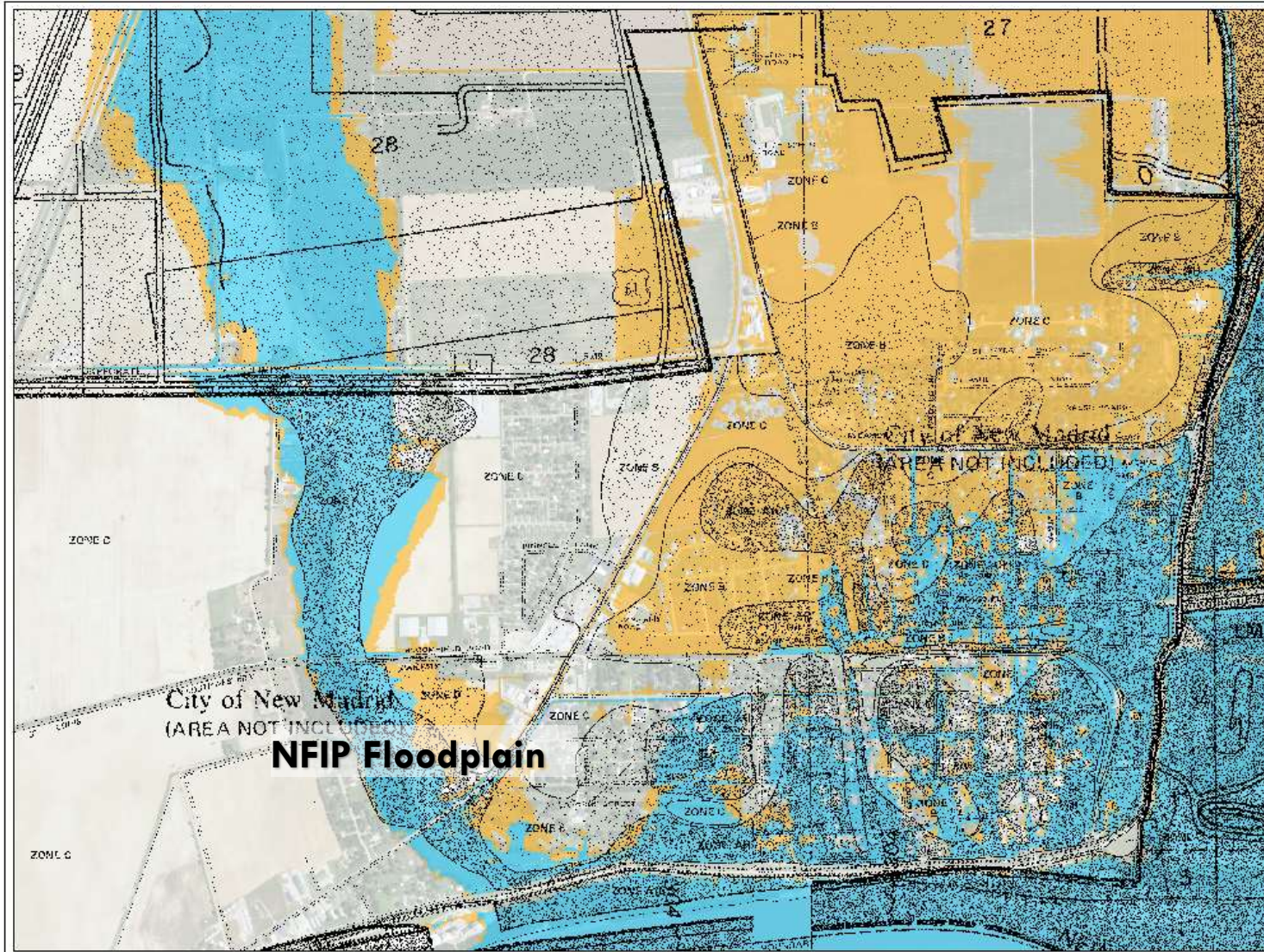


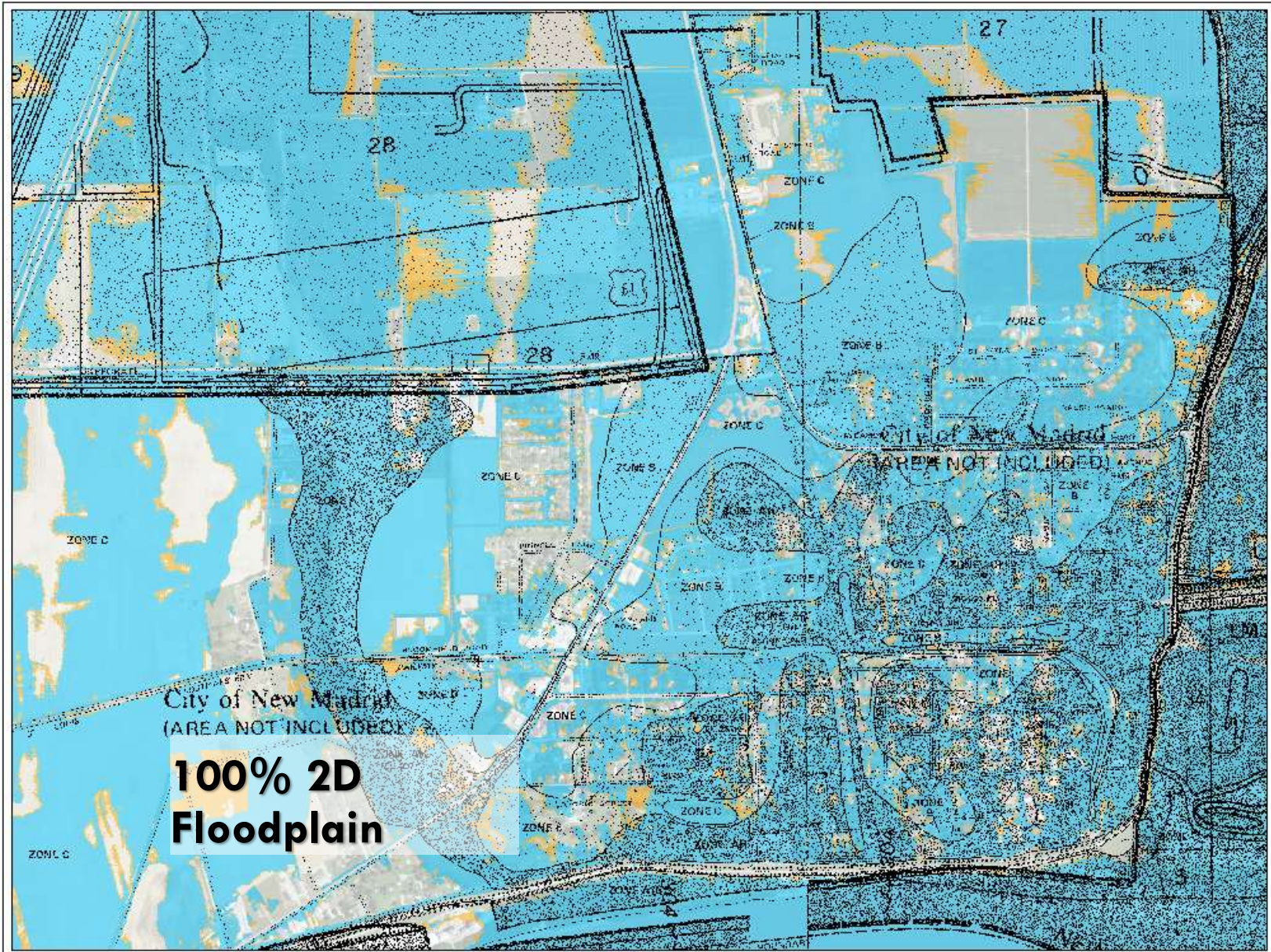
This will be shown quarterly in stakeholder communications

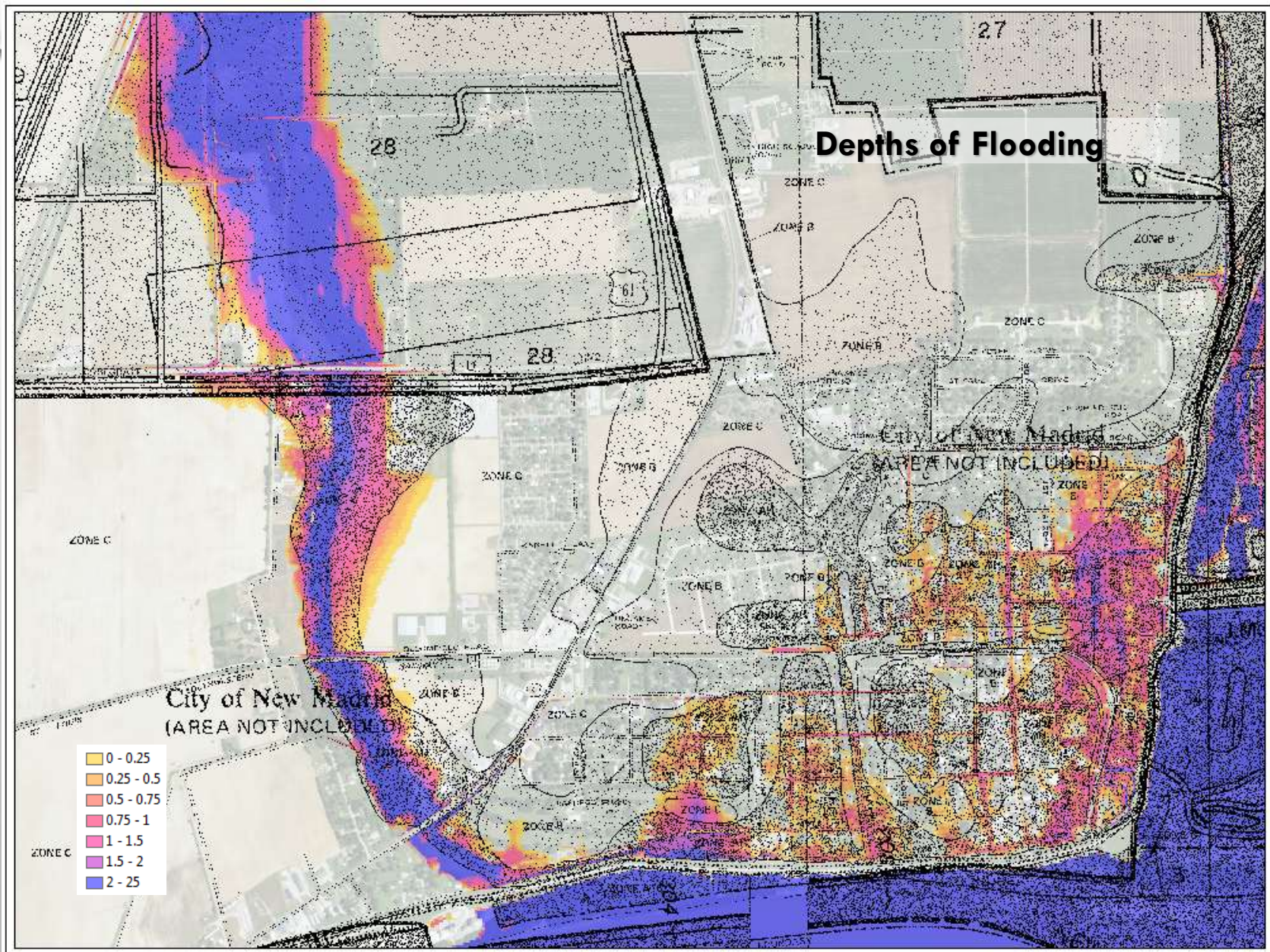
Project Kick-off



CHANGES SINCE LAST FIRM (PIR STYLE!)

