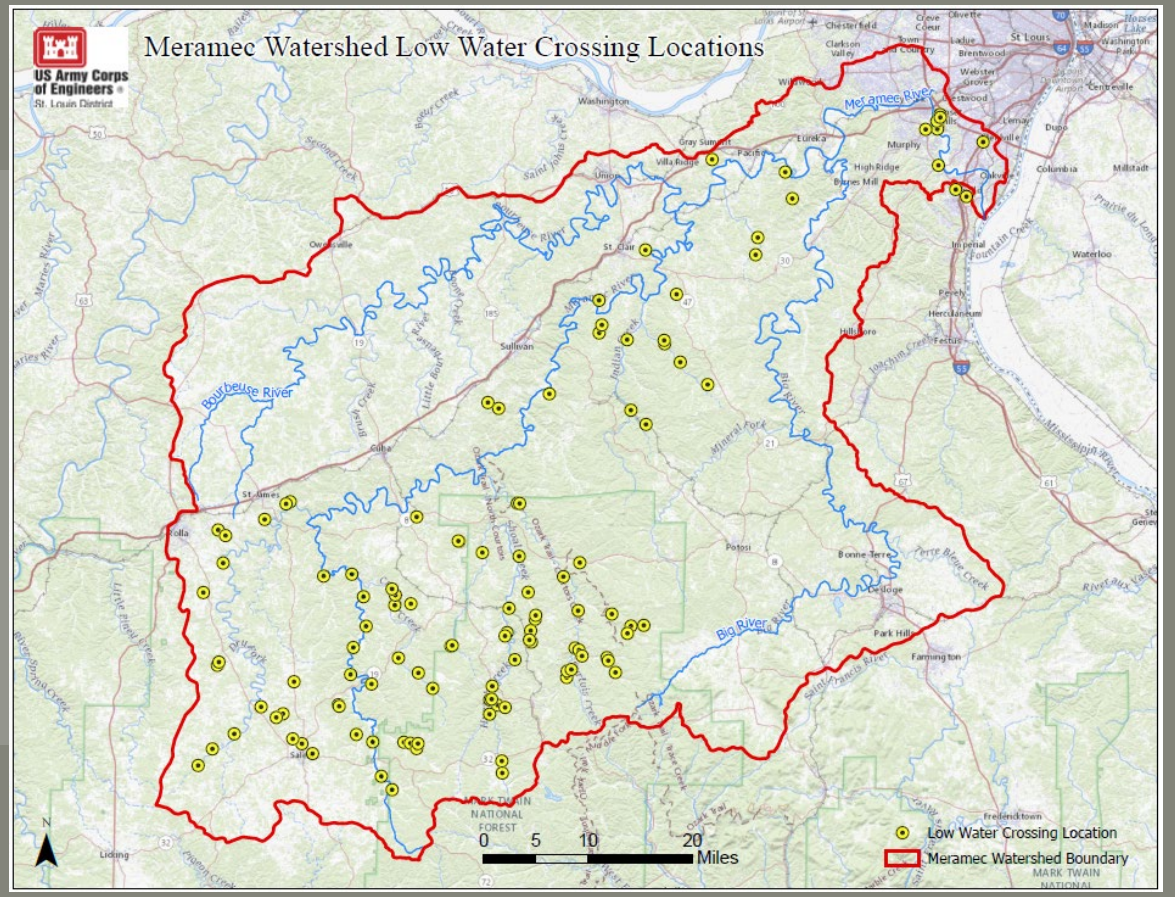
# MERAMEC LOW WATER CROSSINGS (LWC)

## RRAT - 2023




*"The views, opinions and findings contained in this report are those of the authors(s) and should not be construed as an official Department of the Army position, policy or decision, unless so designated by other official documentation."*

US Army Corps of Engineers ®

U.S.ARMY

# SILVER JACKETS PROGRAM

**Interagency Flood Risk Management**

- Silver Jackets teams in states across the United States bring together multiple state, federal, and local agencies to learn from one another in reducing flood risk.
- State-led interagency team.
- By applying their shared knowledge, the teams enhance response and recovery efforts when such events do occur.
- No single agency has all the answers but leveraging multiple programs and perspectives can provide a cohesive solution.
- Although each state Silver Jackets team is unique, common agency participants include state agencies with mission areas of hazard mitigation, emergency management, floodplain management, natural resources management or conservation, etc.

US Army Corps of Engineers ®

U.S.ARMY

# SILVER JACKETS TEAM

**USACE:**

- Liz Norrenberns
- Hal Graef
- Shawn Sullivan
- John Boeckman
- Teri Allen
- Matt Hill
- Asher Leff
- Joey Seib
- Michelle Puzach
- Evan Stewart
- Cathy VanArsdale
- Jamie Simmons
- John McEnery
- Andrea Figueroa Soto
- Terry Acree
- Gafur Umarov
- Cindy Wood

**MODOT:**

- Chris Engelbrecht

**TNC:**

- Barbara Charry
- Rob Pulliam

**MDC:**

- Ange Corson
- Paul Blanchard

**USFWS:**

- Jahn Kallis

**Forrest Service**:

- Kelly Whitsett

**Meramec Regional Planning Commission:**

- Tammy Snodgrass

**East-West Gateway Councils of Government:**

- Mary Grace Lewandowski

**SEMA:**

- Darryl Rockfield
- Patrick Lower

**FEMA:**

- Joe Chandler

US Army Corps of Engineers ®

U.S.ARMY

# MERAMEC LWC BACKGROUND

**PROJECT SCOPE**
Identify low water crossings in the Meramec (HUC-8) Watershed that pose high risk to life, prioritize crossings for mitigation, recommend actions to reduce risk and build resilience, pair projects with mitigation funding sources to address a major public safety issue.

