Stantec

Kansas
Department of Agriculture
Division of Water Resources

2022 Kansas Governor's Water Conference

Technical Assistance and Western Kansas:

The Wild West of Hydrology

Lori Schrader, PE, CFM
Water Resources Engineer
Stantec

Tara Lanzrath, CFM
NFIP Coordinator
KDA

Agenda

1. KDA Risk MAP Program
2. Technical Assistance
3. Western Kansas Hydrology
4. Additional & Upcoming Technical Assistance

Stantec

Kansas
Department of Agriculture
Division of Water Resources

FEMA Floodplain Mapping Program

Risk Mapping, Assessment, and Planning (Risk MAP).

Performed on a watershed basis.

Consists of both Regulatory & Non-Regulatory Products.

Through Risk MAP, we provide updated floodplain maps, as well as other (free!) data and tools that can help you plan to reduce your community's risk.

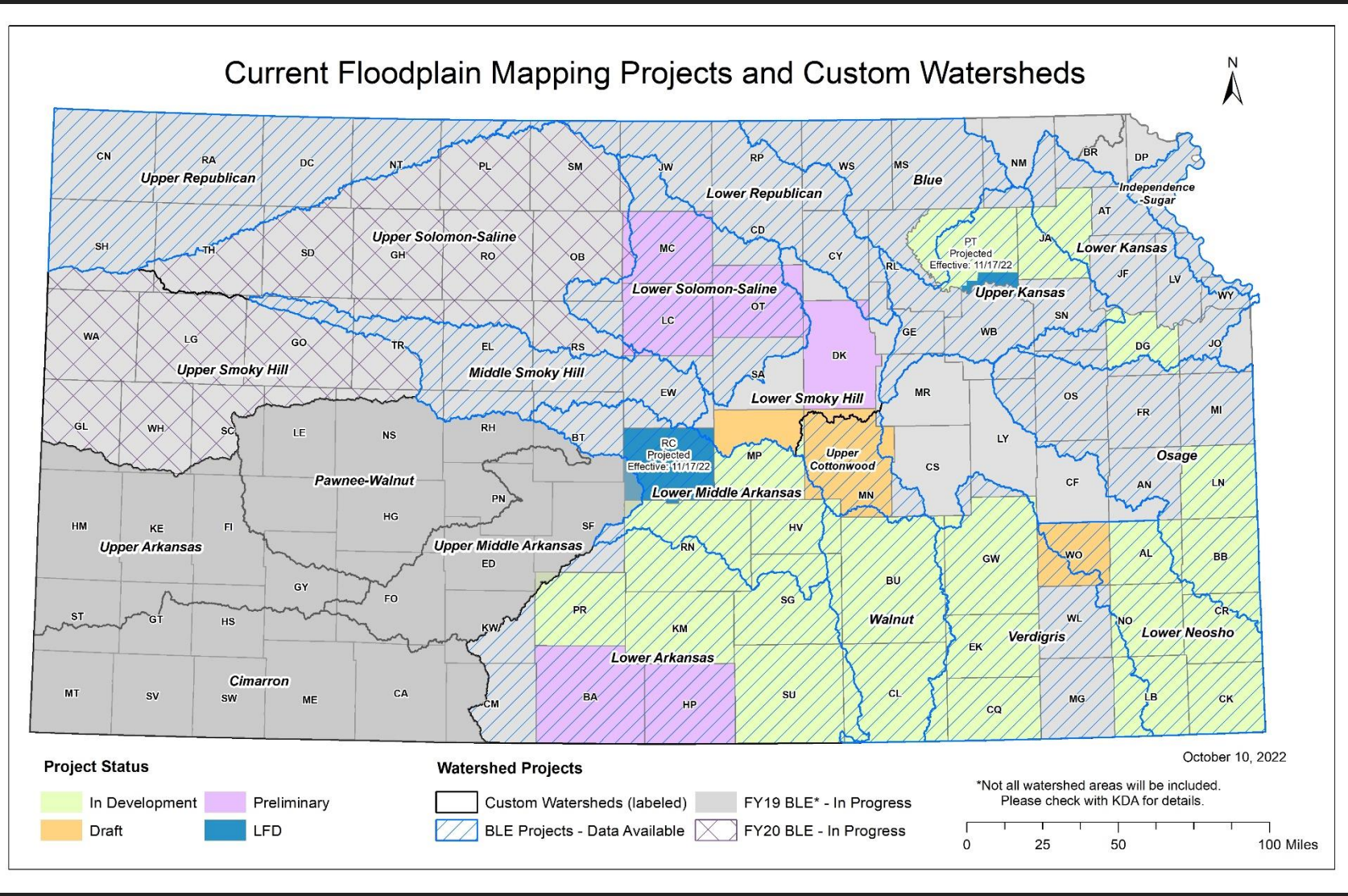
Contains funding for technical assistance projects.

RiskMAP

Increasing Resilience Together

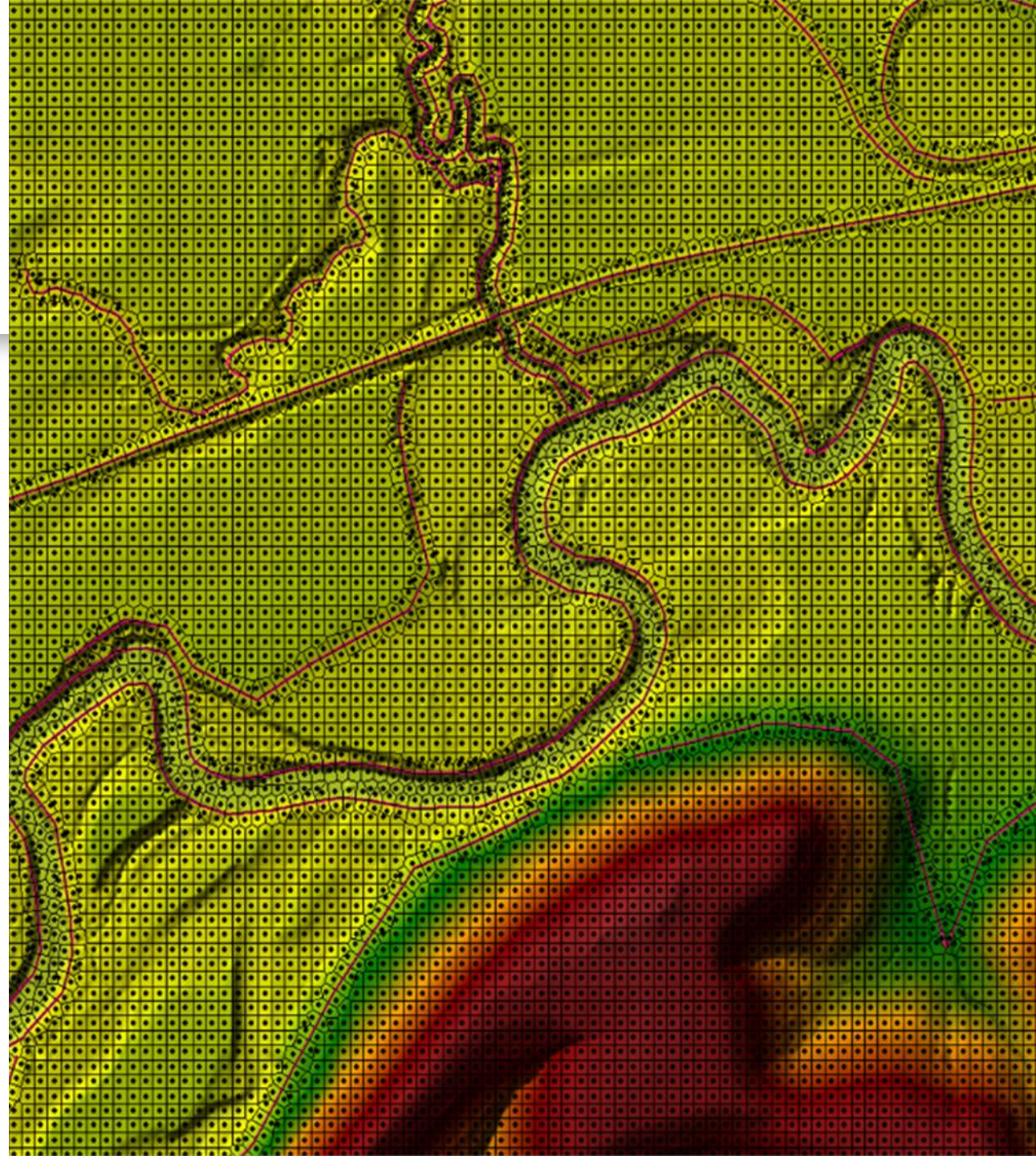
Floodplain Mapping Status in Kansas

- Performed on a custom watershed scale, but the models are broken down into several sub-watersheds
- Providing base flood risk data across the state to areas with no flood risk information or outdated mapping



What is 2D Base Level Engineering (BLE)?