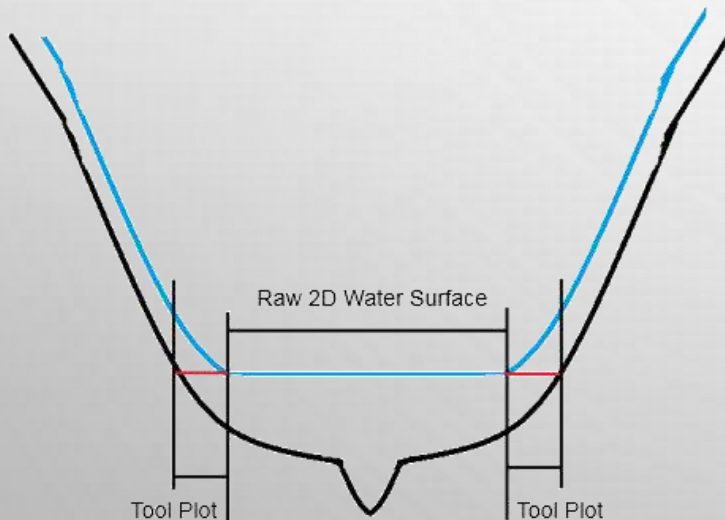






LIMITS OF STUDY IN FLATLANDS

- **1 square mile Study limits**
- **Previously Mapped headwater areas**
- **Areas of needed Floodplain management**
- **Full extents vs Riverine Analysis Shore lining**

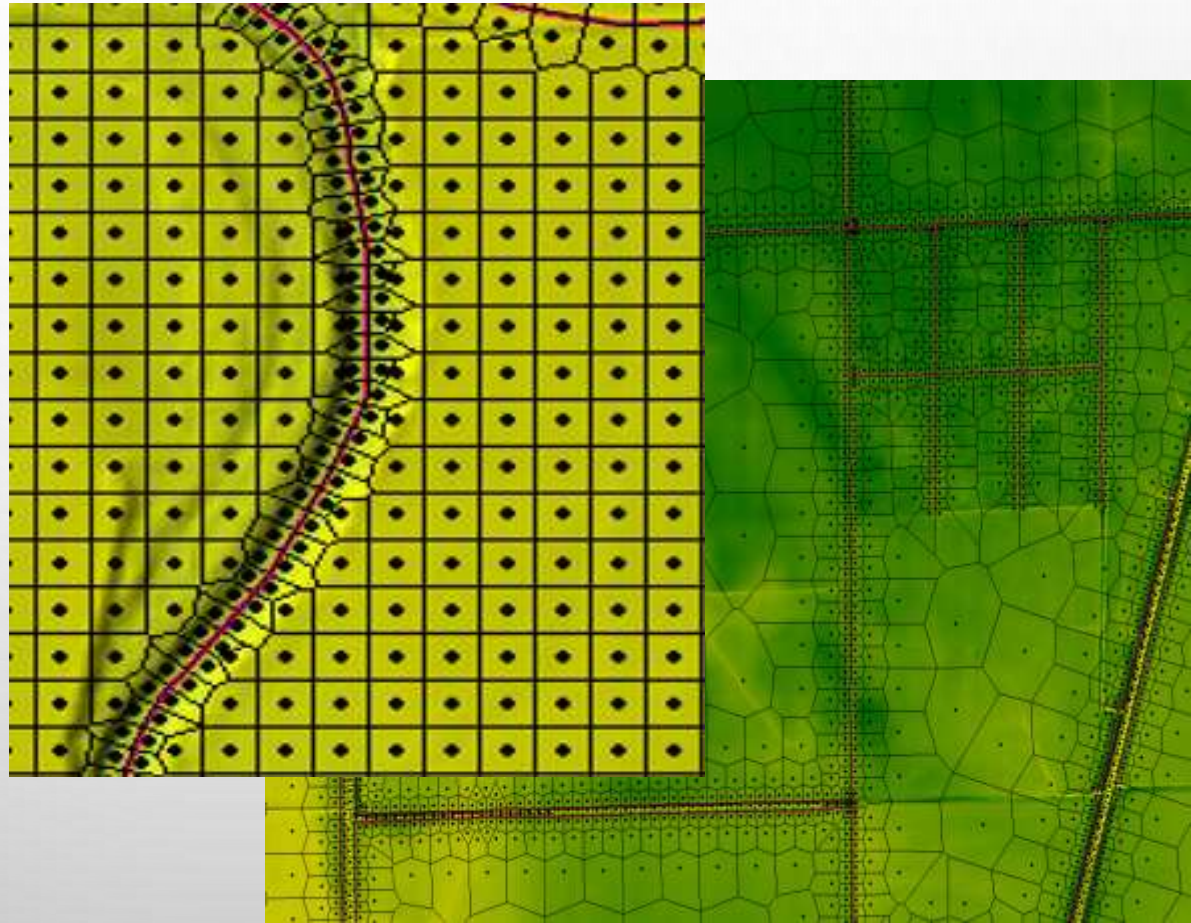


POLICY ISSUES

- **Unmapped Counties voting to Join NFIP**
- **Local FP Administrators Ability to use results**
 - **Training, Workshops, Web Tools, U Tube Videos**
- **Local/Regional Engineering Firms Capabilities**
- **Just What is a “No Rise”**
- **Administrative Floodways!!**
- **Compensating Frequency Based Cut and Fill**

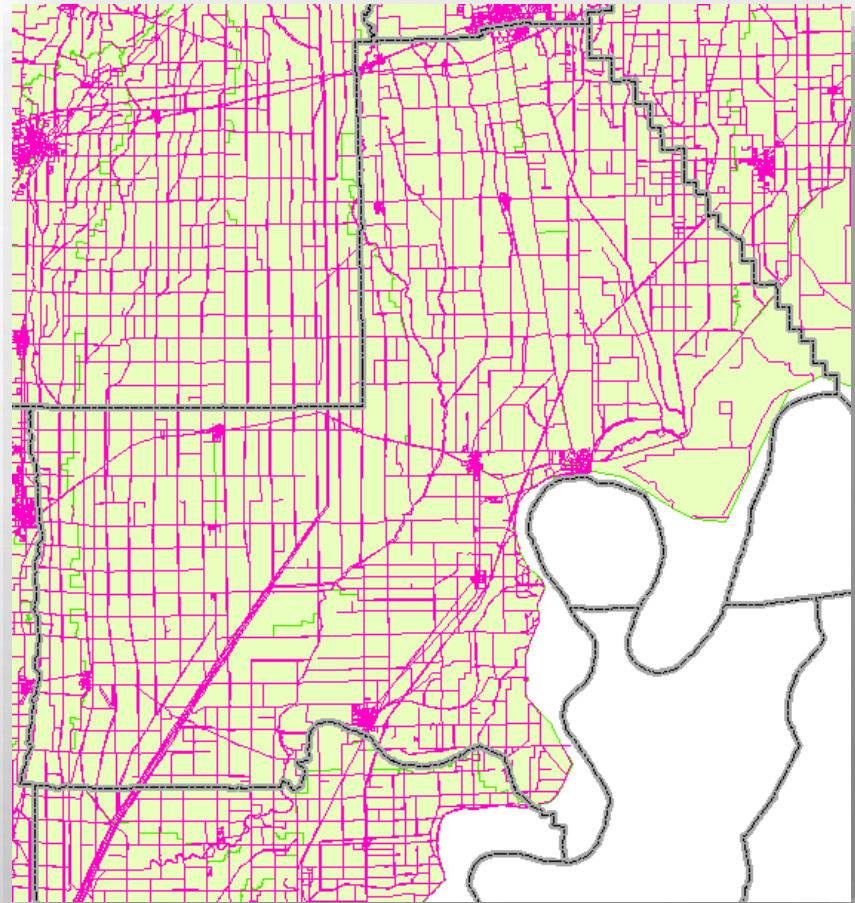
GRID CELL SIZES

- 100 FEET
 - VARIES WITH SLOPE
- 50 FEET
 - STREAMS
- VARIES WITH CURVES



Break Lines

Railroads
Levees
Agricultural Berms
Dams
DOT roads
County roads
Farmer roads



CELL SIZE & BREAK LINES

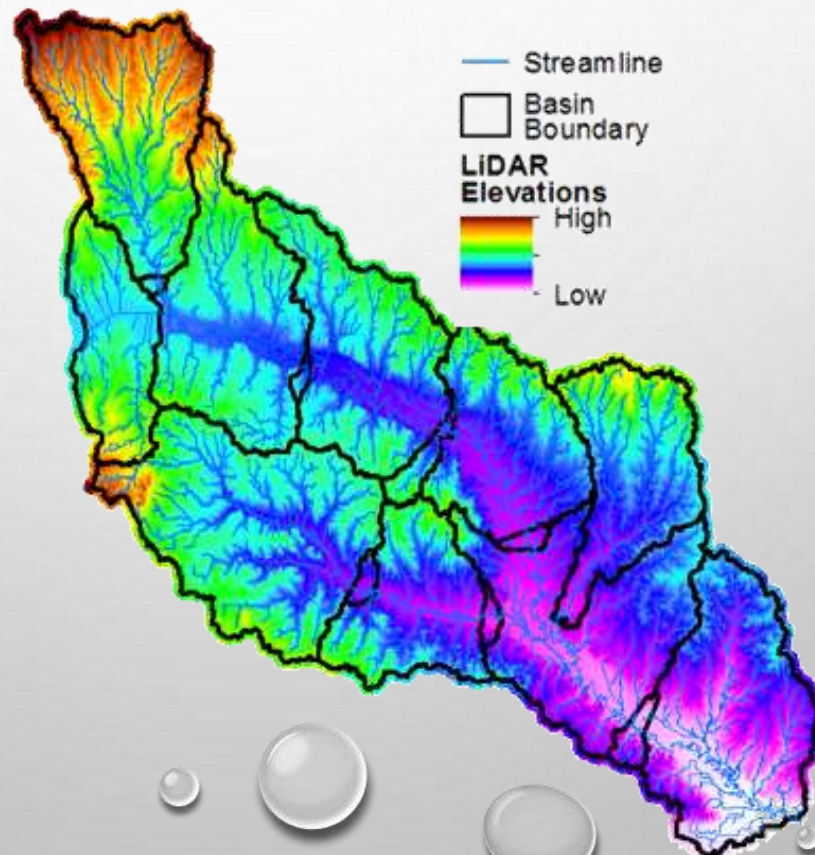
- RAILROADS
- LEVEES
- AG. BERMS
- DAMS
- KDOT ROADS
- COUNTY ROADS
- FARMER ROADS