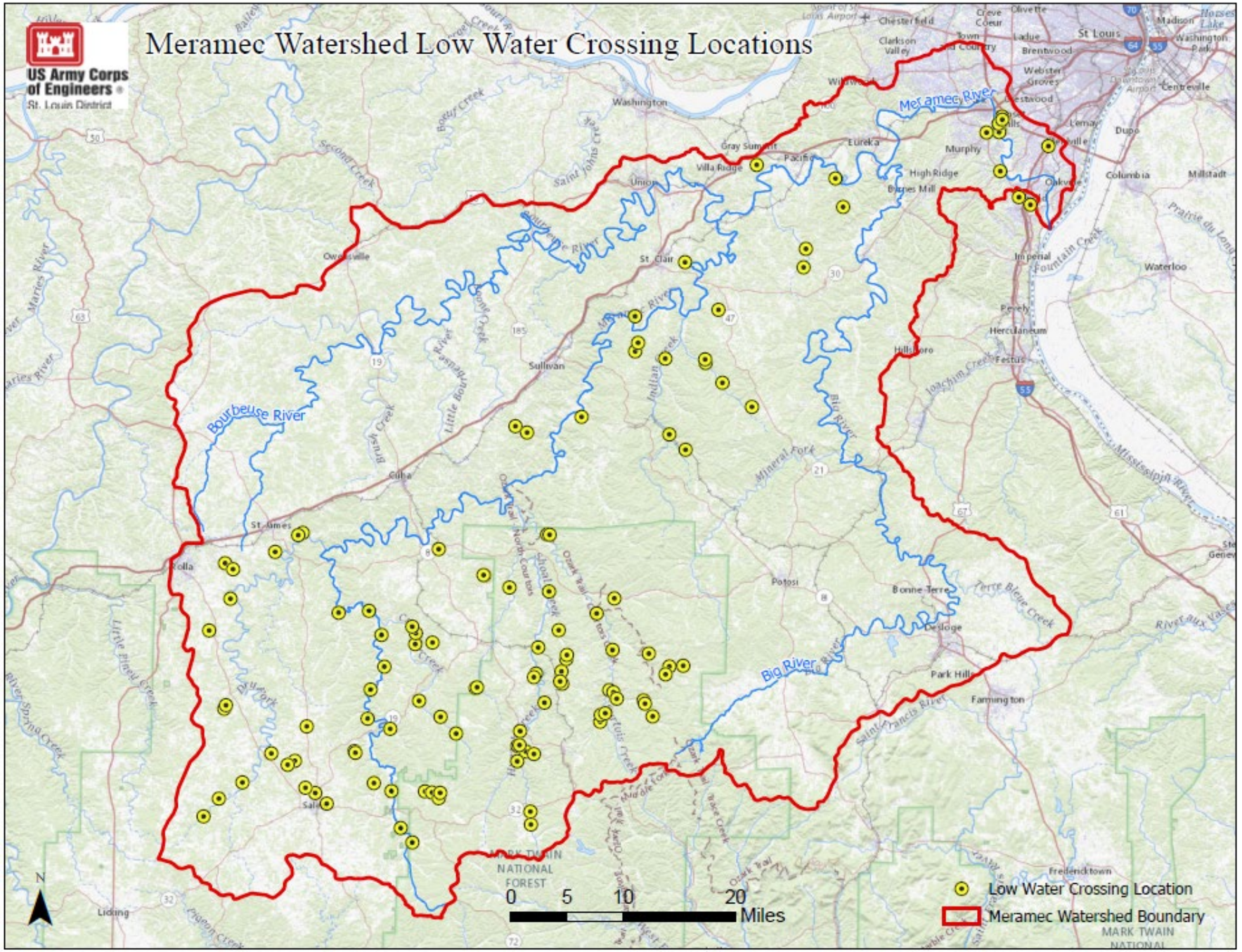
**Objective No.1:** High risk will be based on traffic and/or population served (structures served), its vulnerability to damage, length of time the crossing is unpassable, and available detours.

**Objective No. 2:** Prioritize crossings for physical or non-physical mitigations, recommend actions to reduce risk and build resilience by recommending design and construction standards for specific crossing that will enable them to withstand flash floods and reopen more quickly after a flooding event.

**Objective No.3:** Leverage resources from those agencies where crossing improvements have multiple benefits such as reduced risk to life, reduced repetitive damage to infrastructure as well as improved hydraulic and geomorphic response including aquatic organism passage. Document findings from all objectives in a low water crossing mitigation plan.