- Starting in 5.0 HEC-RAS now includes a robust 2D engine and is no longer limited to 1D. 6.0 includes infiltration options.
- 2D models allow for water movement in multiple directions and shows pluvial risk (from rainfall).
  - It looks at the entire area, rather than a linear step-by-step computation.
- Modeling uses a mesh rather than cross sections, and calculates water movement everywhere, not just along specific streams identified with cross sections
- Breaklines are used to realign and resize mesh cells along features such as roadways and streambanks.



Education and Outreach

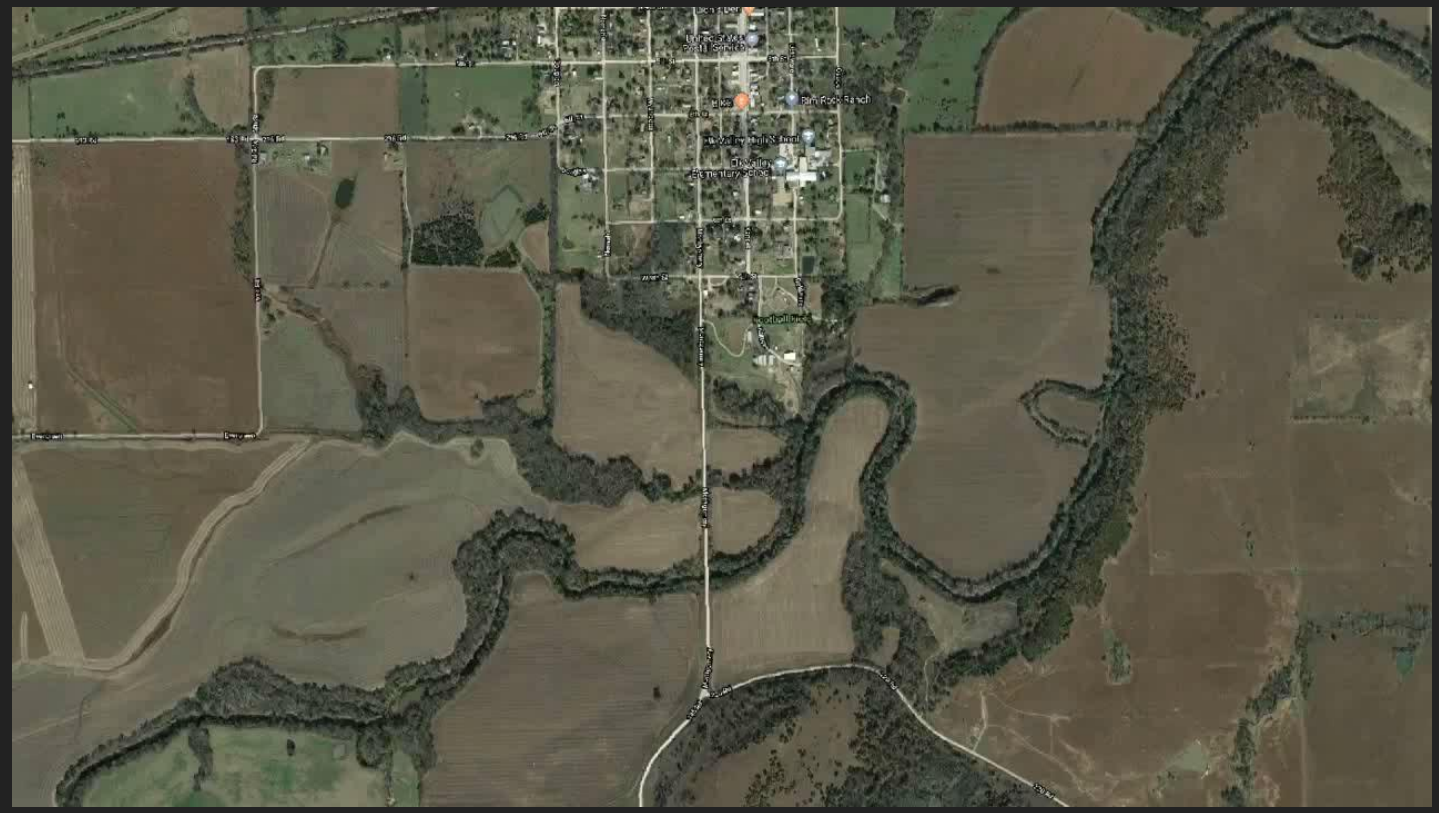
2D Deliverables:

Water Surface Elevation Grids

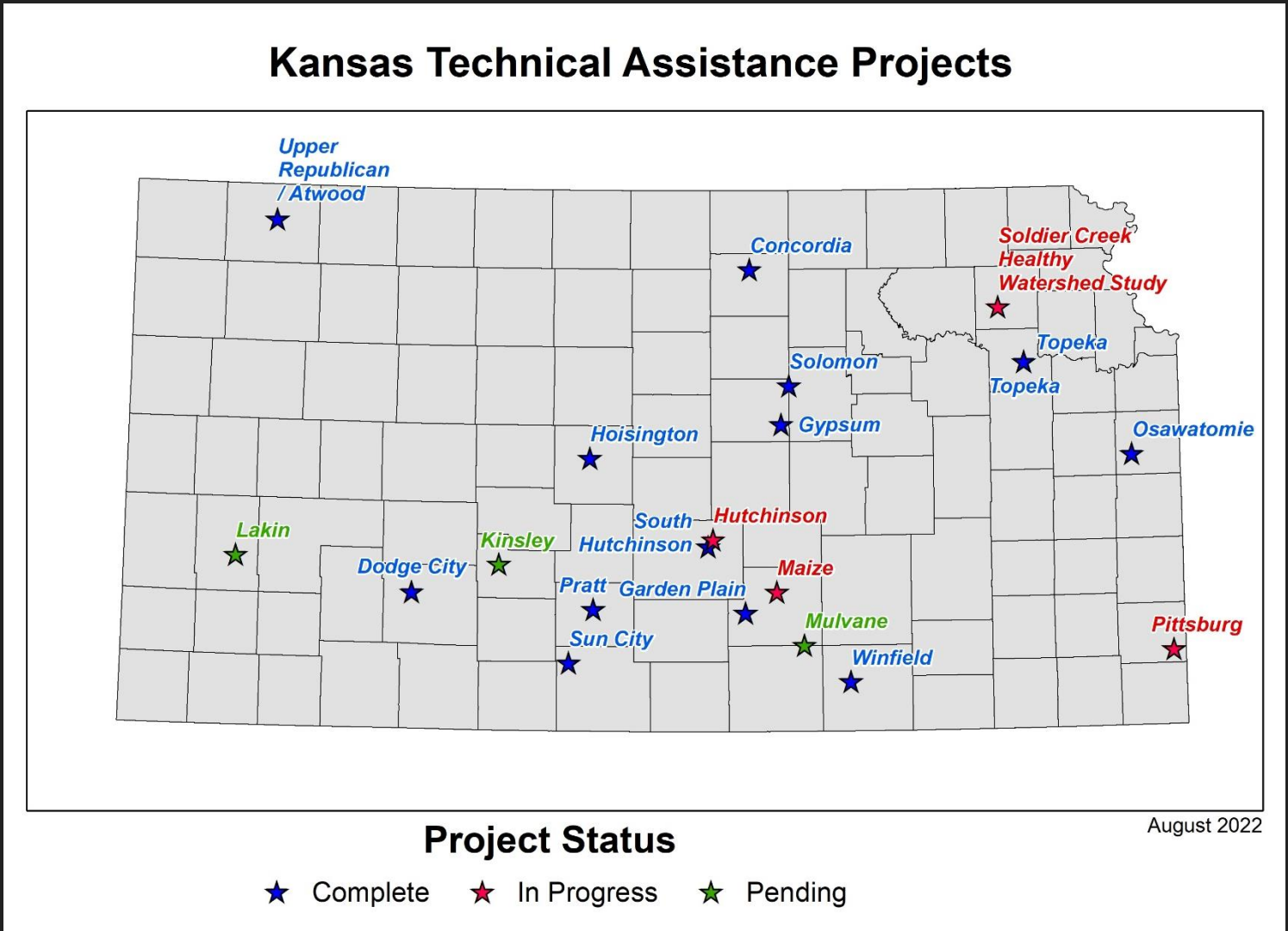
Depth Grids

Velocity Grids

Animations



Technical Assistance

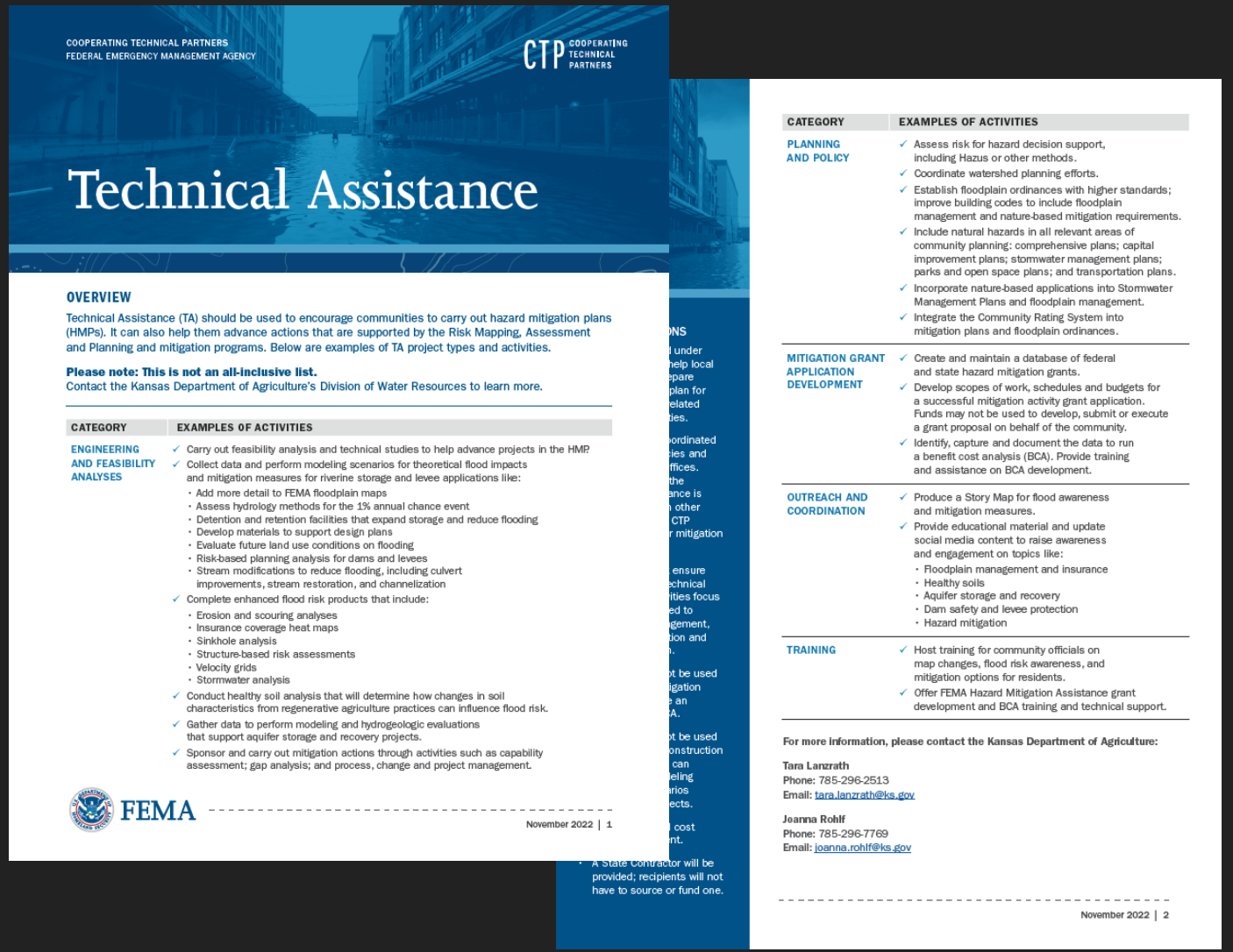


- Initiating Technical Assistance projects early in the Risk MAP process often utilizing the 2D Base Level Engineering Models to run scenarios
- Two Western Kansas hydrology studies funded in 2020-2021

Technical Assistance

- Develop flood and hazard mitigation plans and projects supported by the Risk MAP program
- Coordination with KDA and FEMA Region VII
- No local cost share requirement

KDA TA Fact Sheet



COOPERATING TECHNICAL PARTNERS
FEDERAL EMERGENCY MANAGEMENT AGENCY

CTP COOPERATING TECHNICAL PARTNERS

Technical Assistance

OVERVIEW

Technical Assistance (TA) should be used to encourage communities to carry out hazard mitigation plans (HMPs). It can also help them advance actions that are supported by the Risk Mapping, Assessment and Planning and mitigation programs. Below are examples of TA project types and activities.

Please note: This is not an all-inclusive list.
Contact the Kansas Department of Agriculture's Division of Water Resources to learn more.

CATEGORY	EXAMPLES OF ACTIVITIES
ENGINEERING AND FEASIBILITY ANALYSES	✓ Carry out feasibility analysis and technical studies to help advance projects in the HMP. ✓ Collect data and perform modeling scenarios for theoretical flood impacts and mitigation measures for riverine storage and levee applications like: • Add more detail to FEMA floodplain maps • Assess hydrology methods for the 1% annual chance event • Detention and retention facilities that expand storage and reduce flooding • Develop materials to support design plans • Evaluate future land use conditions on flooding • Risk-based planning analysis for dams and levees • Stream modifications to reduce flooding, including culvert improvements, stream restoration, and channelization ✓ Complete enhanced flood risk products that include: • Erosion and scouring analyses • Insurance coverage heat maps • Sinkhole analysis • Structure-based risk assessments • Velocity grids • Stormwater analysis ✓ Conduct healthy soil analysis that will determine how changes in soil characteristics from regenerative agriculture practices can influence flood risk. ✓ Gather data to perform modeling and hydrogeologic evaluations that support aquifer storage and recovery projects. ✓ Sponsor and carry out mitigation actions through activities such as capability assessment; gap analysis; and process, change and project management.

FEMA

November 2022 | 1

CATEGORY	EXAMPLES OF ACTIVITIES
PLANNING AND POLICY	✓ Assess risk for hazard decision support, including Hazus or other methods. ✓ Coordinate watershed planning efforts. ✓ Establish floodplain ordinances with higher standards; improve building codes to include floodplain management and nature-based mitigation requirements. ✓ Include natural hazards in all relevant areas of community planning; comprehensive plans; capital improvement plans; stormwater management plans; parks and open space plans; and transportation plans. ✓ Incorporate nature-based applications into Stormwater Management Plans and floodplain management. ✓ Integrate the Community Rating System into mitigation plans and floodplain ordinances.
MITIGATION GRANT APPLICATION DEVELOPMENT	✓ Create and maintain a database of federal and state hazard mitigation grants. ✓ Develop scopes of work, schedules and budgets for a successful mitigation activity grant application. Funds may not be used to develop, submit or execute a grant proposal on behalf of the community. ✓ Identify, capture and document the data to run a benefit cost analysis (BCA). Provide training and assistance on BCA development.
OUTREACH AND COORDINATION	✓ Produce a Story Map for flood awareness and mitigation measures. ✓ Provide educational material and update social media content to raise awareness and engagement on topics like: • Floodplain management and insurance • Healthy soils • Aquifer storage and recovery • Dam safety and levee protection • Hazard mitigation
TRAINING	✓ Host training for community officials on map changes, flood risk awareness, and mitigation options for residents. ✓ Offer FEMA Hazard Mitigation Assistance grant development and BCA training and technical support.