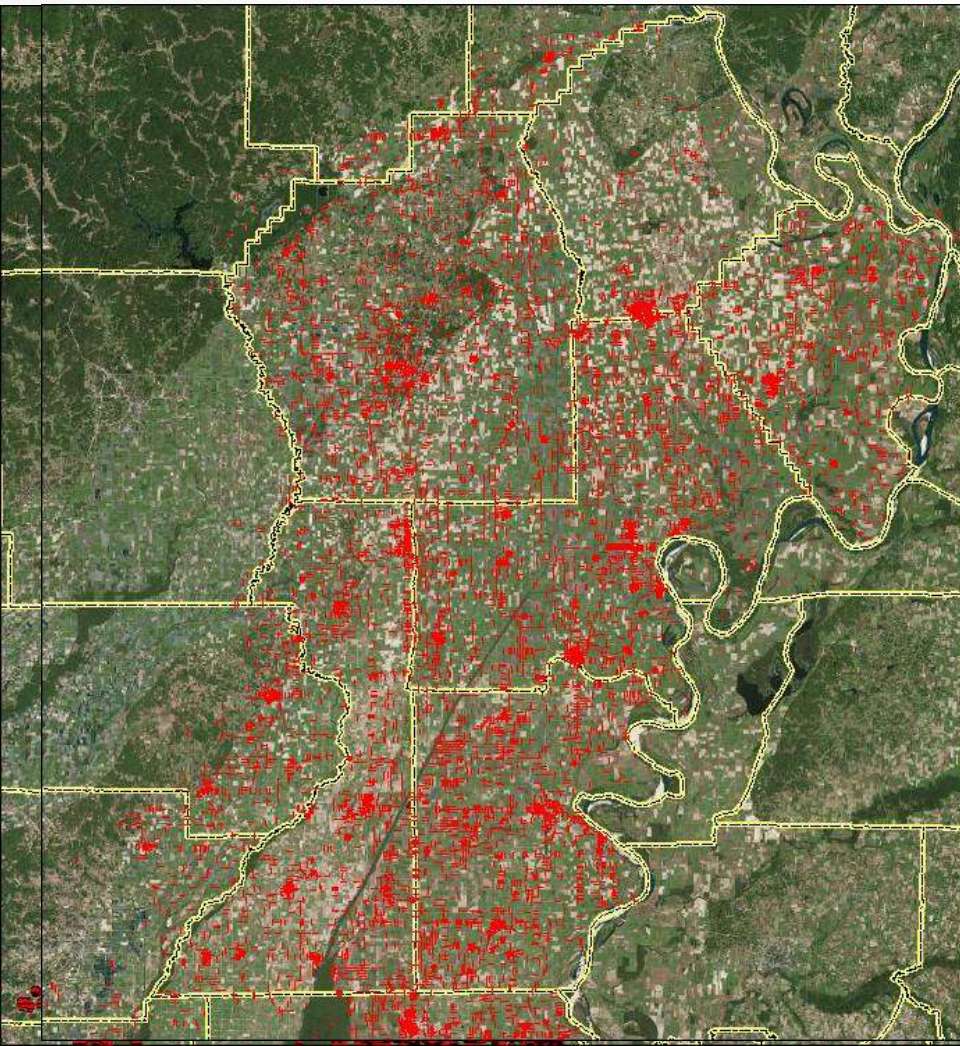
Model Size

Area not greater than 75% of software size limitations

HEC RAS 5.04 64-Bit processing provides ability to model larger areas



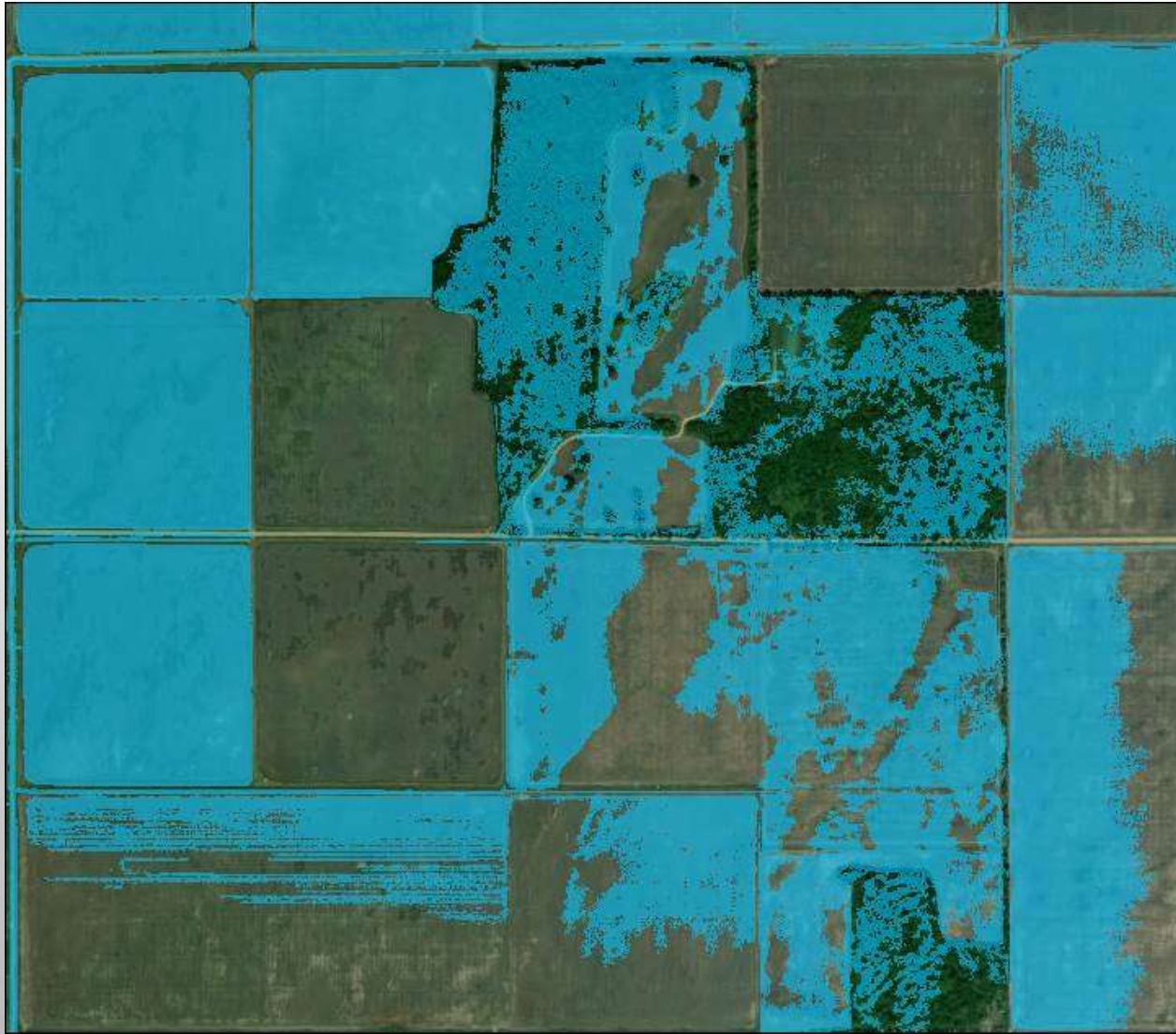
HYDRO CONNECTORS AND BREAKLINES



- **Social Flood Water is hard to Coral (Water Connections)**
- **Multi-tasking raindrops**
- **Lots of Concussion Protocols**