US Army Corps of Engineers ®

U.S.ARMY

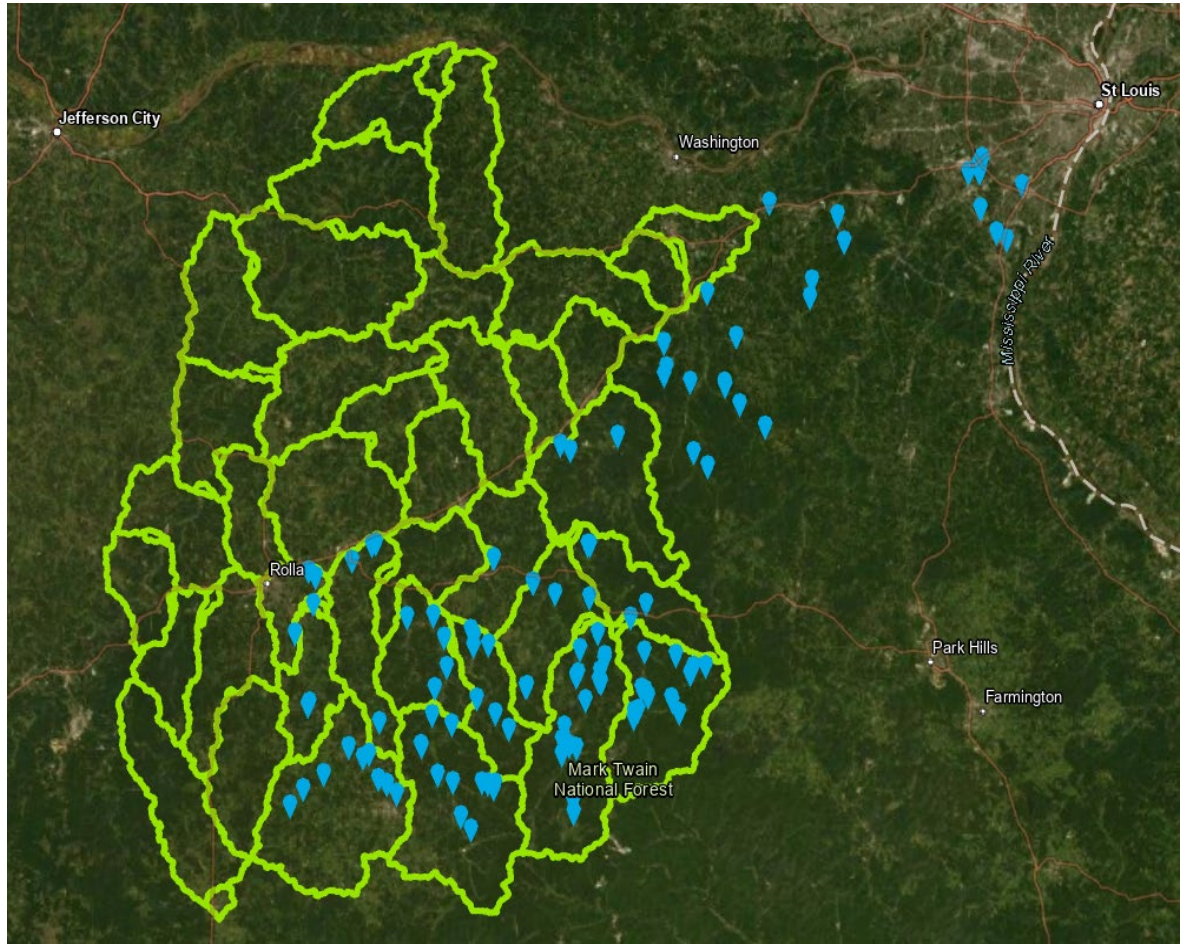



- Locations pulled from FWS Report - Stream Crossings Posing Barriers To Aquatic Organism Movement: Meramec River Watershed
- 118 LWCs displayed

US Army Corps of Engineers ®

U.S.ARMY

# HYDRAULIC STUDY




89 of the 118 structures are within the Meramec HEC-RAS 2D models

The models are currently being run and evaluated to gather data to prioritize these structures

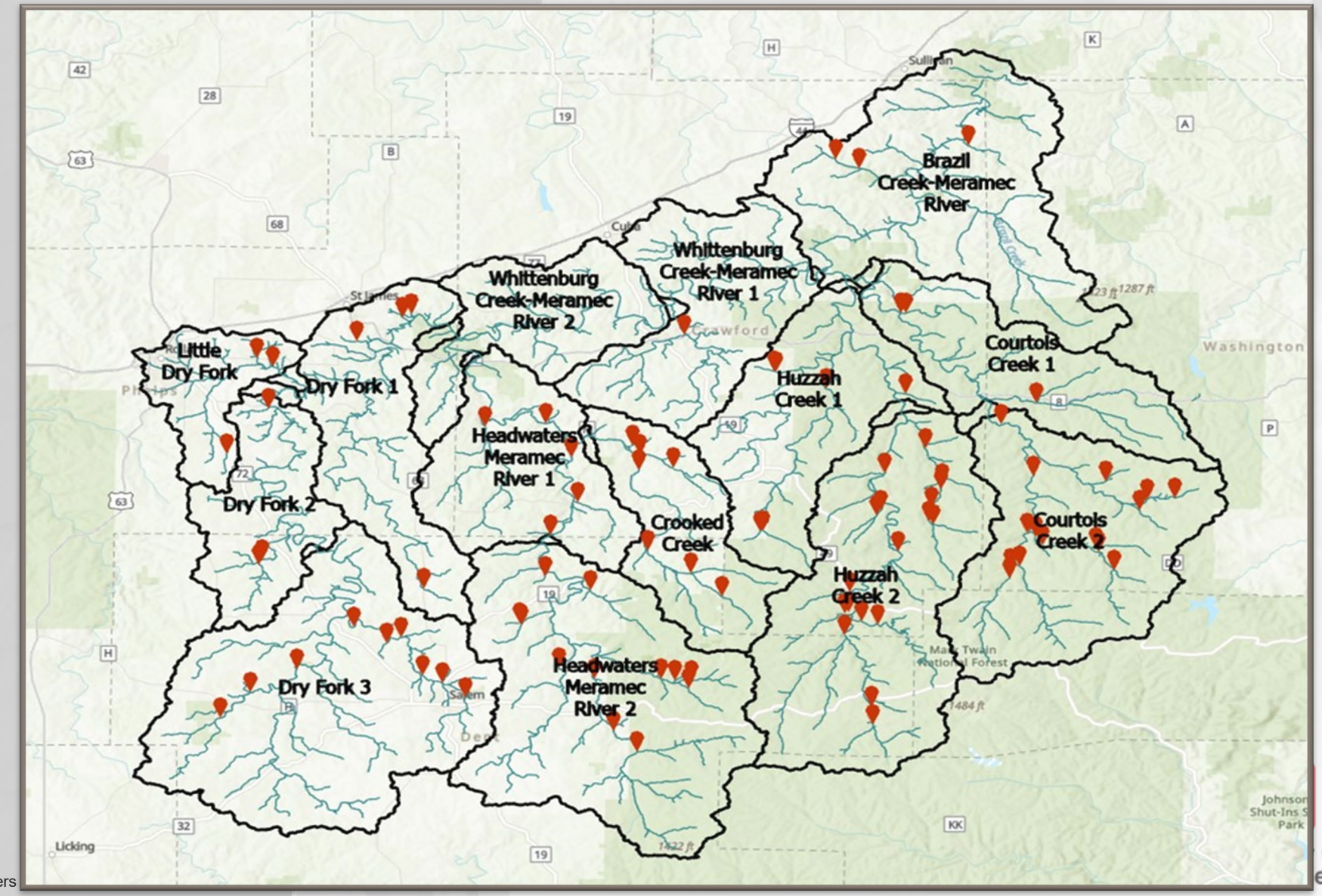
The RAS models cover these streams:

- Boone Creek
- Brush Creek
- Dry Fork Creek
- Lower Bourbeuse River 1,2, 3
- Middle Bourbeuse River
- Spring Creek
- Upper Bourbeuse River 1, 2
- Courtois Creek 1, 2
- Crooked Creek
- Spring Creek
- Brazil Creek-Meramec River
- Courtois Creek 1, 2
- Crooked Creek
- Dry Fork 1,2, 3
- Headwaters Meramec River 1, 2
- Huzzah Creek 1
- Little Dry Fork
- Whittenburg Creek-Meramec River 1, 2