For more information, please contact the Kansas Department of Agriculture:

Tara Lanzrath
Phone: 785-296-2513
Email: tara.lanzrath@ks.gov

Joanna Rohlf
Phone: 785-296-7769
Email: joanna.rohlf@ks.gov

November 2022 | 2

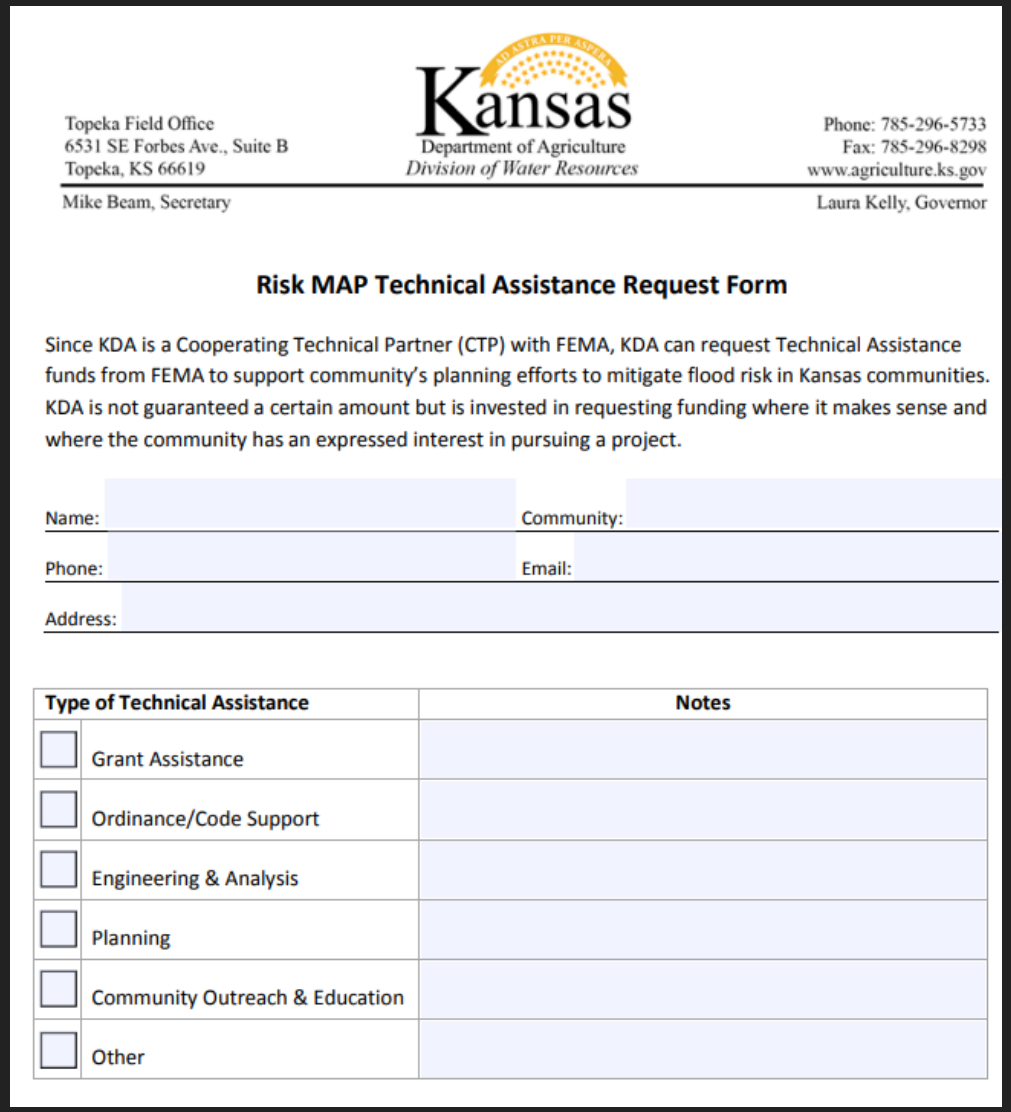
Technical Assistance Requests

Communities within Kansas can apply for Technical Assistance support through KDA

Technical assistance projects include:

- Ordinance or code support
- Grant-related purposes
- Engineering and analysis
- Outreach
- Education

KDA Technical Assistance Website



Topeka Field Office
6531 SE Forbes Ave., Suite B
Topeka, KS 66619

Kansas
Department of Agriculture
Division of Water Resources

Phone: 785-296-5733
Fax: 785-296-8298
www.agriculture.ks.gov

Mike Beam, Secretary — Laura Kelly, Governor

Risk MAP Technical Assistance Request Form

Since KDA is a Cooperating Technical Partner (CTP) with FEMA, KDA can request Technical Assistance funds from FEMA to support community's planning efforts to mitigate flood risk in Kansas communities. KDA is not guaranteed a certain amount but is invested in requesting funding where it makes sense and where the community has an expressed interest in pursuing a project.

Name: Community:

Phone: Email:

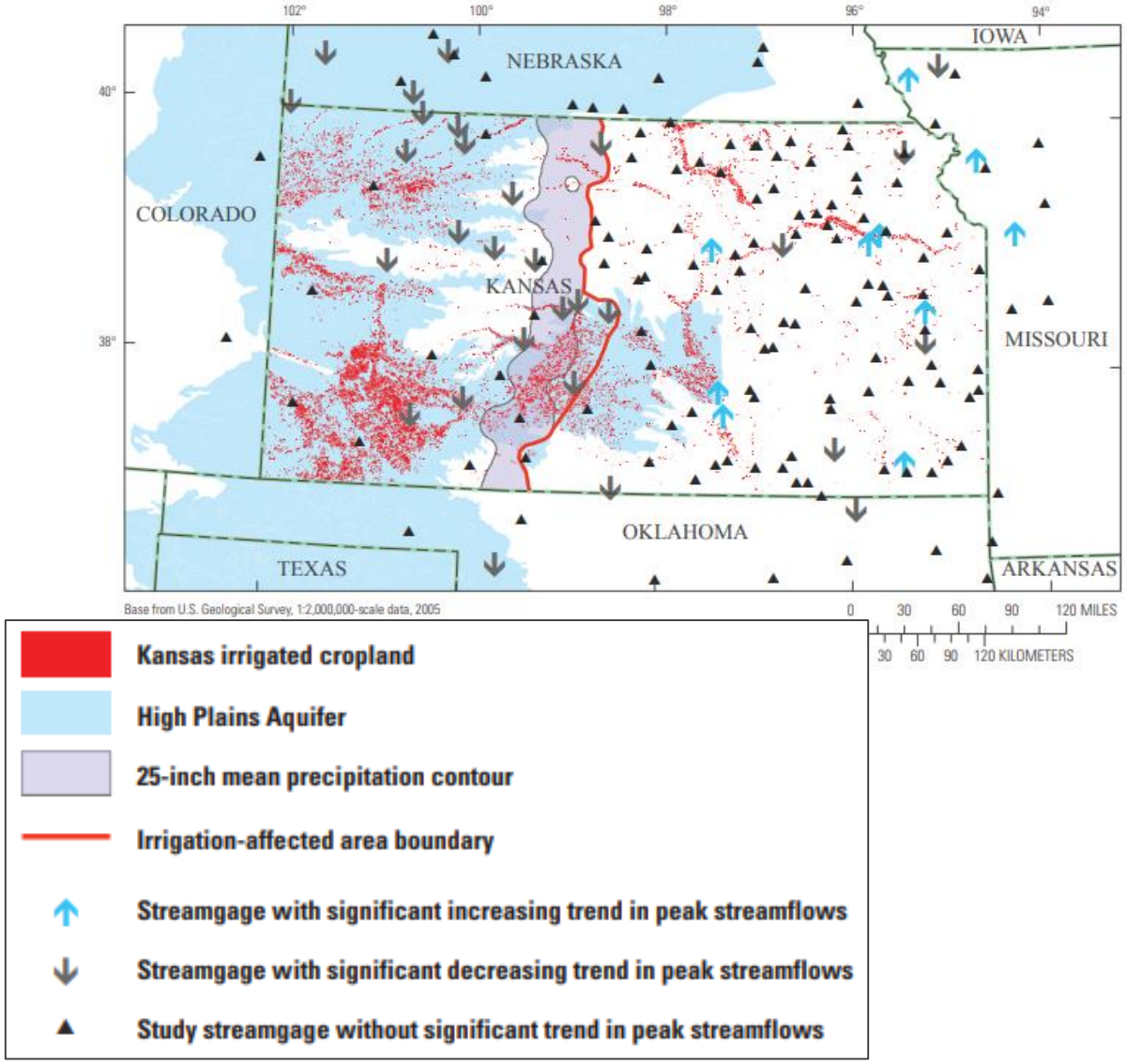
Address:

Type of Technical Assistance	Notes
☐ Grant Assistance	
☐ Ordinance/Code Support	
☐ Engineering & Analysis	
☐ Planning	
☐ Community Outreach & Education	
☐ Other	