ISLANDS IN THE BOOTHEEL

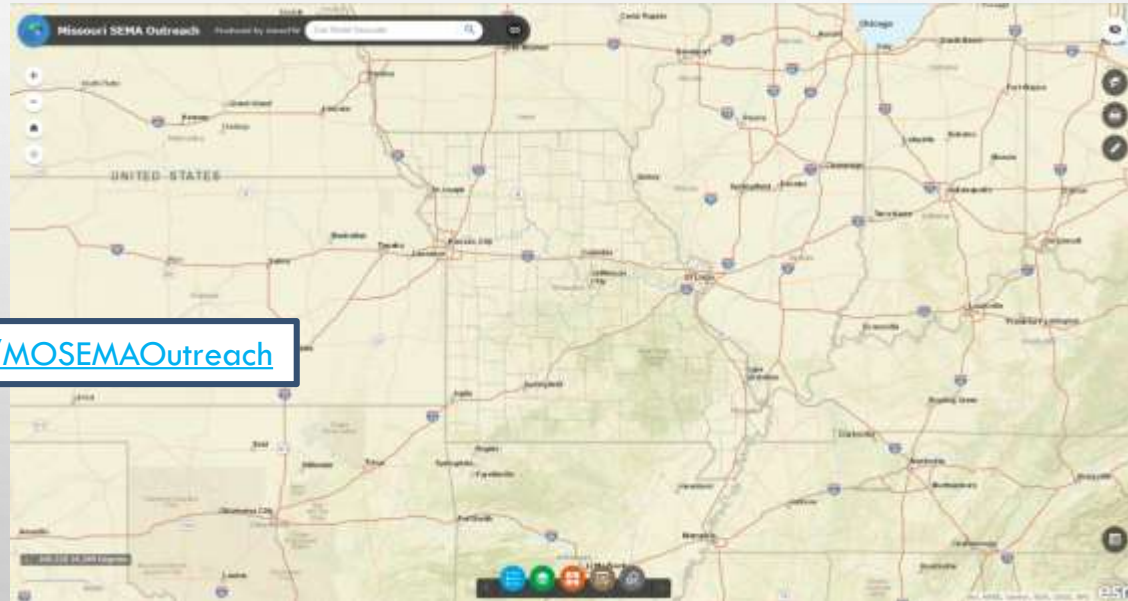


Some Tools for Local Input



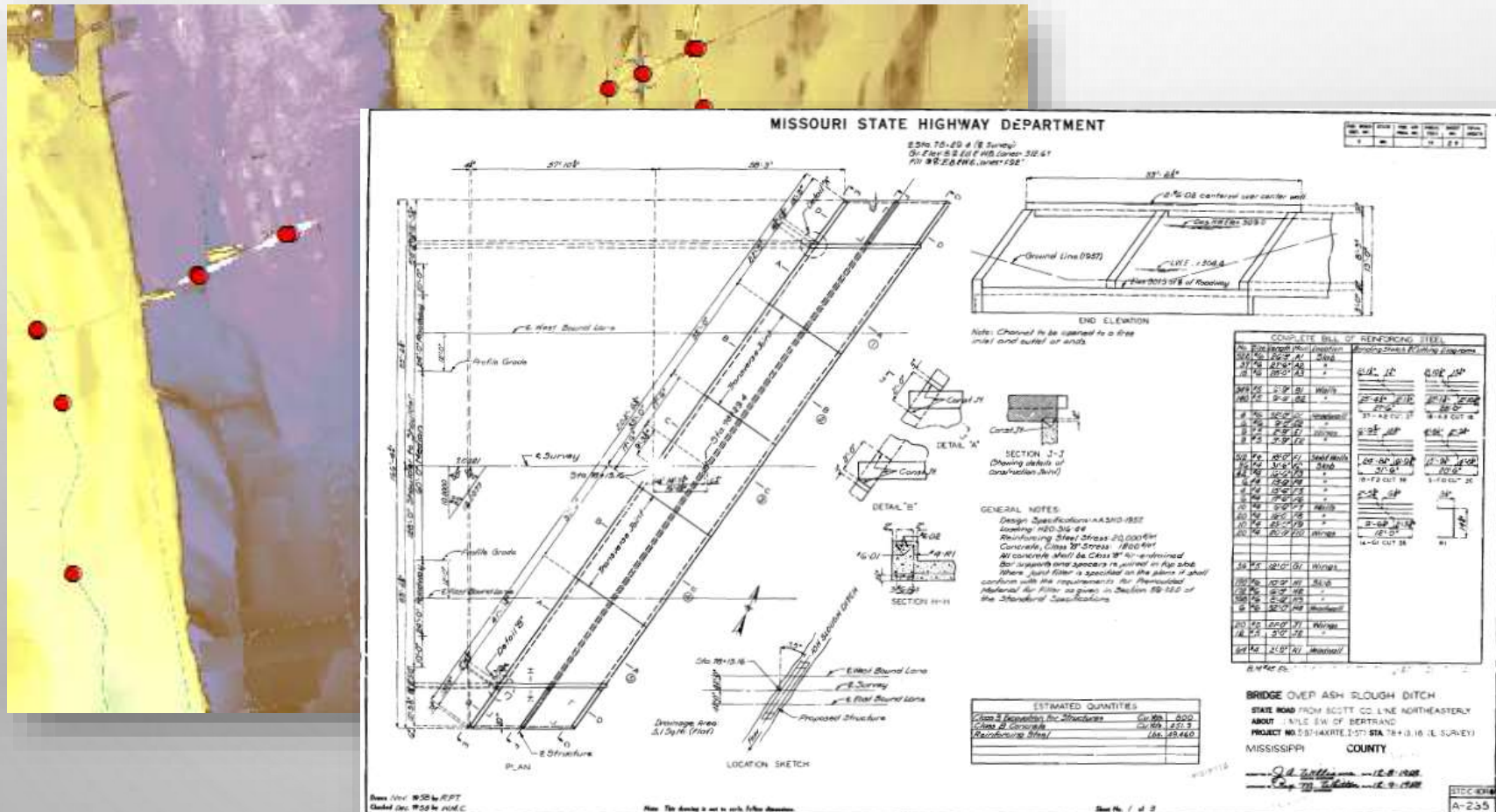
Outreach Website

<http://bit.ly/MOSEMAOutreach>

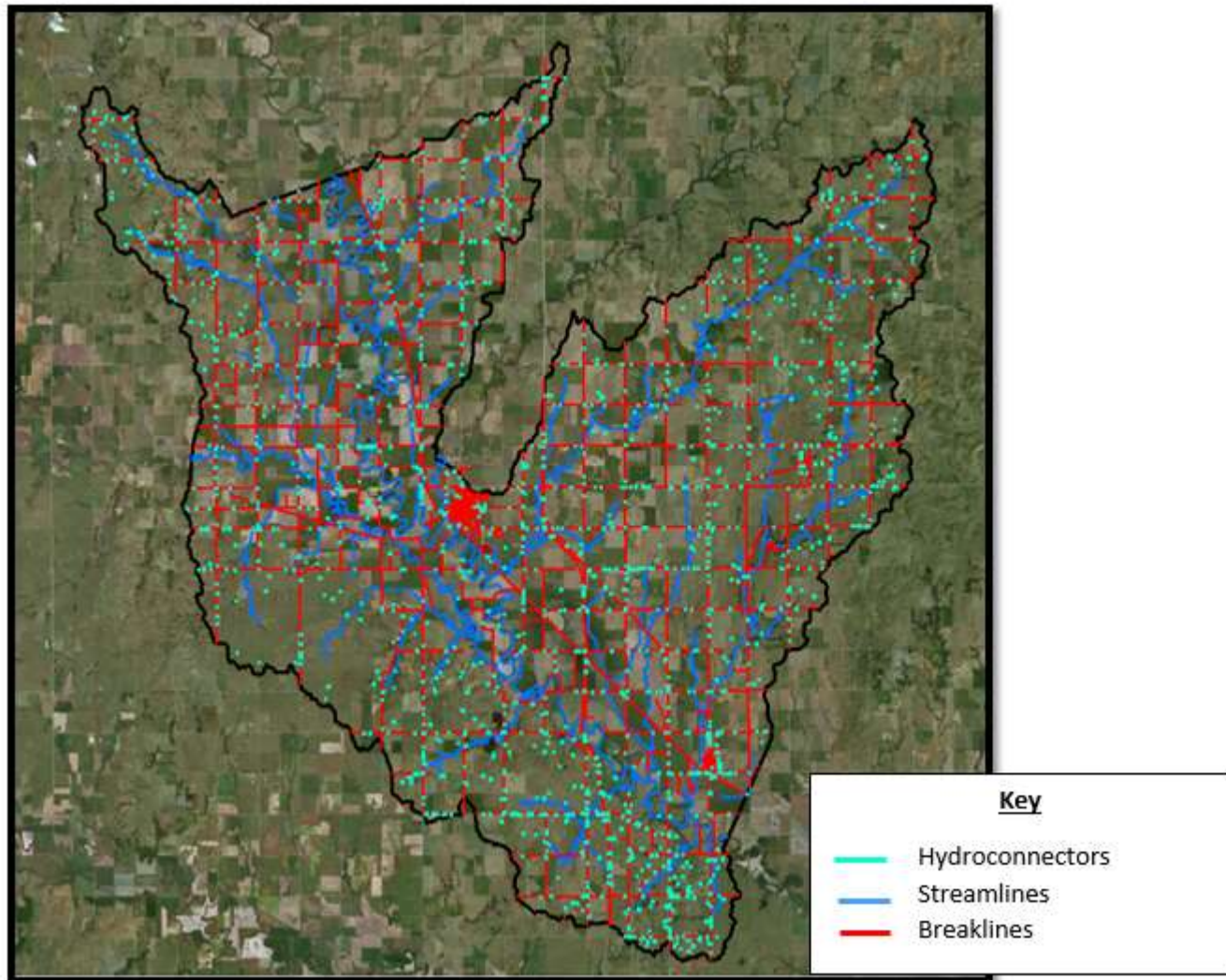


Other - Detailed Studies

Structure Geometry (DB available) FHWA/KDOT



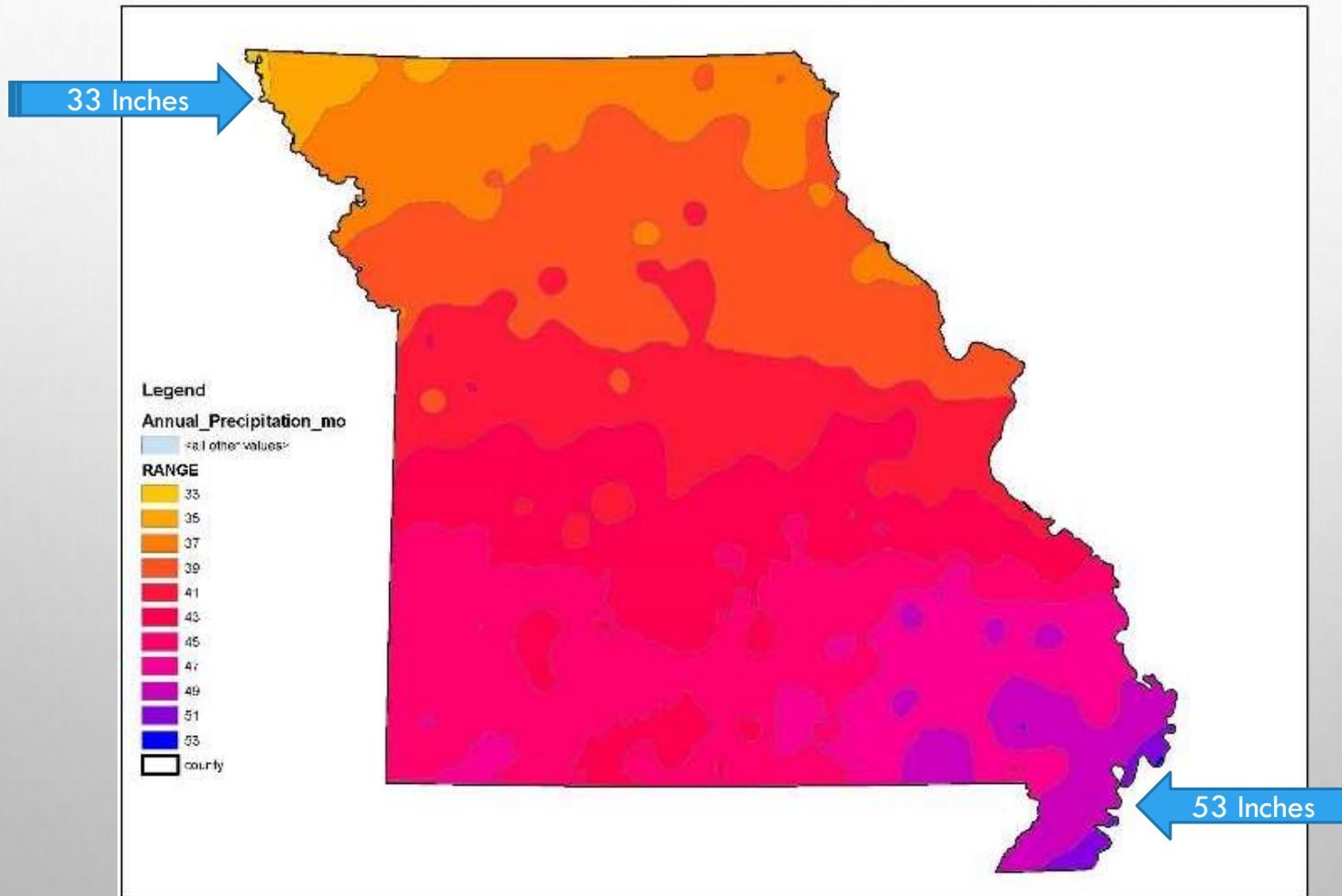
ALL THINGS BLE GEOMETRY



Relationship Between Rain on Grid and HEC HMS

Rain on Grid	HEC HMS
Frequency/Duration Rainfall Depths	Frequency/Duration Rainfall Depths
SCS Excess Rainfall Computed outside Model	SCS Excess Rainfall Computed within Model
Excess Rainfall Hyetograph	Rainfall Hydrograph
2D Routing – Mesh Parameters	Time of Concentration and Channel Routing
Mesh Storage Routing	Muskingum Cunge or other Routing
Break lines and Hydro Connectors	Storage Nodes
Calibration/Verification	Calibration/Verification

5 GALLON BUCKET



Atlas 14 Rainfall

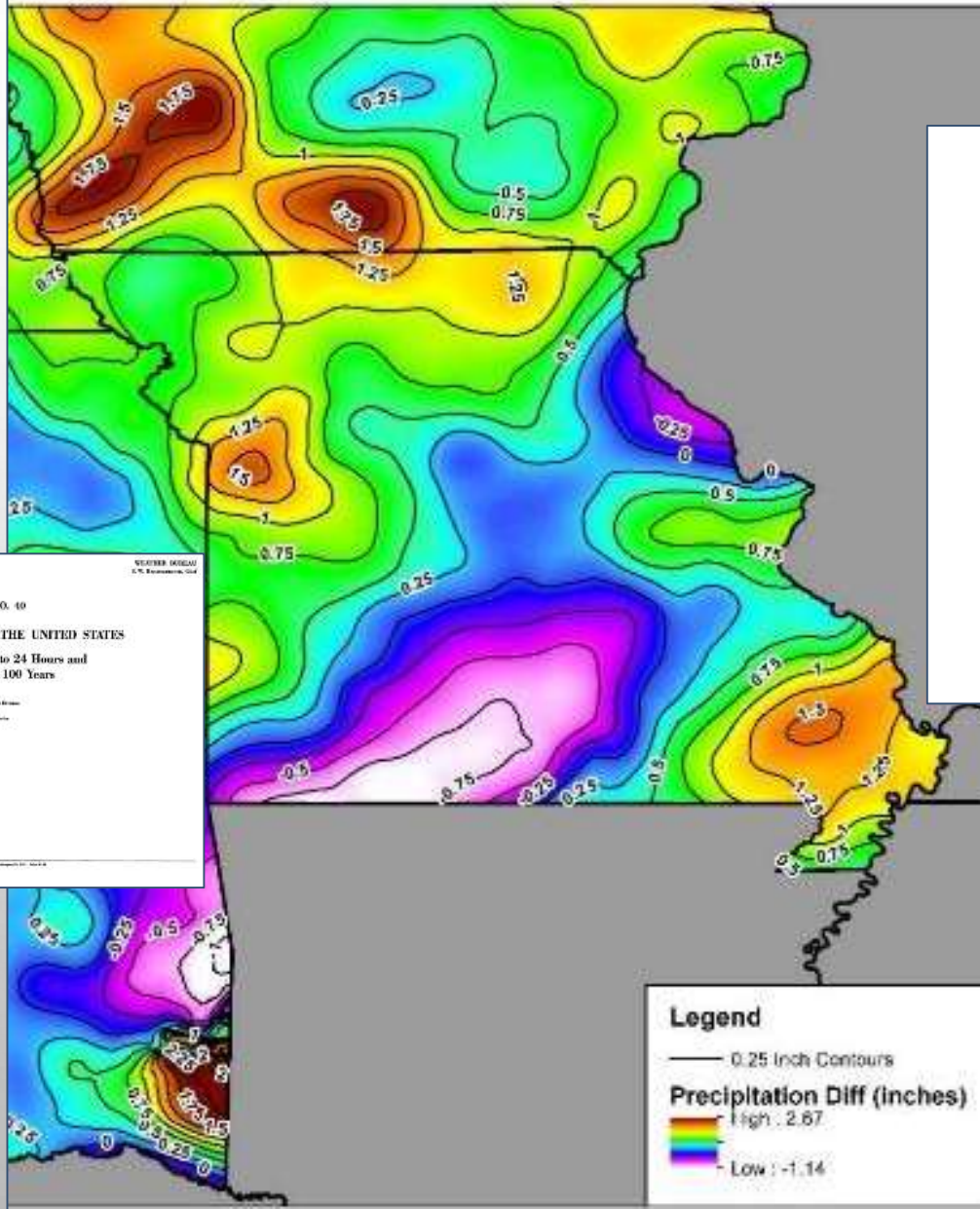
Rainfall Depth

Event	Partial Duration Series Depths (inches)		
	Minimum	Mean	Maximum
10%	5.3	5.5	5.6
4%	6.3	6.6	6.8
2%	7.1	7.5	7.7
1%	7.9	8.4	8.8
1%-plus ²	9.1	9.5	9.8
0.2%	9.9	10.8	11.7

Summary of the Rainfall Depths Calculated from NOAA Atlas 14

- CONVENTIONAL HYDROLOGIC MODELS SUCH AS HEC-HMS ARE IMPRACTICAL FOR FLAT, INTERCONNECTED AREAS
- A TIME SERIES OF EXCESS RAINFALL APPLIED TO THE 2D FLOW AREA WITHIN THE HEC-RAS 5.X SOFTWARE
- HEC-HMS INPUT HYDROGRAPHS USED FOR LARGE LAKES AND DETENTION FACILITIES.
 - PER FEMA GUIDELINES RAINFALL DEPTHS OBTAINED FOR THE 10%, 4%, 2%, 1%, 1%-PLUS AND 0.2% ANNUAL-CHANCE STORM EVENTS
 - FOR EACH 2D FLOW AREA, DEPTHS CALCULATED AS THE AVERAGE OF THE PARTIAL-DURATION GRIDDED VALUES

Atlas 14 vs TP-40 (100yr 24hr)