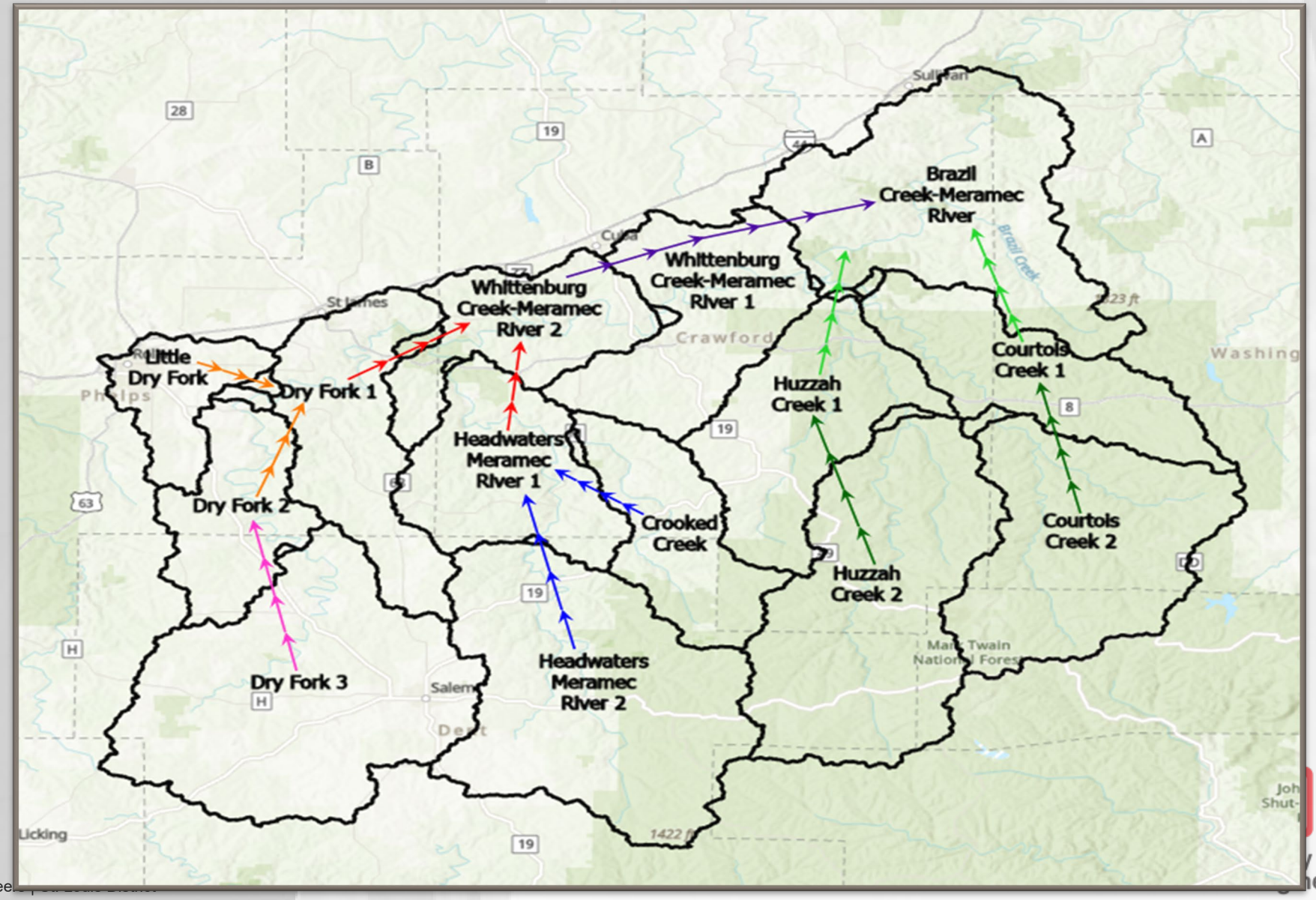
US Army Corps of Engineers ®

U.S.ARMY

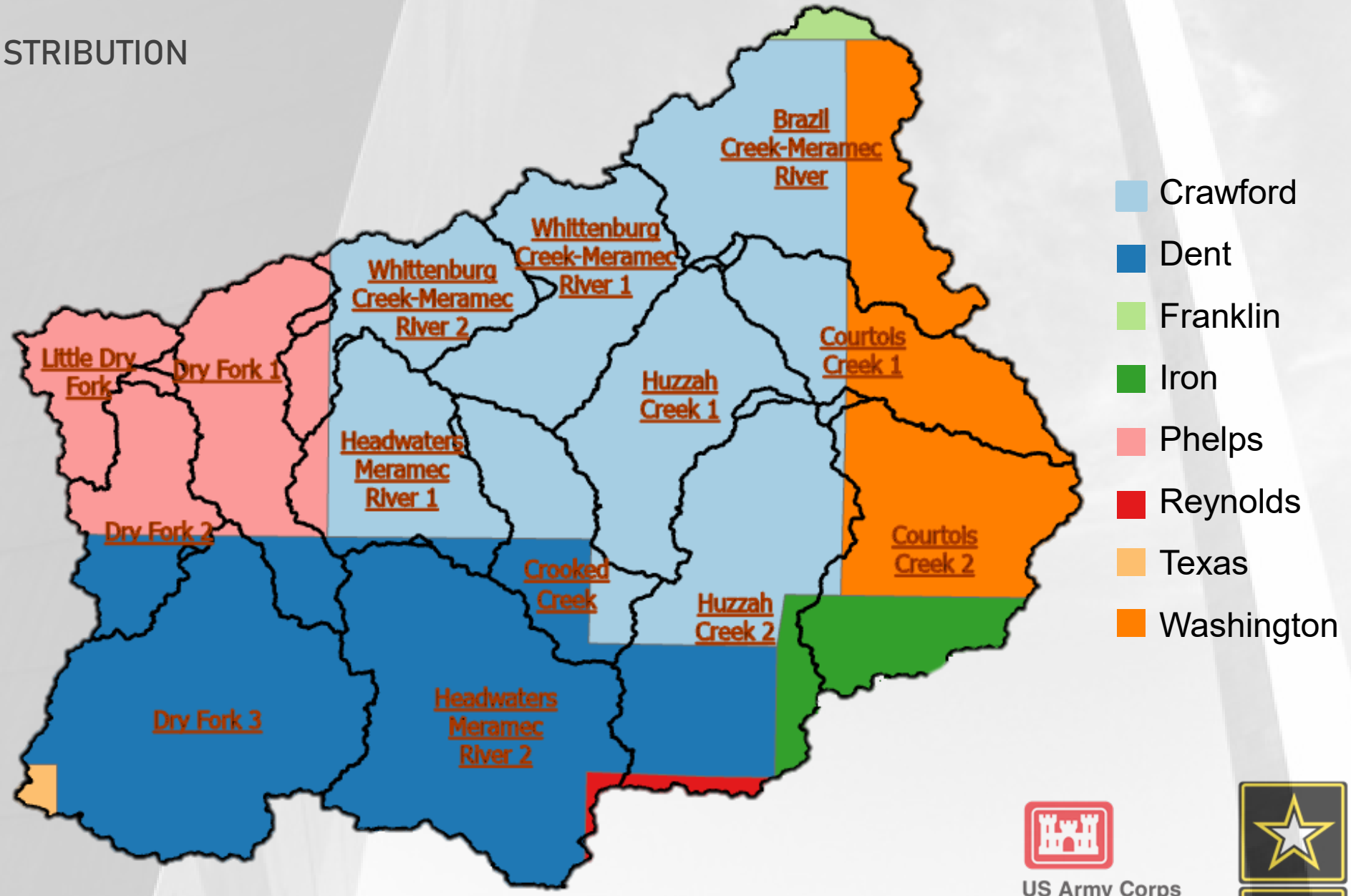
# LWC BASIN MAP



# LWC BASIN FLOW PATHS



# LWC COUNTY DISTRIBUTION






US Army Corps of Engineers ®

U.S.ARMY

# HEC-LIFESIM

Provides the ability to **track individual people** throughout the warning and evacuation process (Agent based)