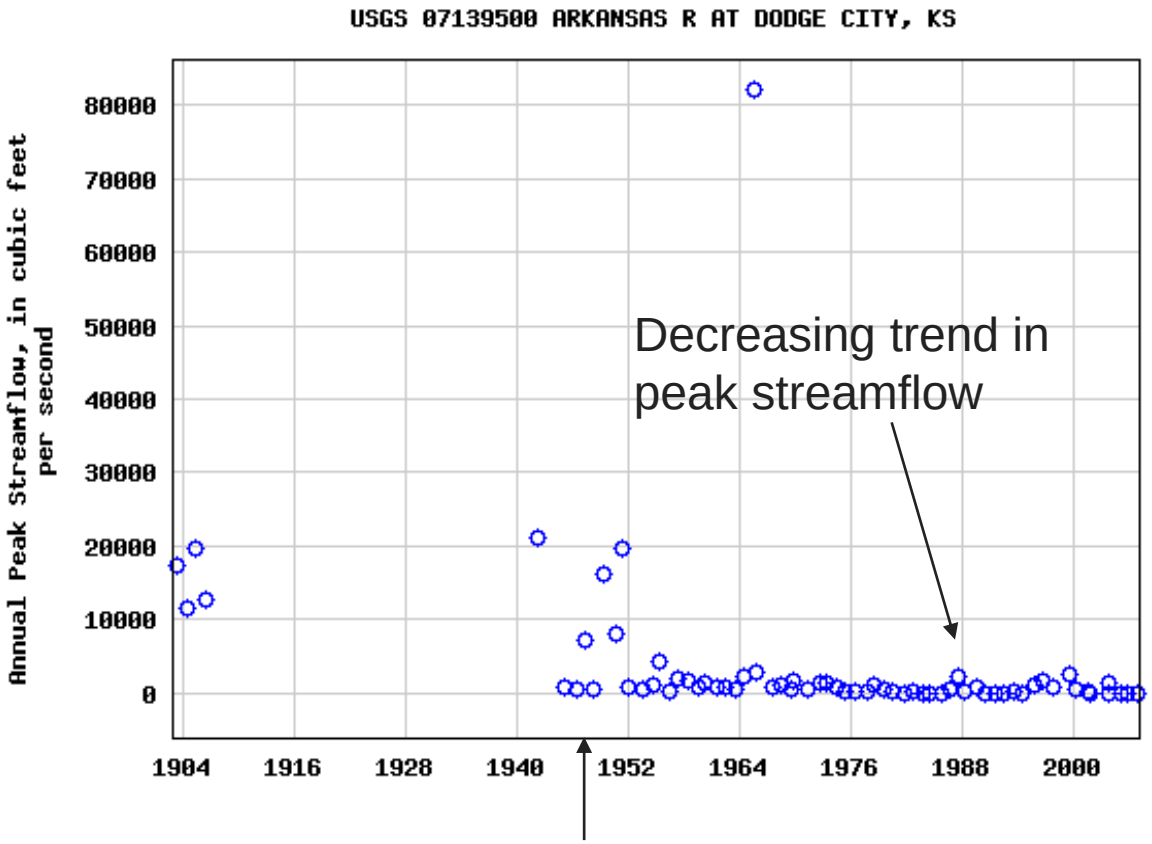
Western Kansas Hydrology

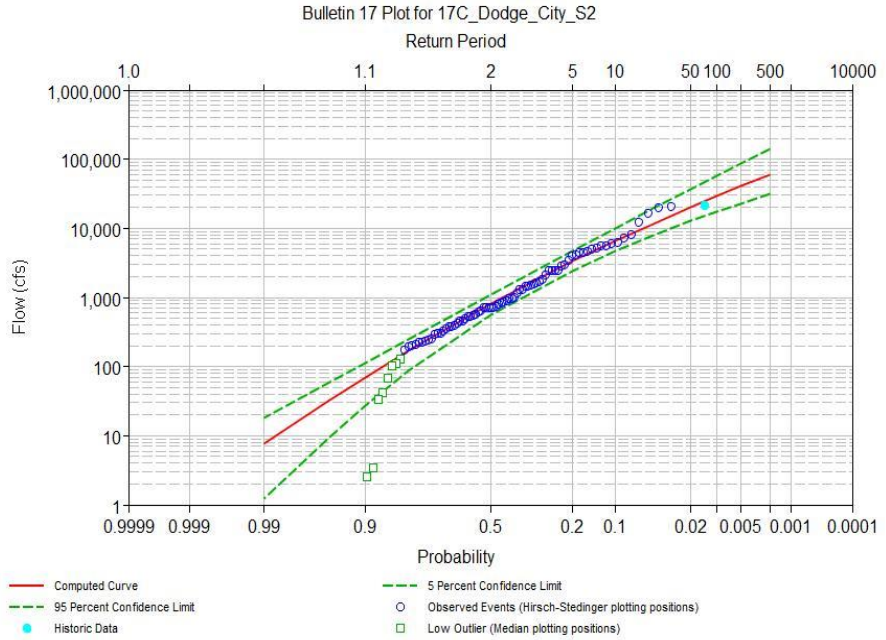
- Decreasing trends in peak stream flows
- No significant changes in precipitation trends

<u>Question #1</u>: How can we determine an appropriate 1% annual chance discharge for streams in Western Kansas that considers both historical gage peaks **and** the more recent decreasing trends of zero and low flow records?



Dodge City, KS - Technical Assistance





Mixed Distribution Analysis

1. Identify low outliers
   - Dodge City Gage = 13 outliers (critical value of 109 cfs)
2. Evaluate the probability density function (PDF) and cumulative distribution function (CDF) of the data
3. Determine appropriate distribution that fits extreme events
   - Log Pearson Type III (LP III) determined best fit for Dodge City
4. Develop a mixed distribution adjusted CDF curve
   - Account for low outliers by using an adjusted CDF curve to estimate annual exceedance probability

$$P_{E\_fit} = \frac{P_{E_{mix}}}{1 - P(low\ outlier)}$$

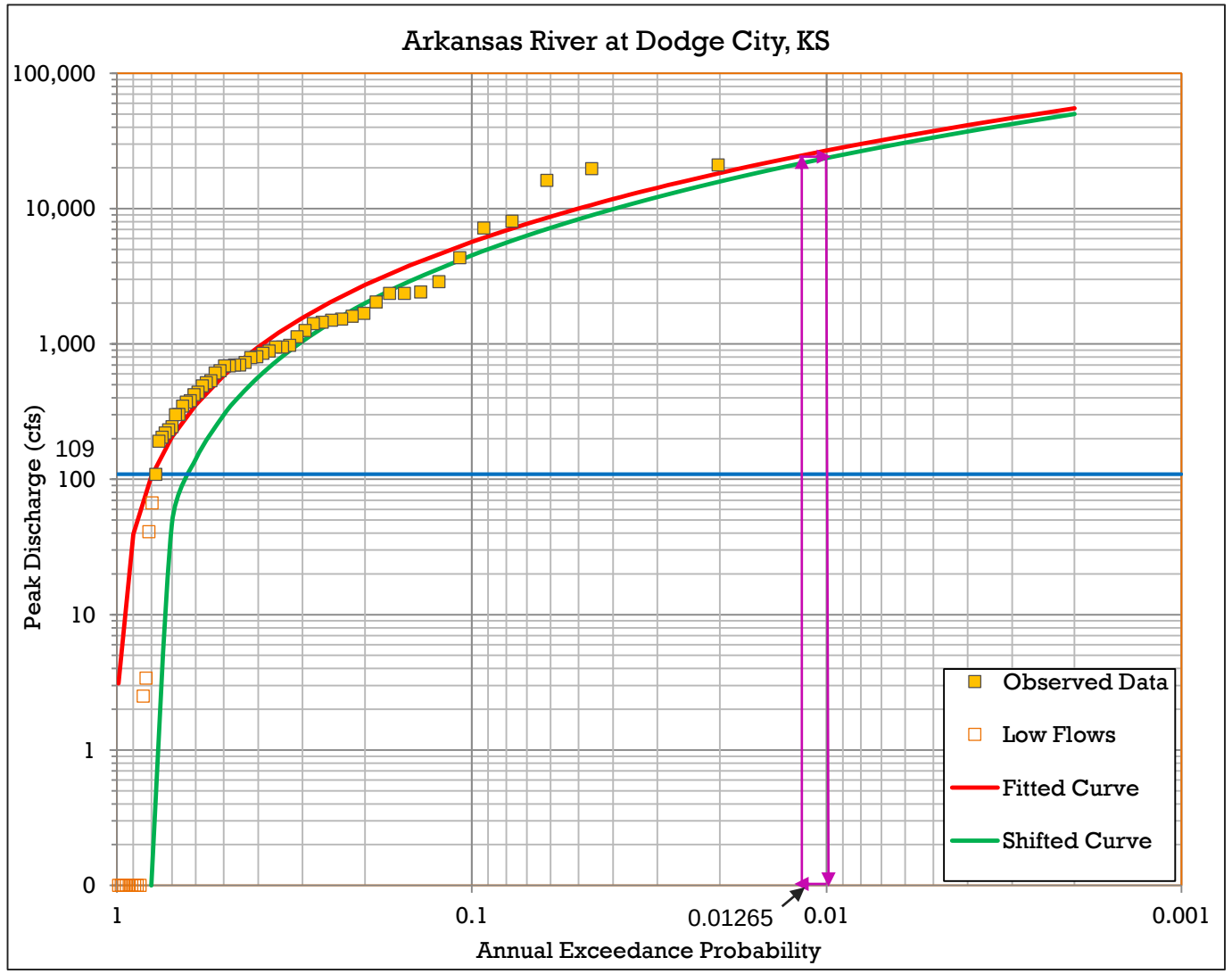
Dodge City Gage:

- P(low outlier) = 13/62
- $P_{E\_mix} = 0.01$
- $P_{E\_fit} = 0.01265$

Dodge City - Results

Analysis	1% Annual Chance Flow (cfs)	Difference
Effective FIS (1984)	49,900	NA
2009 USACE Study (17B)	33,190	-33.5%
Bulletin 17C Analysis (Post 1978)	8,968	-82.0%
USGS Regression Estimate	32,839	-34.2%
Mixed Distribution	23,694	-52.5%

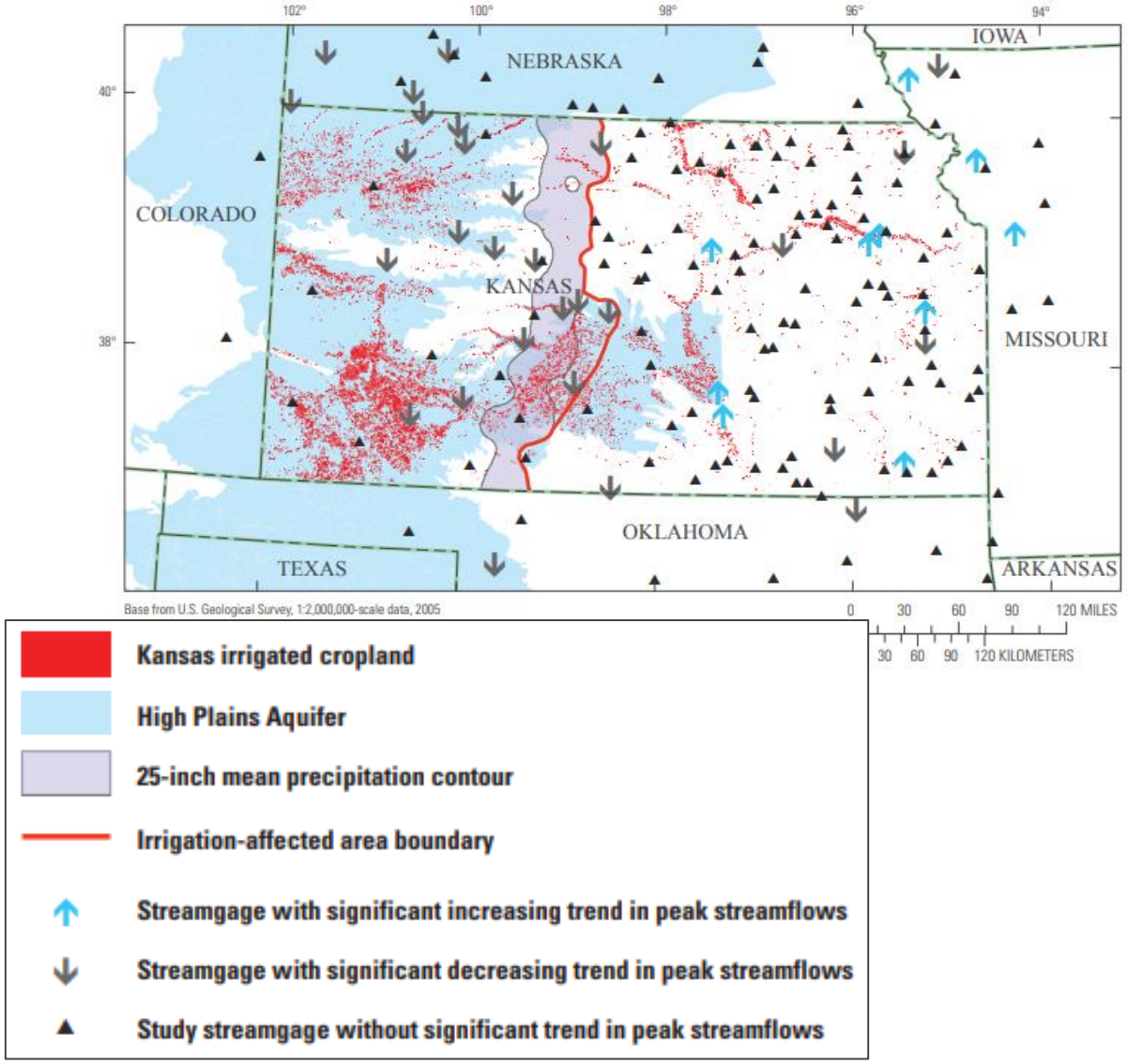
Dodge City TA Report



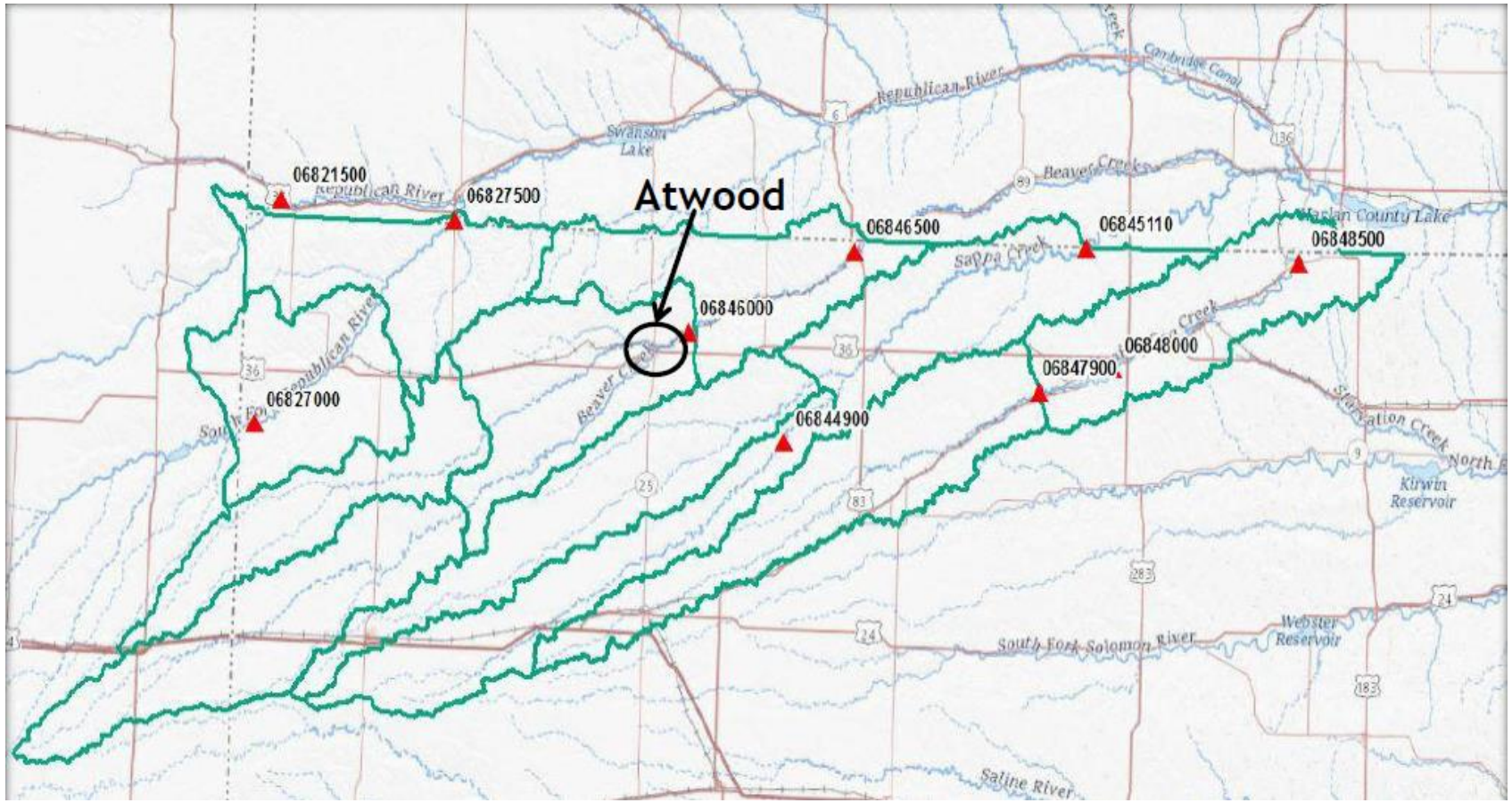
Western Kansas Hydrology

- Limited gage data available
- 2D watershed analysis considerations

Question #2: How does the trend of decreasing flows in Western Kansas impact watershed size (2D BLE) floodplain mapping studies in the area?