NOAA Atlas 14

Precipitation-Frequency Atlas
of the United States

Vol. 100, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2030, 2031, 2032, 2033, 2034, 2035, 2036, 2037, 2038, 2039, 2040, 2041, 2042, 2043, 2044, 2045, 2046, 2047, 2048, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 2057, 2058, 2059, 2060, 2061, 2062, 2063, 2064, 2065, 2066, 2067, 2068, 2069, 2070, 2071, 2072, 2073, 2074, 2075, 2076, 2077, 2078, 2079, 2080, 2081, 2082, 2083, 2084, 2085, 2086, 2087, 2088, 2089, 2090, 2091, 2092, 2093, 2094, 2095, 2096, 2097, 2098, 2099, 2100, 2101, 2102, 2103, 2104, 2105, 2106, 2107, 2108, 2109, 2110, 2111, 2112, 2113, 2114, 2115, 2116, 2117, 2118, 2119, 2120, 2121, 2122, 2123, 2124, 2125, 2126, 2127, 2128, 2129, 2130, 2131, 2132, 2133, 2134, 2135, 2136, 2137, 2138, 2139, 2140, 2141, 2142, 2143, 2144, 2145, 2146, 2147, 2148, 2149, 2150, 2151, 2152, 2153, 2154, 2155, 2156, 2157, 2158, 2159, 2160, 2161, 2162, 2163, 2164, 2165, 2166, 2167, 2168, 2169, 2170, 2171, 2172, 2173, 2174, 2175, 2176, 2177, 2178, 2179, 2180, 2181, 2182, 2183, 2184, 2185, 2186, 2187, 2188, 2189, 2190, 2191, 2192, 2193, 2194, 2195, 2196, 2197, 2198, 2199, 2200, 2201, 2202, 2203, 2204, 2205, 2206, 2207, 2208, 2209, 2210, 2211, 2212, 2213, 2214, 2215, 2216, 2217, 2218, 2219, 2220, 2221, 2222, 2223, 2224, 2225, 2226, 2227, 2228, 2229, 2230, 2231, 2232, 2233, 2234, 2235, 2236, 2237, 2238, 2239, 2240, 2241, 2242, 2243, 2244, 2245, 2246, 2247, 2248, 2249, 2250, 2251, 2252, 2253, 2254, 2255, 2256, 2257, 2258, 2259, 2260, 2261, 2262, 2263, 2264, 2265, 2266, 2267, 2268, 2269, 2270, 2271, 2272, 2273, 2274, 2275, 2276, 2277, 2278, 2279, 2280, 2281, 2282, 2283, 2284, 2285, 2286, 2287, 2288, 2289, 2290, 2291, 2292, 2293, 2294, 2295, 2296, 2297, 2298, 2299, 2300, 2301, 2302, 2303, 2304, 2305, 2306, 2307, 2308, 2309, 2310, 2311, 2312, 2313, 2314, 2315, 2316, 2317, 2318, 2319, 2320, 2321, 2322, 2323, 2324, 2325, 2326, 2327, 2328, 2329, 2330, 2331, 2332, 2333, 2334, 2335, 2336, 2337, 2338, 2339, 2340, 2341, 2342, 2343, 2344, 2345, 2346, 2347, 2348, 2349, 2350, 2351, 2352, 2353, 2354, 2355, 2356, 2357, 2358, 2359, 2360, 2361, 2362, 2363, 2364, 2365, 2366, 2367, 2368, 2369, 2370, 2371, 2372, 2373, 2374, 2375, 2376, 2377, 2378, 2379, 2380, 2381, 2382, 2383, 2384, 2385, 2386, 2387, 2388, 2389, 2390, 2391, 2392, 2393, 2394, 2395, 2396, 2397, 2398, 2399, 2400, 2401, 2402, 2403, 2404, 2405, 2406, 2407, 2408, 2409, 2410, 2411, 2412, 2413, 2414, 2415, 2416, 2417, 2418, 2419, 2420, 2421, 2422, 2423, 2424, 2425, 2426, 2427, 2428, 2429, 2430, 2431, 2432, 2433, 2434, 2435, 2436, 2437, 2438, 2439, 2440, 2441, 2442, 2443, 2444, 2445, 2446, 2447, 2448, 2449, 2450, 2451, 2452, 2453, 2454, 2455, 2456, 2457, 2458, 2459, 2460, 2461, 2462, 2463, 2464, 2465, 2466, 2467, 2468, 2469, 2470, 2471, 2472, 2473, 2474, 2475, 2476, 2477, 2478, 2479, 2480, 2481, 2482, 2483, 2484, 2485, 2486, 2487, 2488, 2489, 2490, 2491, 2492, 2493, 2494, 2495, 2496, 2497, 2498, 2499, 2500, 2501, 2502, 2503, 2504, 2505, 2506, 2507, 2508, 2509, 2510, 2511, 2512, 2513, 2514, 2515, 2516, 2517, 2518, 2519, 2520, 2521, 2522, 2523, 2524, 2525, 2526, 2527, 2528, 2529, 2530, 2531, 2532, 2533, 2534, 2535, 2536, 2537, 2538, 2539, 2540, 2541, 2542, 2543, 2544, 2545, 2546, 2547, 2548, 2549, 2550, 2551, 2552, 2553, 2554, 2555, 2556, 2557, 2558, 2559, 2560, 2561, 2562, 2563, 2564, 2565, 2566, 2567, 2568, 2569, 2570, 2571, 2572, 2573, 2574, 2575, 2576, 2577, 2578, 2579, 2580, 2581, 2582, 2583, 2584, 2585, 2586, 2587, 2588, 2589, 2590, 2591, 2592, 2593, 2594, 2595, 2596, 2597, 2598, 2599, 2600, 2601, 2602, 2603, 2604, 2605, 2606, 2607, 2608, 2609, 2610, 2611, 2612, 2613, 2614, 2615, 2616, 2617, 2618, 2619, 2620, 2621, 2622, 2623, 2624, 2625, 2626, 2627, 2628, 2629, 2630, 2631, 2632, 2633, 2634, 2635, 2636, 2637, 2638, 2639, 2640, 2641, 2642, 2643, 2644, 2645, 2646, 2647, 2648, 2649, 2650, 2651, 2652, 2653, 2654, 2655, 2656, 2657, 2658, 2659, 2660, 2661, 2662, 2663, 2664, 2665, 2666, 2667, 2668, 2669, 2670, 2671, 2672, 2673, 2674, 2675, 2676, 2677, 2678, 2679, 2680, 2681, 2682, 2683, 2684, 2685, 2686, 2687, 2688,

[illegible]

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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

Presented by
DAVID A. LEBENTVITZ
Graduate Studies Section, Engineering Sciences Division
for
Engineering, Modeling, and Communications Section
U.S. Department of Agriculture



STUDIOS FOR THE 21ST CENTURY

Parvathy K. S. *Department of Mathematics, T. J. Somasundar College, Madhavapatti, Salem-636 005*

Legend

— 0.25 Inch Contours

Precipitation Diff (inches)

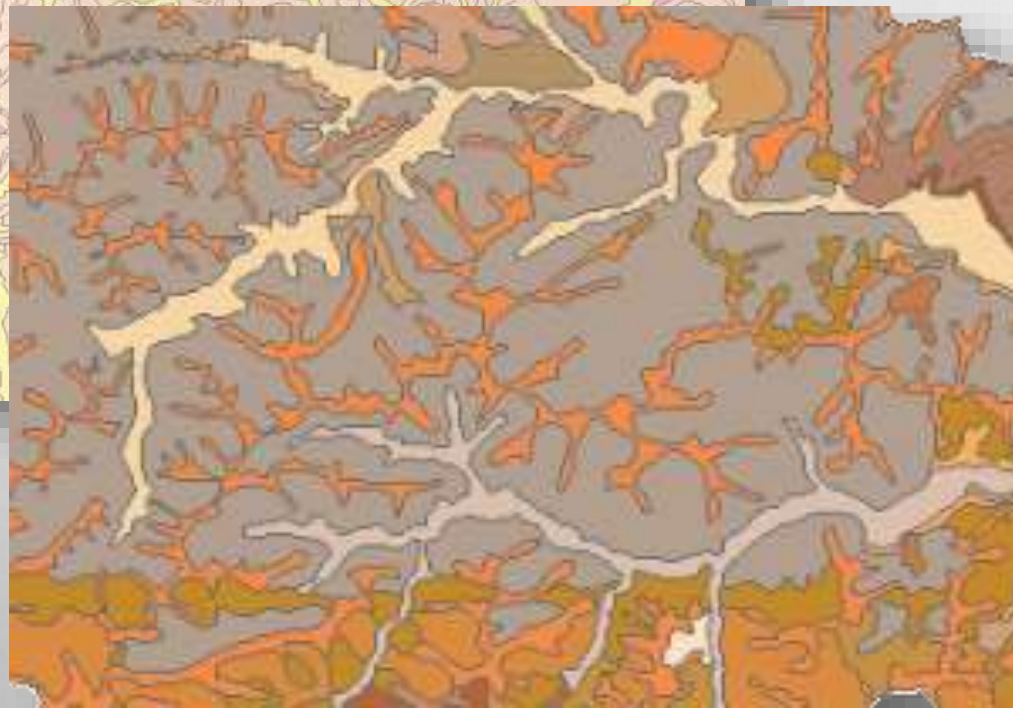
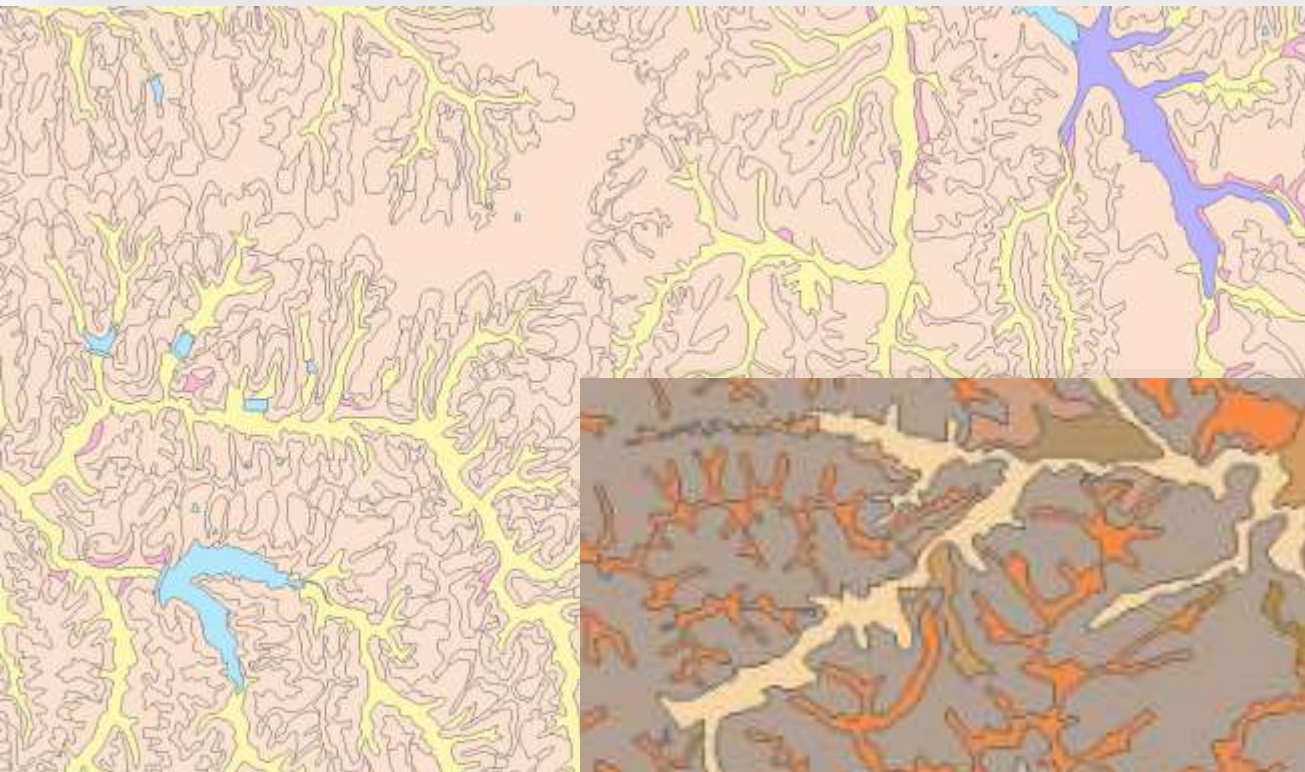
High: 2.67

- Low : -1.14

Soils

Hydrologic Soil Groups

- A, B, C, D



LAND USE

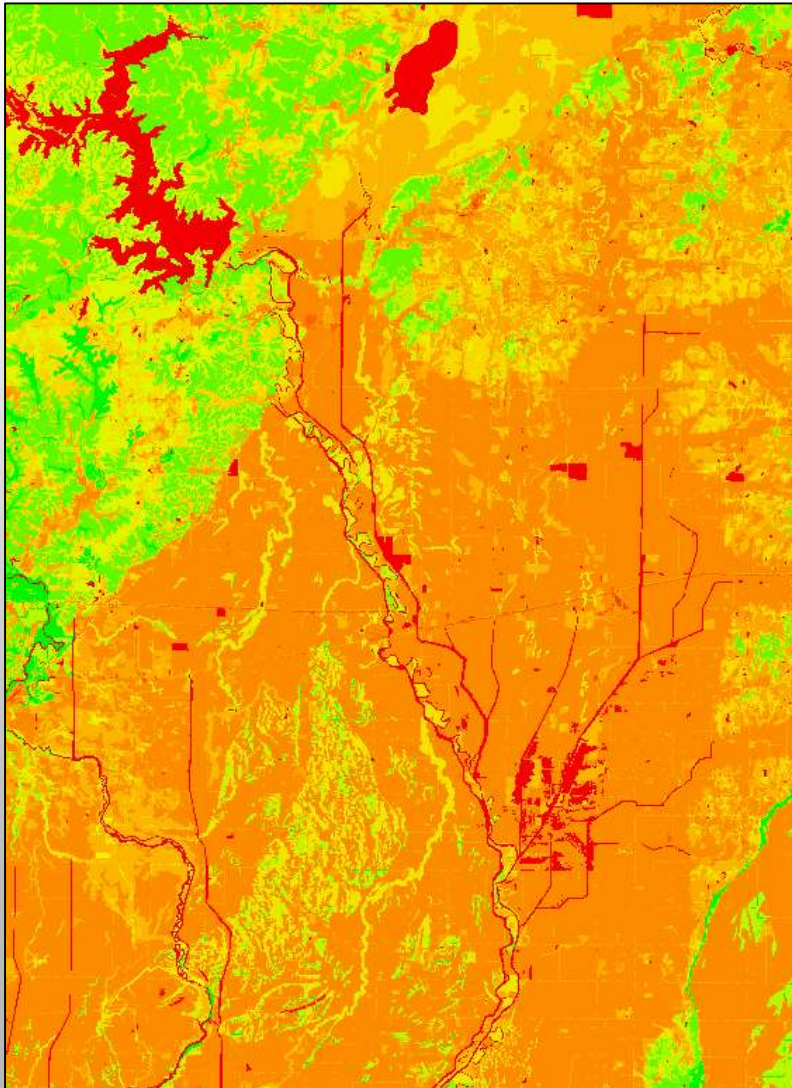
NLCD Land Cover Classification Legend

- 11 Open Water
- 12 Perennial Ice/ Snow
- 21 Developed, Open Space
- 22 Developed, Low Intensity
- 23 Developed, Medium Intensity
- 24 Developed, High Intensity
- 31 Barren Land (Rock/Sand/Clay)
- 41 Deciduous Forest
- 42 Evergreen Forest
- 43 Mixed Forest
- 51 Dwarf Scrub*
- 52 Shrub/Scrub
- 71 Grassland/Herbaceous
- 72 Sedge/Herbaceous*
- 73 Lichens*
- 74 Moss*
- 81 Pasture/Hay
- 82 Cultivated Crops
- 90 Woody Wetlands
- 95 Emergent Herbaceous Wetlands

* Alaska only



CURVE NUMBER



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

EXCESS RAINFALL DEPTHS

- TO OBTAIN THE EXCESS RAINFALL TIME SERIES, **INTERCEPTION AND INFILTRATION (I&I) LOSSES** WERE SUBTRACTED FROM THE RAINFALL HYETOGRAPH BEFORE APPLYING THE 2D MODEL SINCE THE CURRENT VERSION OF THE SOFTWARE DOES NOT HAVE THAT CAPABILITY YET.