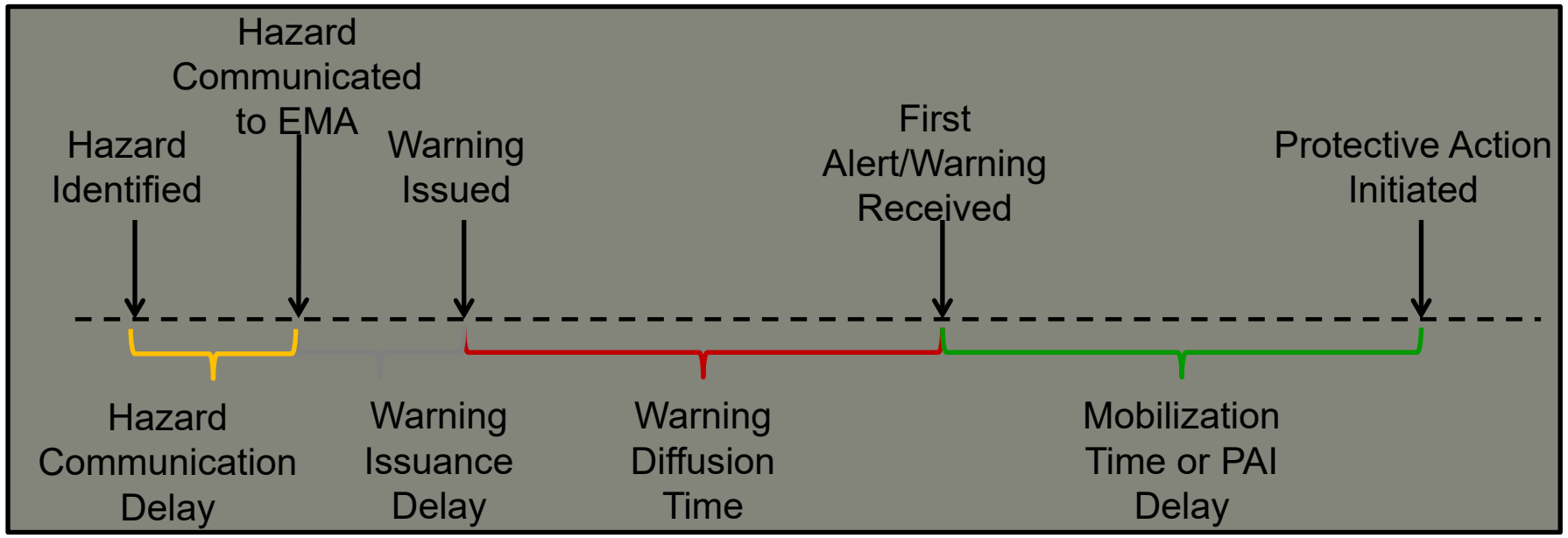
**Traffic simulation** engine to estimate the evacuation process

Monte Carlo sampling with uncertainty produces a **distribution of life loss results**

US Army Corps of Engineers ®

U.S.ARMY

# LifeSim – Population Redistribution




US Army Corps of Engineers ®

U.S.ARMY

# POPULATION REDISTRIBUTION

US Army Corps of Engineers ®

U.S.ARMY

# FISH PASSAGE

## Objective: Optimize longitudinal **aquatic organism passage** while reducing risk to life, and repetitive damage to infrastructure

Fish Passage Considerations:

- Physical and behavioral barriers
- Length of stream habitat reconnected
- Passage opportunity
- Natural streambed preferred
- Hydraulic and habitat diversity is necessary


Constraints:

- **Existing conditions** (stream type, width, inundation frequency, flow volume, traffic/usage) **influence crossing structure types**: hardened, at-grade crossing, arch/oversized culvert, prefabricated arch crossing, slab crossing.
- **COST**