Upper Republican – Technical Assistance



- Gage Analysis and Rural Regression Equations (RRE) discrepancy
- Irrigation impacts on streamflow
- Standard 2D BLE flow verification methods challenging
  - RRE estimates considered unreasonable compared to Gage Analysis

Recommended Procedure

- Gage analysis given highest priority for verifying peak flows
  - Mixed distribution should be considered for areas affected by irrigation
- Flow verification methods may vary depending on basin characteristics and gage estimates
- Helpful Model Adjustments

Case	Description
1	Basins with Region 1 rural regression estimates that are in accordance with mixed distribution gage discharge estimates.
2	Basins with Region 2 rural regression estimates that are in accordance with mixed distribution gage discharge estimates.
3	Basins with Region 1 or Region 2 rural regression estimates that are not in accordance with mixed distribution gage discharge estimates.

Upper Republican TA Report

Flood Forecasting:
Pottawatomie Creek at Osawatomie

- Goal: Improve levee system operations along Pottawatomie Creek based on flood forecasting using the USGS Gage in Lane, KS
- Unsteady-state HEC-RAS modeling used to predict timing and stage of flooding at the levee
- Pottawatomie Creek impacted by flood conditions along Marais Des Cygnes River

Flood Forecasting:
Pottawatomie Creek at Osawatomie

- Based on analysis, development of a forecasting matrix to aid emergency preparedness

- Example: May 2019
  - MDC Gage: 41.5 ft
  - Lane Gage: 27.5 ft

- As more flood events occur, these tables can be compared to those observed flood events to fine-tune the timing of emergency actions

Osawatomie TA Report

MDC Lane / Stage (ft)	Stage (ft) / Elevation (ft)	23.0	28.0	36.0	40.0	41.5	43.0	46.0	51.0
Stage (ft)	Elevation (ft)	839.8	844.8	852.8	856.8	858.3	859.8	862.8	867.8
18.0	858.4	842.5 (3:20)	844.3 (3:00)	850.7 (2:35)	855.3 (2:10)	857.0 (2:25)	858.7*** (0:00)	862.2*** (0:00)	
23.0	863.4	847.8 (8:15)	848.4 (8:05)	851.8 (7:05)	855.6 (4:50)	857.3 (3:55)	858.9 (2:50)	862.3 (0:40)	
24.0	864.4	848.8 (9:20)	849.1 (9:00)	852.3 (8:00)	855.8 (5:40)	857.4 (4:30)	859.0 (3:30)	862.3 (1:15)	867.5*** (0:00)
25.0	865.4	850.1 (9:50)	850.4 (9:40)	852.7 (8:20	856.0	857.6	859.1	862.5 2:35)	
27.0	867.4	852.4	852.5	854.0				862.6	
27.5	867.9	853.3 (9:15)	853.4 (9:00)	854.7 (8:20				862.8 3:35)	
28.5	868.9	854.0 (9:00)	854.1 (8:45)	855.0 (8:20				862.9 3:40)	868.2 (0:40)
30.0	870.4	856.0 (8:25)	856.0 (8:15)	856.6 (7:55)	(7:15)	(6:45)	(6:00)	863.3 (4:05)	868.3 (1:15)
31.2	871.6	857.7** (8:00)		858.2 (7:30)	859.6 (6:55)	860.4 (6:30)	861.4 (5:55)	863.7 (4:25)	**868.5 (1:45)**
32.0	872.4	858.7** (7:05)		858.7 (7:25)	859.9 (6:50)	860.7 (6:30)	861.6 (5:50)	863.8 (4:25)	**868.6 (1:50)**
33.0	873.4	860.3** (7:05)		860.6 (6:50)	861.6 (6:10)	862.2 (5:50)	863.0 (5:30)	864.7 (4:20)	**868.9 (2:05)**
35.3	875.7	864.0** (5:50)		864.1 (5:35)	864.7 (5:25)	865.1 (5:30)	865.8 (4:45)	866.4 (3:15)	**869.6 (1:50)**
36.0	876.4	864.7** (5:40)		864.7 (5:30)	865.3 (5:10)	865.8 (5:35)	866.1 (4:05)	866.6 (3:10)	**869.8 (1:55)**
37.0	877.4	866.5** (5:35)		866.7 (5:35)	867.1 (4:35)	867.1 (4:00)	867.1 (3:35)	867.7 (3:20)	**870.2 (2:05)**

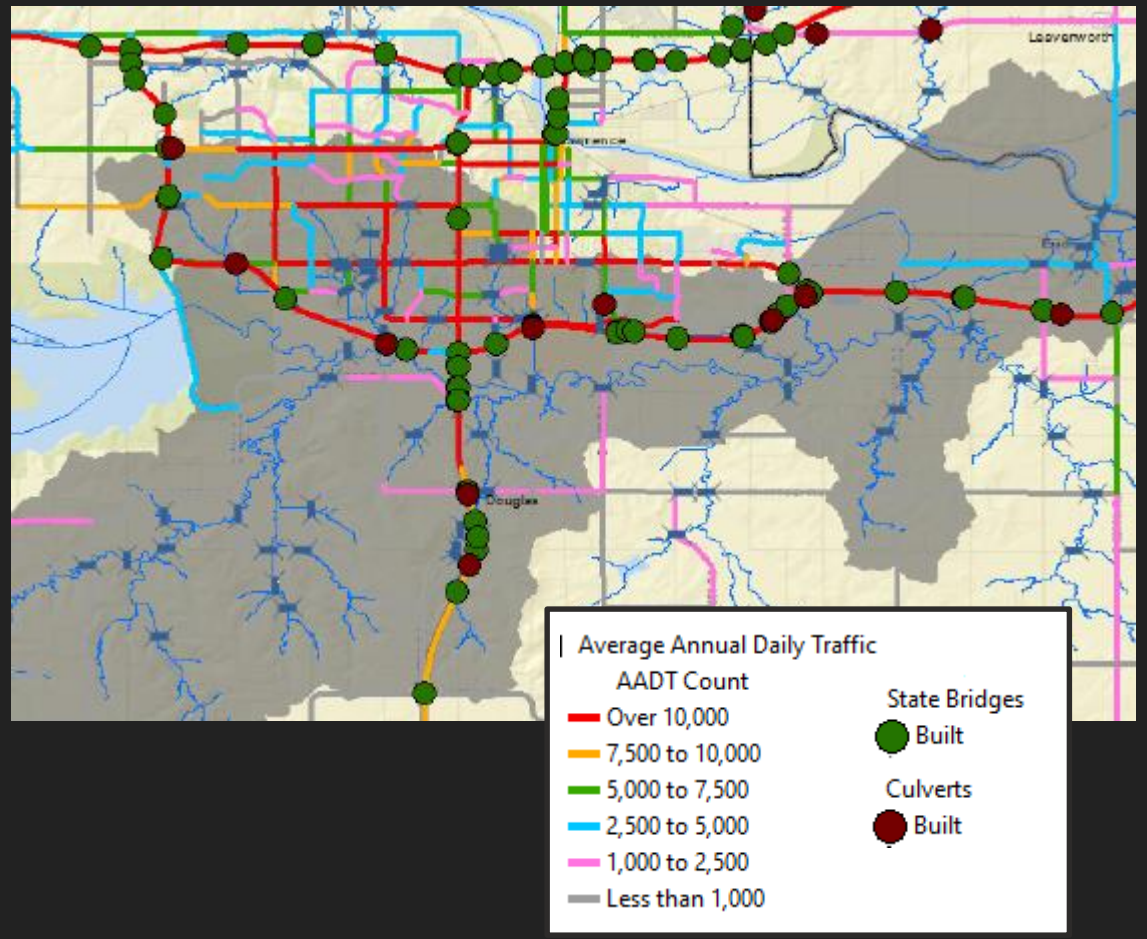
May 2019 Event

858.3
(6:20)

No flooding at the railroad closure | Water within 2.0 ft below railroad closure invert | Water overtops railroad closure invert | Levee overtopping at railroad closure

Roadway Overtopping Frequency Analysis:

Douglas County, KS



- Goal: leverage existing 2D BLE watershed modeling to determine
  1. Flash flood potential given rainfall forecast data
  2. Roadway overtopping frequencies

- Produce report summarizing analysis procedures, key assumptions, results, and potential recommendations