8.4" rainfall for 1%

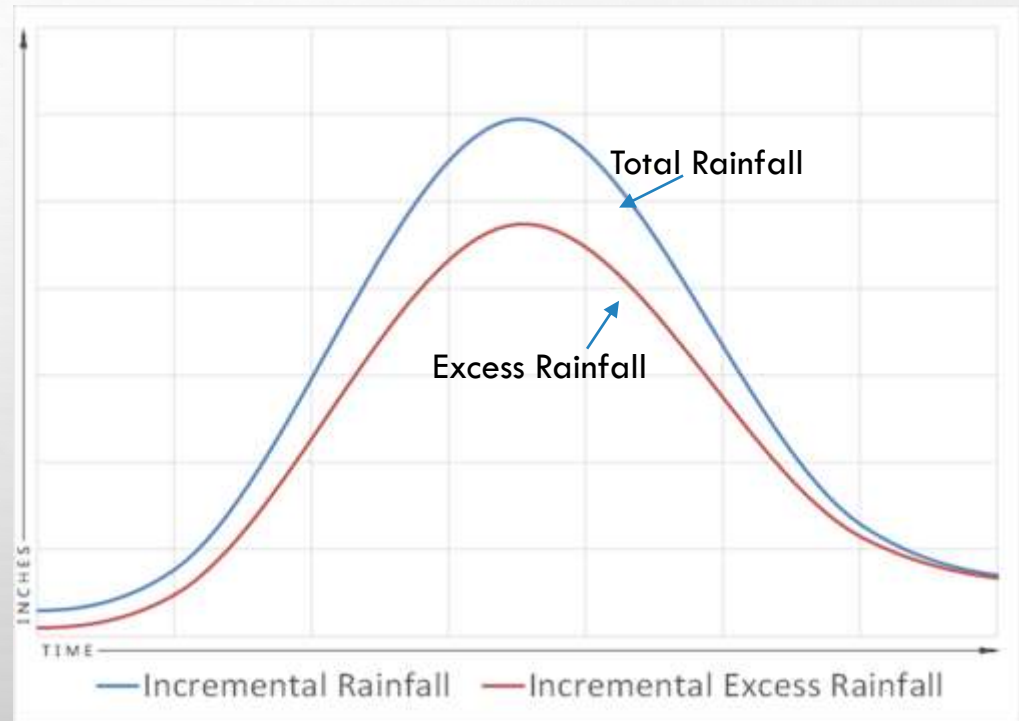
-2.1" I&I losses

6.3" excess rainfall for 1%

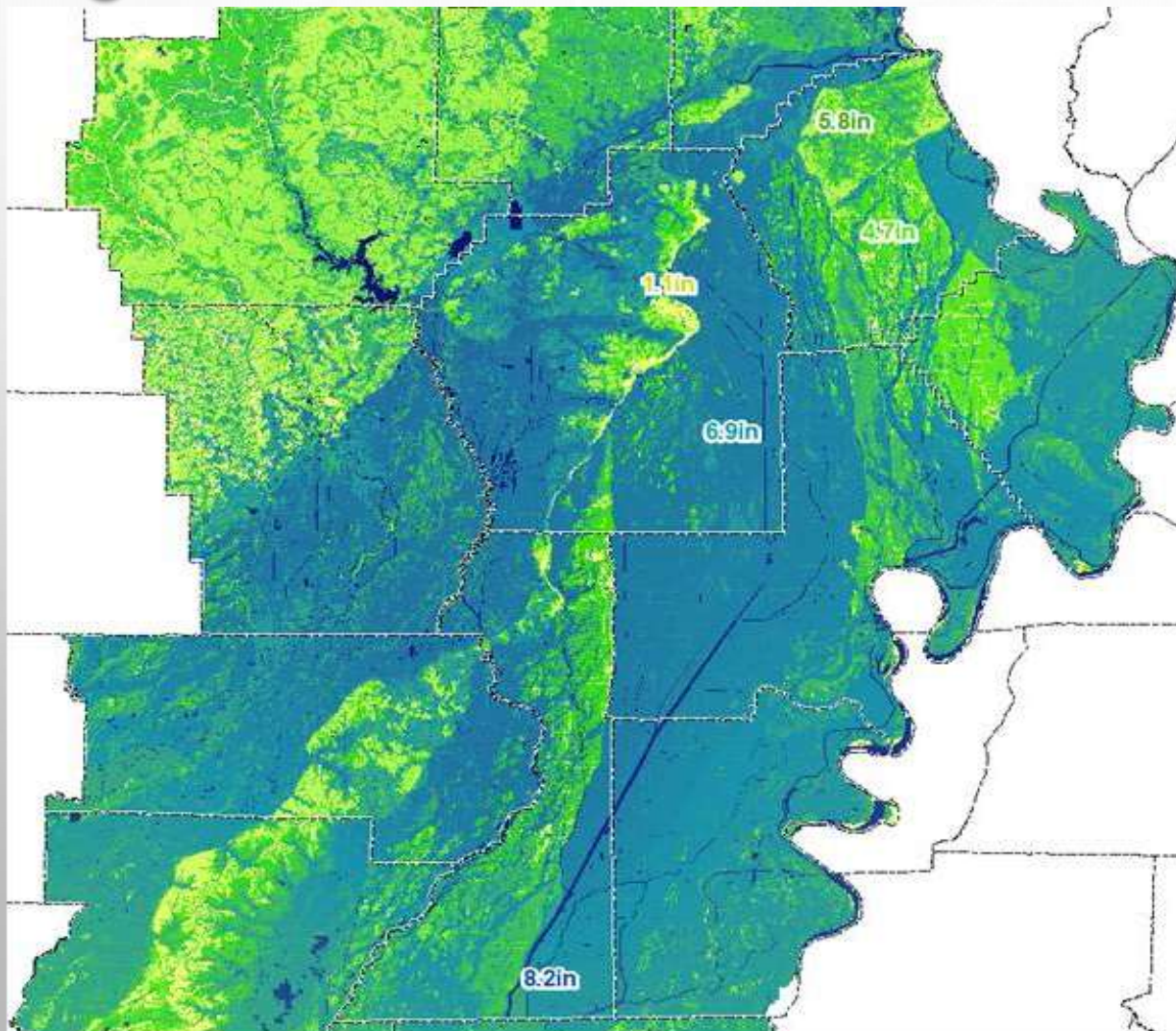
EXCESS RAINFALL

- A Type II distribution was selected for the rainfall hyetograph
- After removing the losses, the excess rainfall can be applied directly to the 2D areas in HEC-RAS as a precipitation boundary condition time series

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



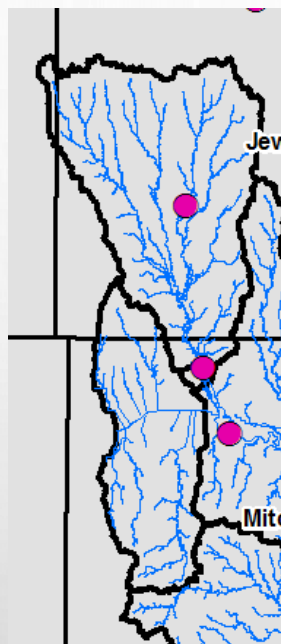
HYDROLOGY



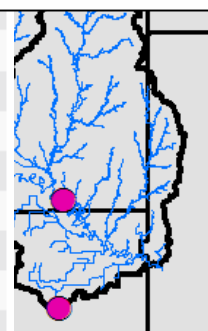
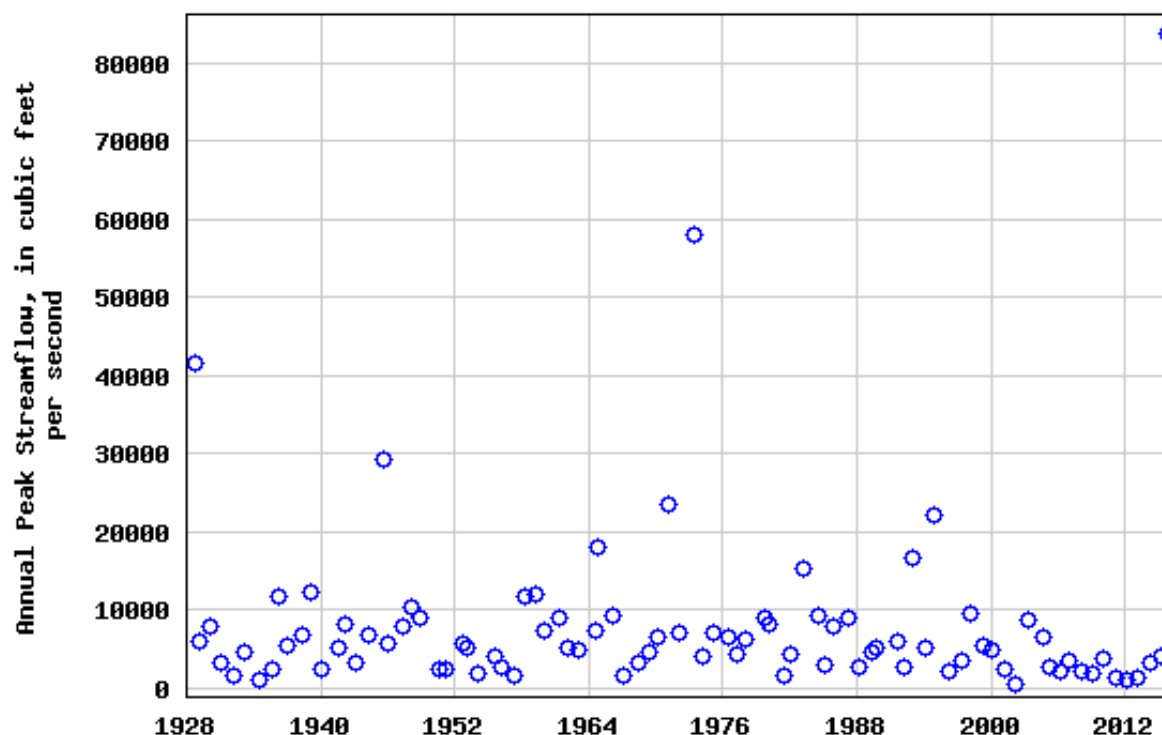
Excess Rainfall Plot for 1% Event

- THE RANGE OF EXCESS RAINFALL FOR THE 1% EVENT VARIED FROM AS LOW AS 1.1 INCHES IN THE SAND BAR AREAS TO 6.9 INCHES IN THE CLAY/GUMBO AREA AND 8.2 INCHES IN THE MOSTLY WATER AREAS