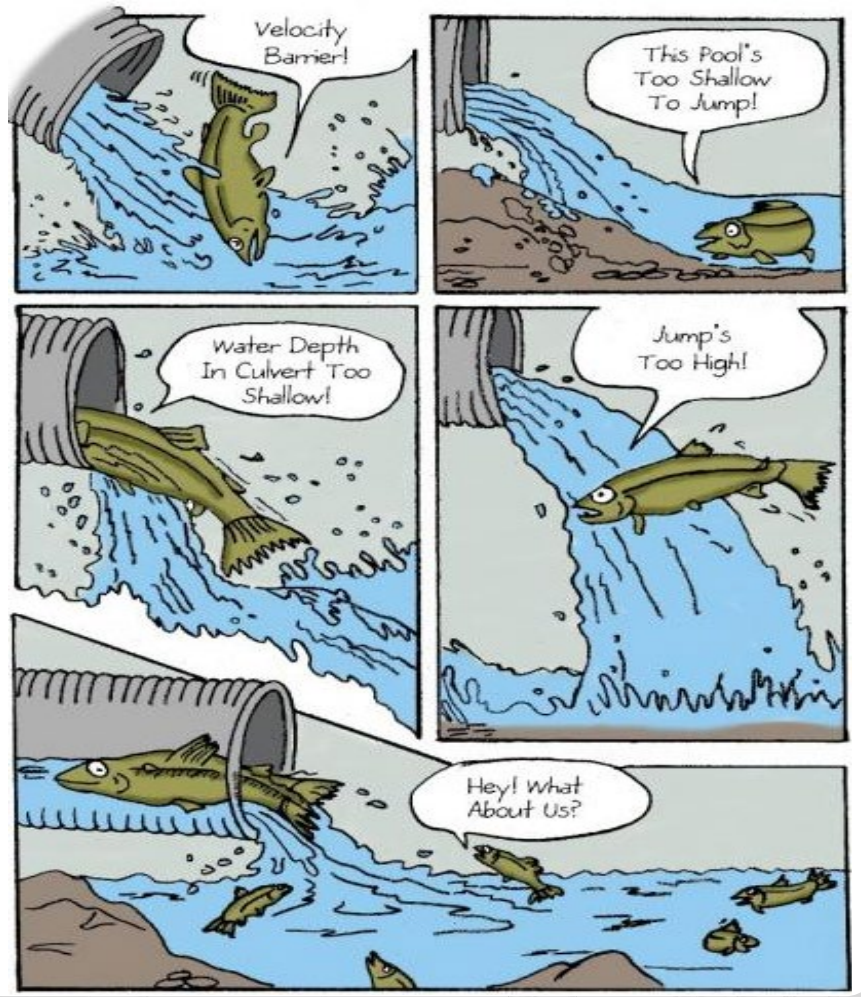
US Army Corps of Engineers ®

U.S.ARMY

# FISH PASSAGE

## Description of Barriers to Fish Passage and Possible Effects

| Barrier Type | Description | Impact |
|---|---|---|
| **Drop** | Drop at outlet exceeds fish jumping ability, or jump pool is insufficient to generate sufficient thrust. | Fish cannot enter structure, can be injured, or will expend too much energy entering the structure to traverse other obstacles. |
| **Velocity** | High velocity exceeds fish swimming ability. | Fish becomes exhausted before passing the crossing. |
| **Turbulence** | Turbulence within structure prevents fish from entering, or confuses sense of direction. | Fish do not enter structure, or are unable to successfully navigate the waterway. |
| **Length** | | Fish may not enter structure due to darkness. Fish may fatigue before traversing the structure. |
| **Depth** | Low flow depth causes fish not to be fully submerged. | Fish will be unable to swim efficiently or unable to pass the structure. |
| **Debris** | Debris can become caught, blocking flow or portions of flow. | Fish may not be able to pass by debris, or constricted flow may create a velocity or turbulence barrier within the culvert. |
| **Cumulative** | Series of structures, each of which stresses fish during passage. | Groups of structures, each marginally passable, may be a combined barrier. |



# FISH PASSAGE - COUNTY ROAD 2330 (CROSSING ID: 97711)



## Preliminary Recommendation:
## Multiple oversized/buried culverts

# FISH PASSAGE - SAPPINGTON BRIDGE ROAD (CROSSING ID: 94865)

## Preliminary Recommendation: Prefabricated Arch Culvert



# FISH PASSAGE - COUNTY ROAD 5225 (CROSSING ID: 97890)



## Preliminary Recommendation: Slab Crossing

# CIVIL

- Objective: produce preliminary conceptual designs for different sites and present baseline cost estimates
- Crossing structure types:
  - Arch/oversized culvert
  - Prefabricated arch crossing
  - Slab crossing
  - Bridge (out-of-scope)
- Crossing structure type chosen from existing conditions:
  - Stream type
  - Stream width
  - Inundation frequency
  - Traffic/usage
    - Potential additional factors TBD
- Choose example sites and develop a 10% level design for each type of crossing
- Scale to similar locations to develop a baseline cost estimate for all sites

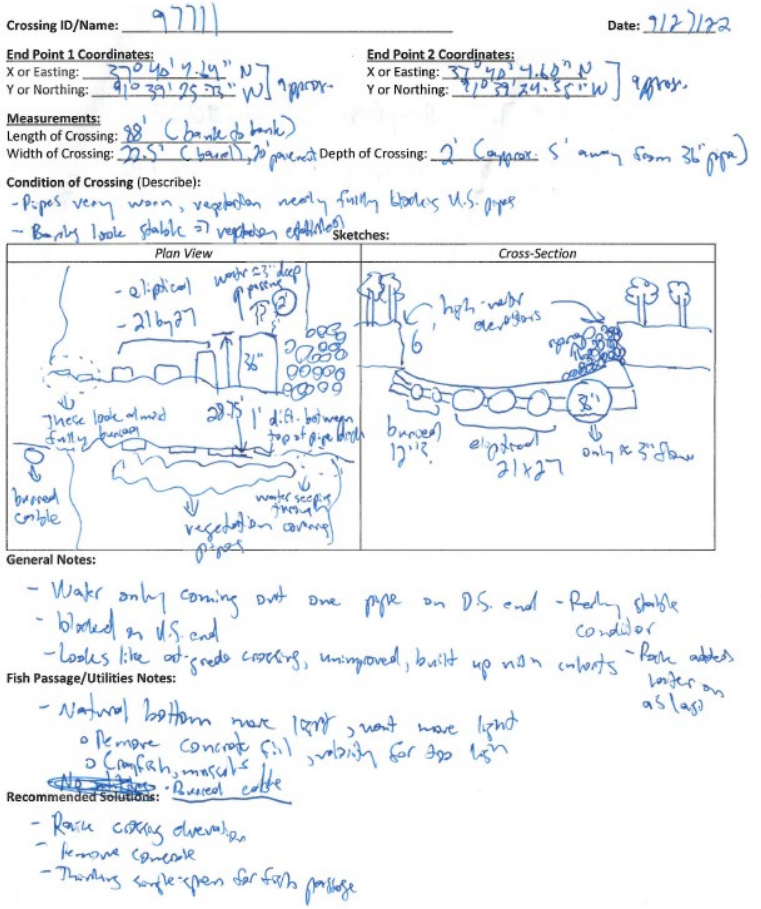
US Army Corps of Engineers ®

U.S.ARMY


Owensville
Freeburg
Vienna
Sullivan
94865
94987
Festus
Prairie Du
Cuba
Bloomsdale
St Jame
Potosi
Bonne Terre
New Offenburg
Park Hills
Farmington
97508
Viburnum
Edgar Springs
97711
Salem
97890
Boss
Ironton
Fredericktown
Doss
Licking
Jadwin
Image Landsat / Copernicus
Lesterville
Bunker

# SITE VISIT

- 94987 – Blue Springs Creek on Highway N
  - Concrete slab with 3 culverts
  - 2 of 3 pipes blocked
  - Degraded/damaged pipes
- 94865 – Greens Creek on Sappington Bridge Rd
  - Concrete slab with 3 culverts
  - Pipes in good condition
- 97980 – Meramec River on County Road 5225
  - Concrete slab with 8 culverts with 7 buried culverts below
  - Channel was dry up and down stream
  - Heavy scour
- 97711 – Dry Fork at County Road 2330
  - Concrete slab with 6 culverts
  - Very worn pipes, some buried, flow only passing through one pipe
  - Water seepage under roadway
- 97508 – Crooked Creek on Gibbs Road
  - Concrete slab/at grade crossing
  - Flow over roadway


Crossing ID/Name: 97711 Date: 9/27/22

End Point 1 Coordinates:
X or Easting: 37° 42' 7.64" N
Y or Northing: 91° 39' 25.32" W ] approx.