Estimated Completion: Winter 2023/2024

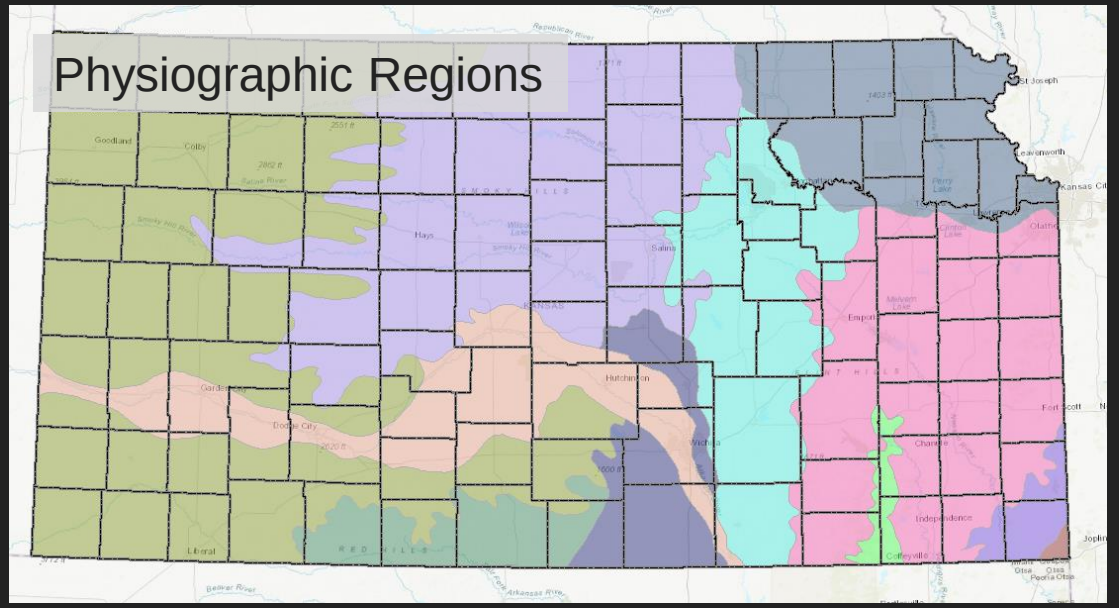
Natural and Nature-based Solutions:

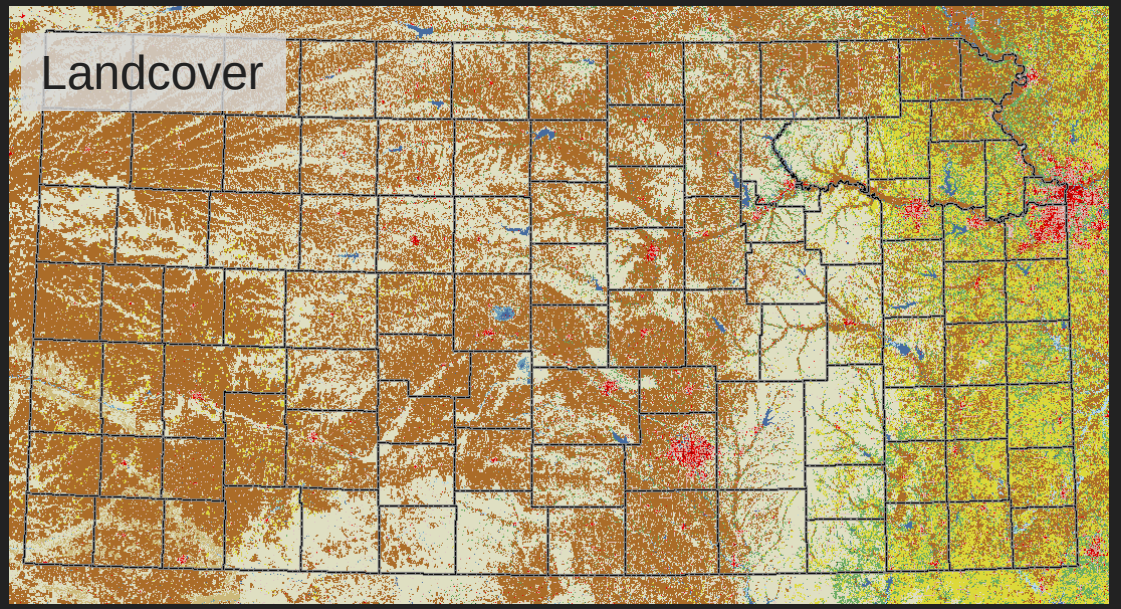
State of Kansas

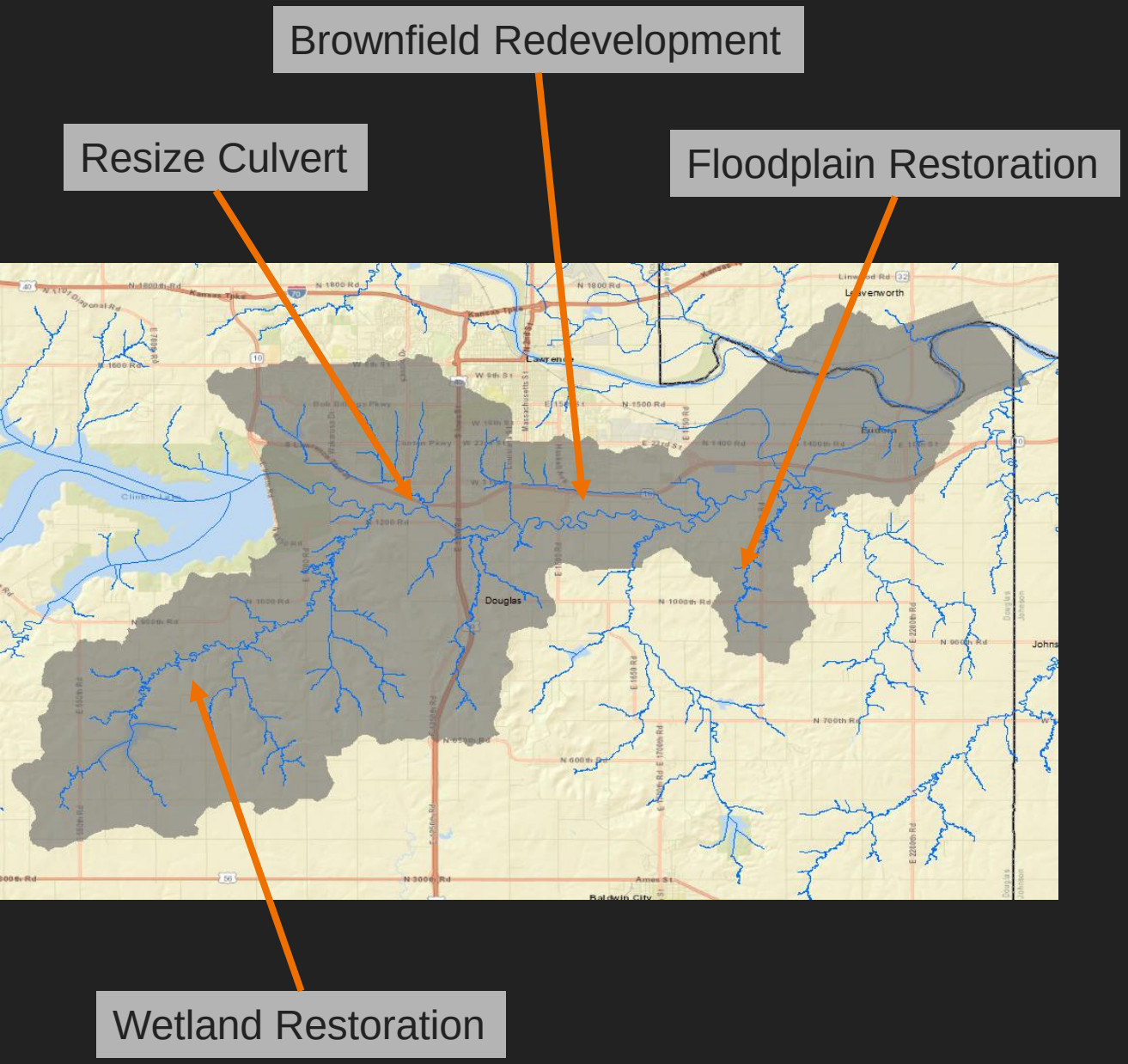
- Goal: Identify what and where there is potential to reduce flood risk in Kansas using natural and nature-based solution projects which are BRIC eligible

- Produce report summarizing most applicable solutions throughout the state of Kansas

Estimated Completion: Winter 2023/2024







Watershed Mitigation Solutions:

State of Kansas

- Goal: utilize findings of previous two TA projects to evaluate mitigation actions using existing 2D BLE watershed models

- Evaluate benefits and costs to develop a hierarchy for competitive and non-competitive funding opportunities

Estimated Completion: Winter 2023/2024

Questions?

Lori Schrader, PE, CFM
Water Resources Engineer
Stantec
Lori.Schrader@stantec.com

Tara Lanzrath, CFM
NFIP Coordinator
Kansas Department of Agriculture
Tara.Lanzrath@ks.gov