Gage Data



USGS 02136000 BLACK RIVER AT KINGSTREE, SC

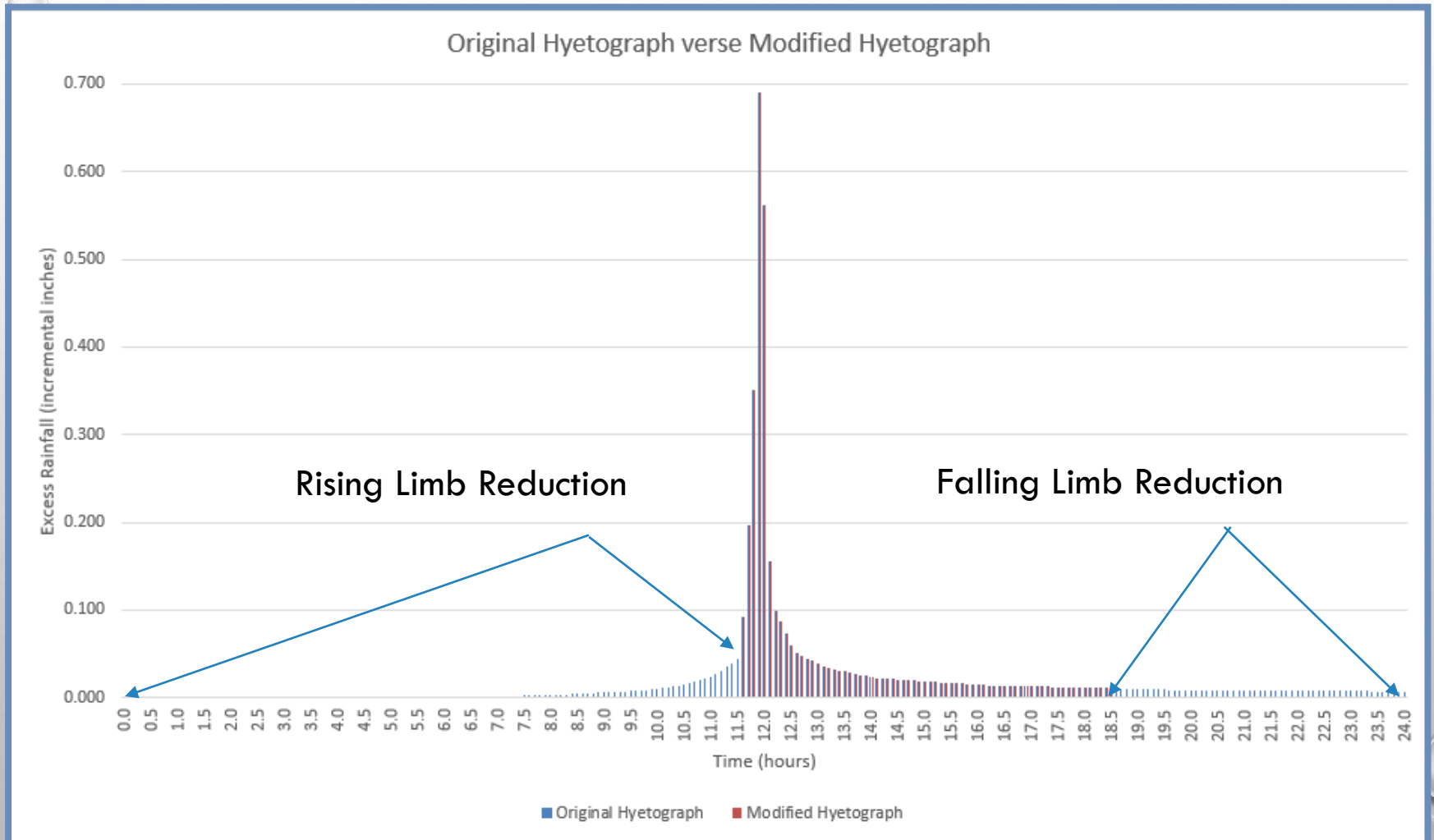


Gage Number

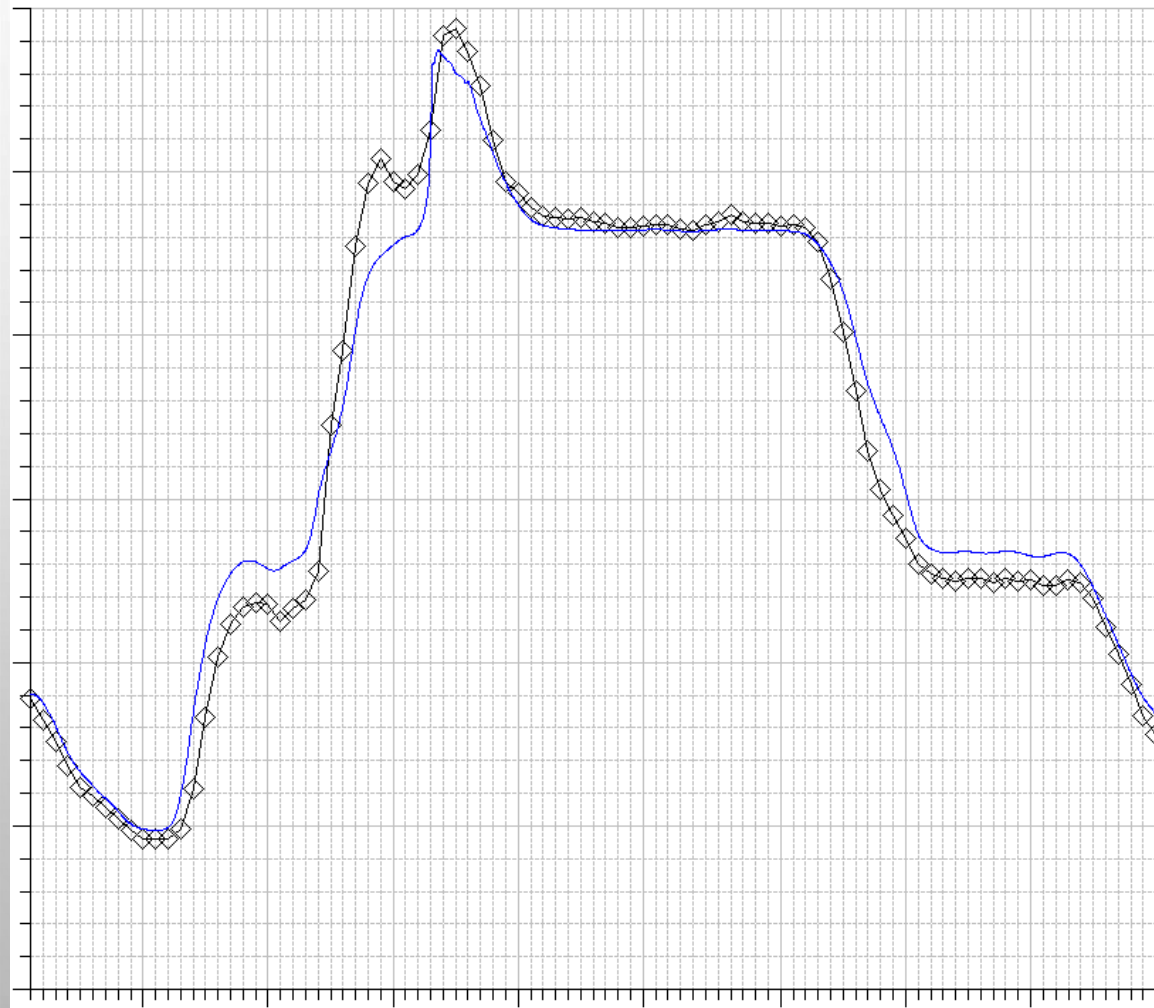
Gage Description

06874500	East Limestone Creek near Ionia, KS	20	1934 - 1965
06875800	Limestone Creek near Glen Elder, KS	210	1965 - 1986
06876200	Middle Pipe Creek near Miltonvale, KS	10	1957 - 1977
06876700	Salt Creek near Ada, KS	406	1960 - 2015
06875900	Solomon River near Glen Elder, KS	5,340	1965 - 2015
0687600	Solomon River at Beloit, KS	5,440	1895 - 2015
06876070	Solomon River near Simpson, KS	5,538	1991 - 2005
06876440	Solomon River at Minneapolis, KS	6,060	1979 - 2015
06876900	Solomon River at Niles, KS	6,770	1897 - 2015

Aerial Reduction Indices



Calibration/Verification

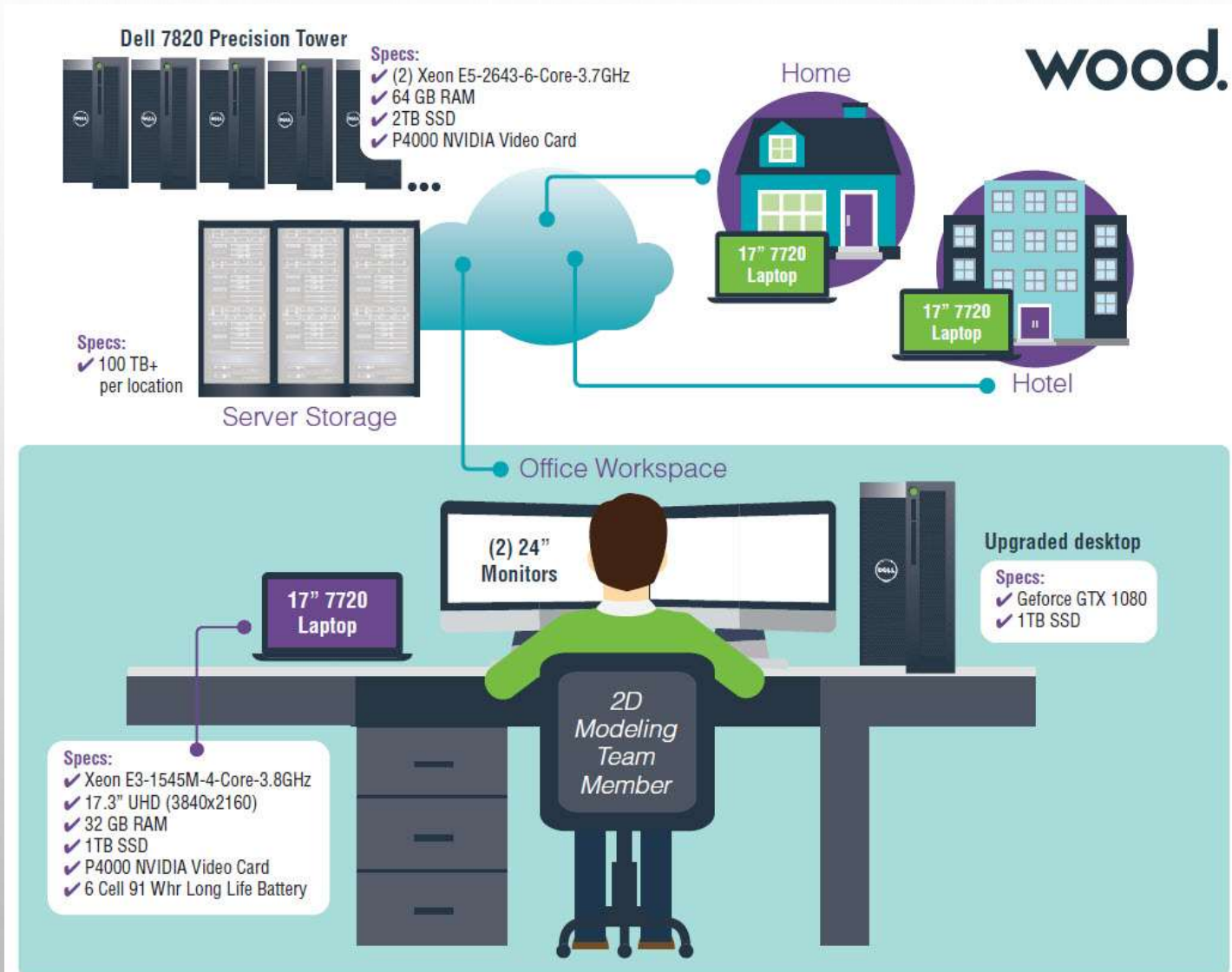


Legend

Stage

Obs Stage

OUR PROCESSING CAPACITY



ADDITIONAL BENEFITS TO 2D BEYOND RISK MAP

- **MODELS USACE COMPATIBLE**
- **STREAM STABILITY ANALYSIS FRIENDLY**
- **DAM INUNDATION MAPPING COMPATIBLE**
- **MS4 VOLUME BASED BMP ANALYSIS FRIENDLY**
- **SCIENCE BASED DERIVATIVES MANAGING DEVELOPMENT FLOOD RISK**
- **CIP UPDATES – MITIGATION ACTION PLANS**