End Point 2 Coordinates:
X or Easting: 37° 42' 4.68" N
Y or Northing: 91° 39' 24.55" W ] approx.

Measurements:
Length of Crossing: 88' (bank to bank)
Width of Crossing: 22.5' (barrel), 30' pavement Depth of Crossing: 2' (approx. 5' away from 36" pipe)

Condition of Crossing (Describe):
- Pipes very worn, vegetation nearly fully blocking U.S. pipe
- Banks look stable w/ vegetation established

Sketches:

Plan View



Cross-Section



General Notes:
- Water only coming out one pipe on D.S. end - Really stable condition
- blocked on U.S. end
- Looks like at-grade crossing, unimproved, built up non culverts - Rock added later on as lags

Fish Passage/Utilities Notes:
- Natural bottom more light, want more light
  - Remove concrete fill - visibility for fish
  - Crayfish, mussels

Recommended Solutions:
- Buried cobble
- Rock crossing elevation
- Remove concrete
- Throating couple spans for fish passage

US Army Corps of Engineers ®

U.S.ARMY

# RANKING MATRIX

| ID | Recommended Replacement | County | PQI | Richness | Eco Factor (Adjusted PQI and Mussels) | Traffic Risk Factor 1 (AADT X I) | Parametric Cost | Cost Factor | 100-Year Life Loss factor +1 | Saftey Factor (combined Traffic risk and 100 LL) | Combined Ranking Factor (Safety +Eco) | CRF/Cost Factor |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 97791 | PFA | Dent | 0.89 | 0 | 1.93 | 1022 | $ 671,652 | 6.72 | 1 | 715.7 | 358.8 | 53.423 |
| 97308 | AOC | Washington | 0.26 | 0 | 1.46 | 21.6 | $ 118,814 | 1.19 | 1.866667 | 15.7 | 8.6 | 7.211 |
| 97188 | AOC | Washington | 0.18 | 0 | 1.40 | 88 | $ 497,000 | 4.97 | 1.866667 | 62.2 | 31.8 | 6.394 |
| 94987 | LWB | Crawford | 1.43 | 20 | 7.33 | 422.9 | $ 3,819,000 | 38.19 | 2.666667 | 296.8533333 | 152.1 | 3.983 |
| 97748 | AOC | Dent | 0.48 | 0 | 1.62 | 42.5 | $ 500,584 | 5.01 | 1.555556 | 30.2 | 15.9 | 3.180 |
| 97399 | PFA | Dent | 1.52 | 17 | 6.65 | 33 | $ 486,612 | 4.87 | 1 | 23.4 | 15.0 | 3.088 |
| 97702 | AOC | Dent | 0.68 | 0 | 1.77 | 25.5 | $ 342,386 | 3.42 | 1.555556 | 18.3 | 10.0 | 2.933 |
| 97463 | PFA | Crawford | 0.44 | 0 | 1.59 | 65 | $ 898,049 | 8.98 | 1 | 45.8 | 23.7 | 2.638 |
| 97209 | PFA | Washington | -0.23 | 0 | 1.09 | 74.7 | $ 1,272,000 | 12.72 | 1.866667 | 52.9 | 27.0 | 2.120 |
| 97701 | AOC | Dent | 0.63 | 0 | 1.73 | 34 | $ 723,762 | 7.24 | 1.555556 | 24.3 | 13.0 | 1.796 |
| 97295 | PFA | Washington | 0.59 | 0 | 1.70 | 35 | $ 759,442 | 7.59 | 1.866667 | 25.1 | 13.4 | 1.762 |
| 97322 | AOC | Dent | 0.61 | 0 | 1.72 | 37.5 | $ 812,677 | 8.13 | 1 | 26.6 | 14.1 | 1.739 |
| 96043 | AOC | Phelps | 0.48 | 9 | 3.87 | 30 | $ 731,504 | 7.32 | 1 | 21.3 | 12.6 | 1.720 |
| 96936 | AOC | Washington | -0.29 | 0 | 1.04 | 7.5 | $ 204,122 | 2.04 | 1 | 5.6 | 3.3 | 1.615 |
| 97832 | AOC | Dent | 0.66 | 1 | 2.01 | 35 | $ 880,463 | 8.80 | 1 | 24.8 | 13.4 | 1.522 |
| 97589 | PFA | Dent | 0.63 | 7 | 3.48 | 7.5 | $ 311,720 | 3.12 | 1.555556 | 5.7 | 4.6 | 1.476 |
| 96383 | AOC | Crawford | 0.14 | 2 | 1.87 | 8 | $ 311,764 | 3.12 | 1.666667 | 6.1 | 4.0 | 1.277 |
| 97456 | PFA | Dent | 0.84 | 0 | 1.89 | 45 | $ 1,337,996 | 13.38 | 1 | 31.8 | 16.8 | 1.259 |
| 97605 | LWB | Dent | 0.28 | 0 | 1.47 | 60 | $ 1,742,889 | 17.43 | 1 | 42.3 | 21.9 | 1.256 |
| 95879 | PFA | Phelps | 0.75 | 12 | 4.82 | 20 | $ 773,342 | 7.73 | 1 | 14.3 | 9.6 | 1.236 |
| 96002 | LWB | Crawford | 1.7 | 1 | 2.79 | 127.2 | $ 3,916,849 | 39.17 | 11 | 92.34 | 47.6 | 1.214 |
| 95833 | AOC | Crawford | 0.32 | 3 | 2.25 | 21 | $ 797,920 | 7.98 | 2 | 15.3 | 8.8 | 1.100 |
| 97113 | PFA | Crawford | -0.28 | 0 | 1.05 | 15 | $ 562,523 | 5.63 | 1 | 10.8 | 5.9 | 1.053 |

# RANKING MATRIX

## Factors

- **Ecological Factor**
  - Passage Quality Index (PQI)
  - Richness (Mussels)
- **Traffic Risk Factor**
  - Annual Average Daily Traffic (AADT)
  - Inundation Frequency
- **Safety Factor**
  - Traffic Risk Factor
  - LifeSIM – 100 yr LL
- **Cost Factor**

*Table 1.Stream crossing assessment index variable information.*

| Variable Name | Number of Variables | Variable Weight | Total Weight | Contribution to Final Score |
|---|---|---|---|---|
| PERCH | 4 | 0.25 | 1 | 22% |
| JUMP | 4 | 0.25 | 1 | 22% |
| RECONNECT | 1 | 0.5 | 0.5 | 12% |
| PPF | 2 | 1 | 2 | 44% |

US Army Corps of Engineers ®

U.S.ARMY

# POSSIBLE FUNDING SOURCES

- USFWS National Fish Passage Program
- USACE Continuing Authorities Program Section 206
- FEMA Mitigation Program
- In Lieu Fee Mitigation

US Army Corps of Engineers ®

U.S.ARMY

## NATIONAL FISH PASSAGE PROGRAM

- The program works with transportation agencies and others to improve stream crossings so that the streams can flow naturally beneath them.