Other - Stream Networks

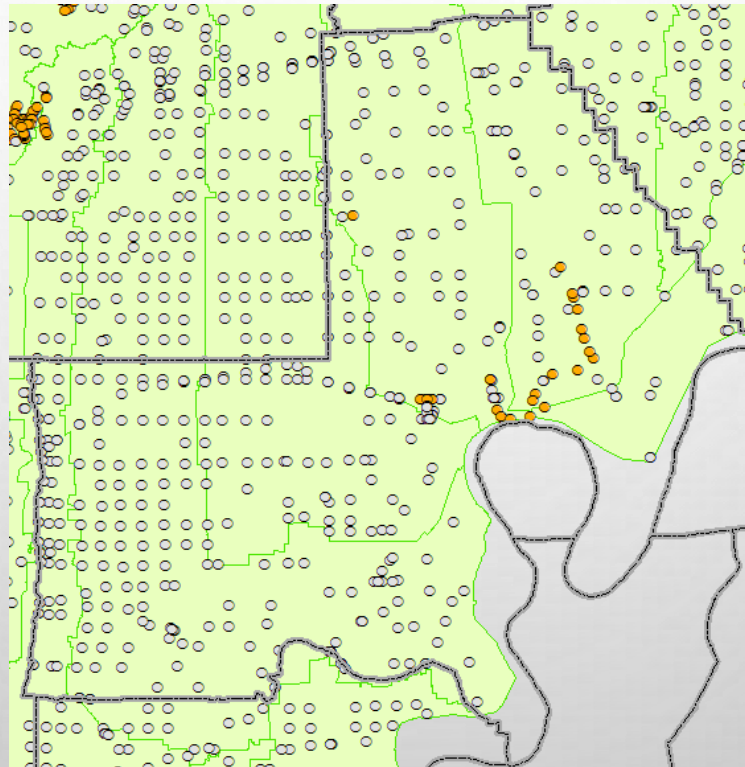


- ▶ Flow Paths and Stream Lines Developed from Hydro-Enforced LiDAR
- ▶ Smaller Threshold for Contributing Drainage Area
 - ▶ 1 sq. Mile
 - ▶ 2 sq. Mile
 - ▶ 3 sq. Mile
 - ▶ ½ sq. Mile
 - ▶ ¼ sq. Mile
- ▶ FEMA extents (41 miles) Sample Area
 - ▶ 40-acre drainage
 - ▶ 10-acre drainage
 - ▶ 1-acre drainage

Other

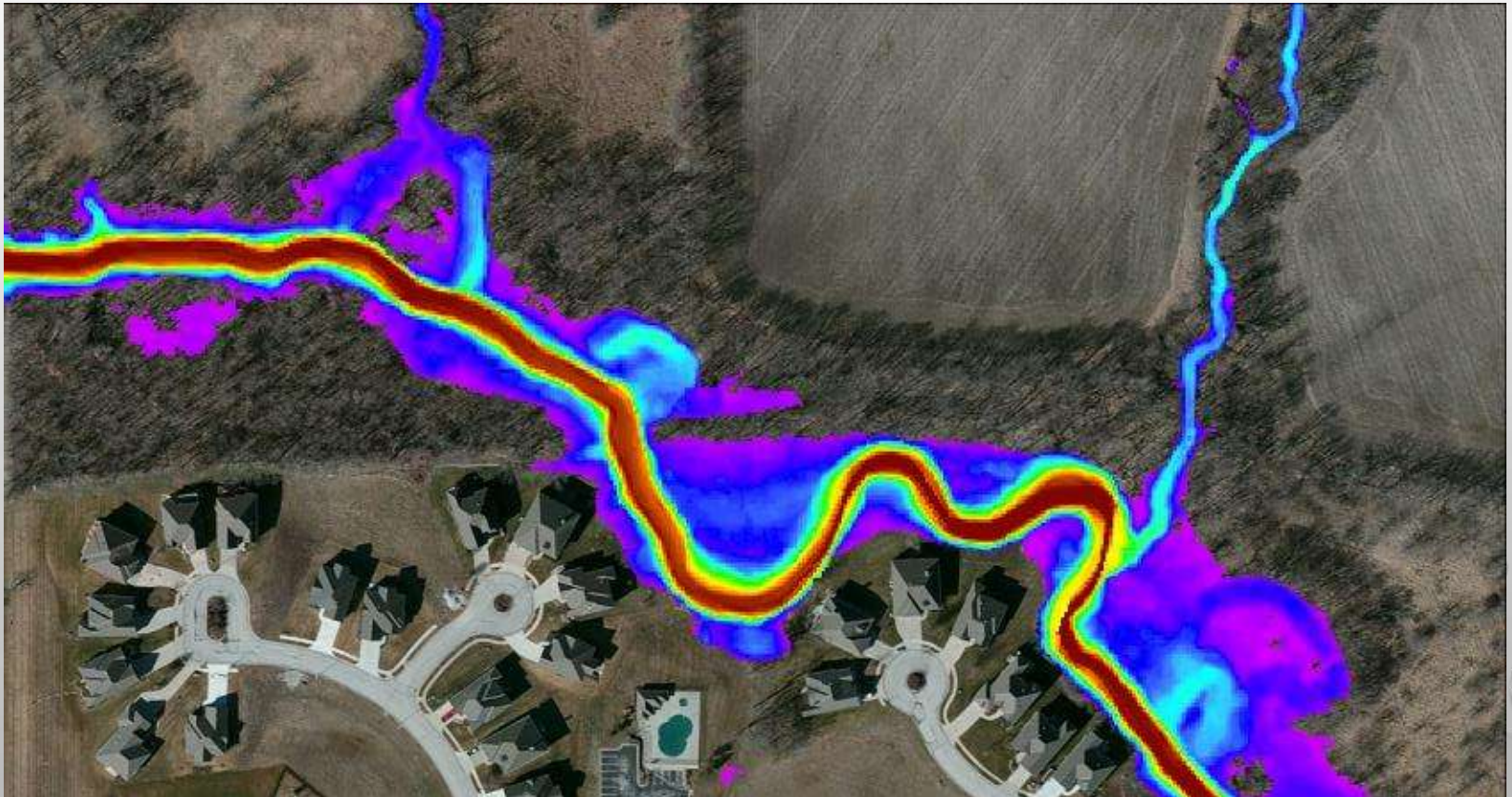
wood.

Conveyance Crossing Assessments

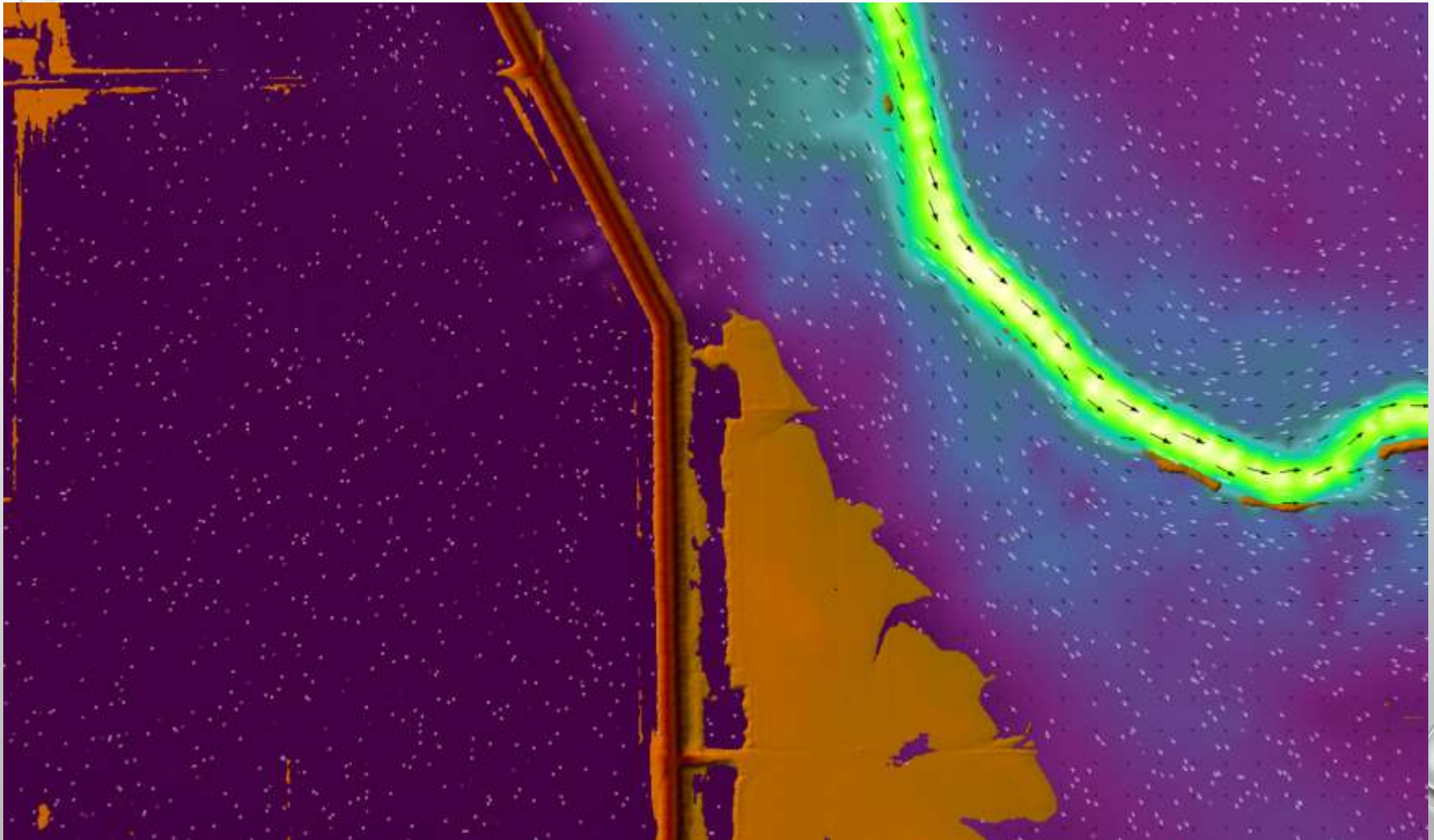


Floodways

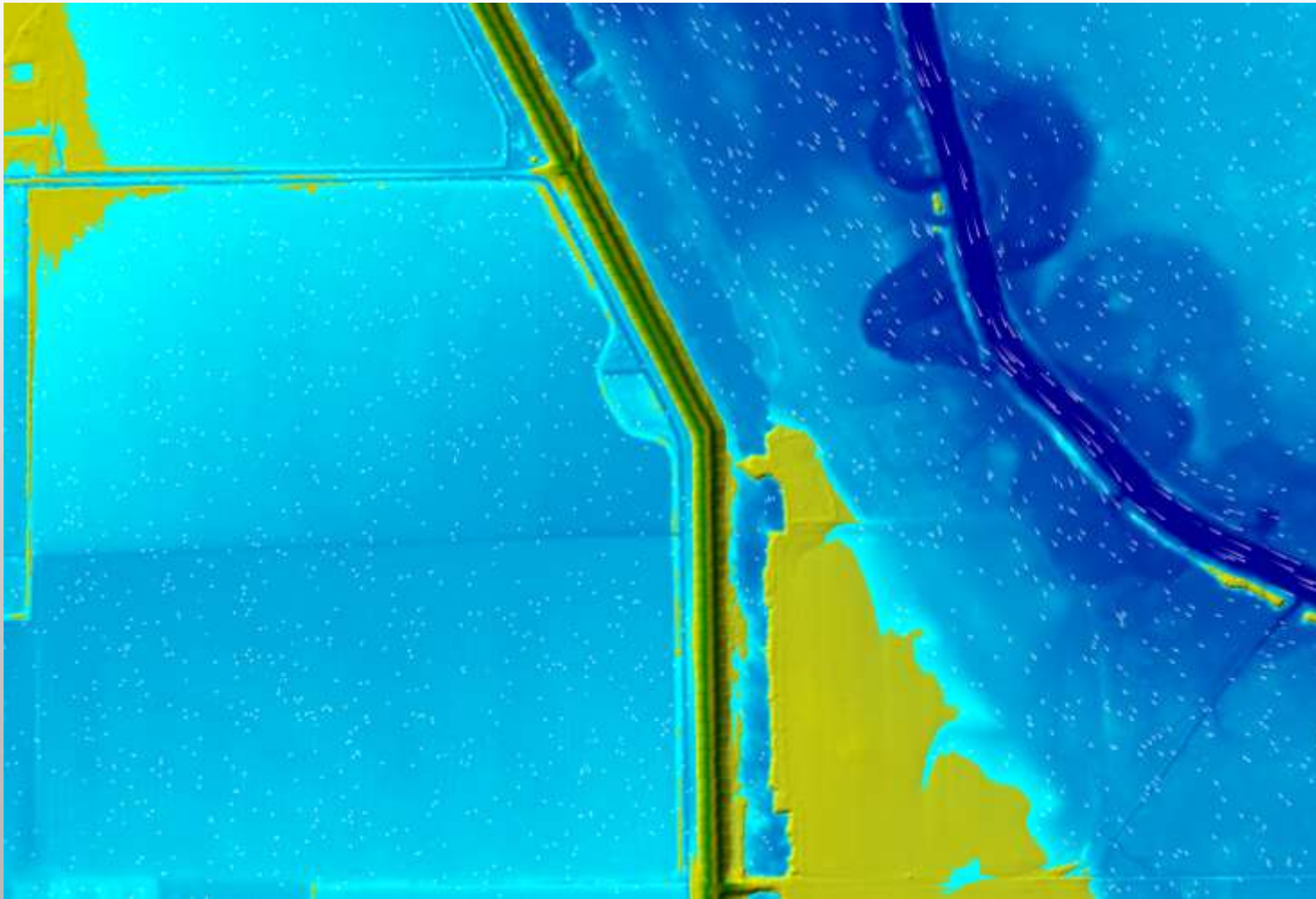
Velocity/Depth Derived
Frequency Based



VELOCITY AND DEPTH



DEPTH



QUESTIONS?