- Ensures infrastructure is more resilient to flooding and benefits communities by saving money in long-term repair and replacement costs.

- Eligible projects are those that address outdated, unsafe or obsolete dams, culverts, levees and other barriers fragmenting our nation’s rivers and streams.

- BIL includes $200 million for restoring fish and wildlife passage

- Funding is distributed over five year at approximately $38 million/year.  After

- After FY23 appears to be three additional opportunities.

- Is their any required cost share?

# Bipartisan Infrastructure Law Funding through the National Fish Passage Program

U.S. Fish and Wildlife Service

Filter by Partner

Search by Partne

## NFPP Funding

**$34.3M**

## Partner Match

**$29.3M**

## Barriers to be Removed*

**97**

*Some barriers are on private land and are not shown.

## Stream Miles to be Reopened

**5,051**

| Partnered Projects | |
|---|---|
| State | 36 |
| Tribal | 10 |
| Federal | 22 |


### Single Barrier Projects
(Click item in List to Zoom in Map)

- Fish Ladder and Spillway Addition on Tieton Dam
- Illingsworth Creek Culvert Removal
- Mill Creek Culvert Removal
- Myrtle Creek Culvert Removal
- Samson Creek Culvert Replacement
- Schaffer Boom Road Camp Creek Fish Passage Barrier Removal
- West Fork Grays River Fish Passage Project
- Albert and Bessie Kronkosky State Natural Area Dam Removal
- Bylas Springs Habitat Expansion and Barrier Removal

### Multiple Barrier Projects
(Click item in List to Zoom in Map)

- Anton & Cedar Creek Fish Culvert Redesign
- Anton & Cedar Creek Fish Culvert Redesign
- Johnson Creek Culvert Replacement
- Johnson Creek Culvert Replacement
- Johnson Creek Culvert Replacement
- Johnson Creek Culvert Replacement
- Wisen Creek Fish Passage Restoration
- Wisen Creek Fish Passage Restoration

### Map Lege

Single or Multiple Barrier Project
project detail)

Single or Grouped Project

- Multiple
- Single

### Number of Barriers by

*Some barriers are on private la

# FEMA MITIGATION PROGRAMS

- **Hazard Mitigation Grant Program (HMGP)** contains funding available to states, local governments, tribes and nonprofits when authorized under a Presidential Major Disaster Declaration, in areas of the state requested by the governor.

- **HMGP** Projects must be shown to reduce future damage in a similar disaster event and rebuilt in a way that reduces, or mitigates, future disaster losses.

- **HMGP** NOIs can be submitted at anytime before and after the event
-

- **Section 406 Public Assistance** Mitigation is applied on the parts of the facility that were damaged by the disaster and the mitigation measure directly reduce the potential of future, similar disaster damages to the eligible facility.  Limited to declared counties and eligible damaged facilities.

US Army Corps of Engineers ®

U.S.ARMY

# USACE CONTINUING AUTHORITIES PROGRAM 206

Provides for dam removal and/or in stream barrier removal to restore fish passage/aquatic habitat.

Likely that we can lump multiple crossing under one evaluation.

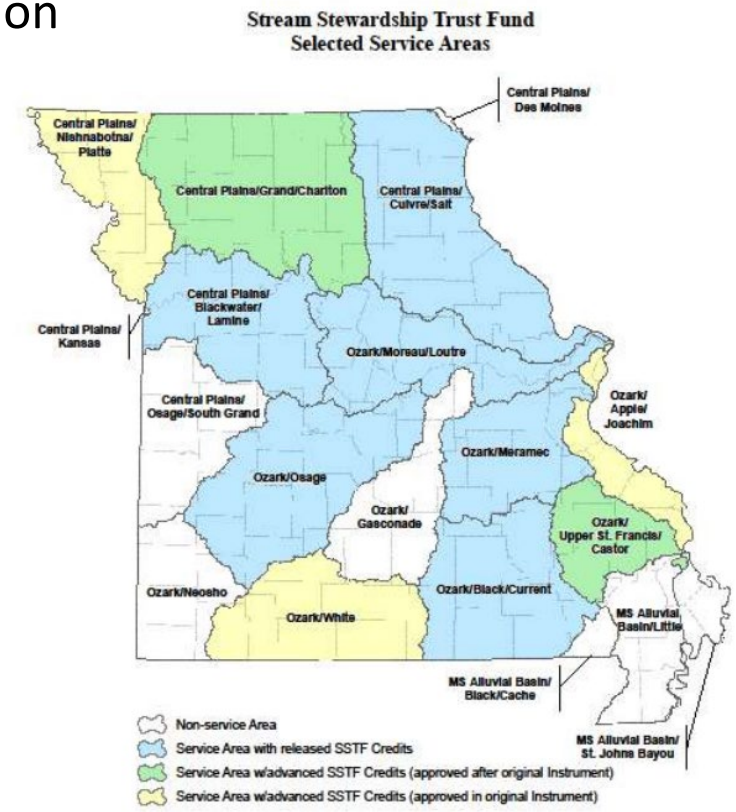
USACE can fund the removal of the barrier but the replacement structure will likely be the sponsors cost (or
funds they can leverage from other partners).

Also the assumption is that real estate will need to be fee title but their may be exceptions.

# IN LIEU FEE MITIGATION

In-Lieu Fee Mitigation
Missouri Conservation Heritage Foundation

Points of Contact:
Mr. Kevin Roper
Ms. Sherry Fischer
573-634-2080
E-mail: mchf@MoCHF.org




Land Learning Foundation
Scott Martin, Executive Director
Office: 877-573-2323
ILF Hotline: 800-761-6171
info@landlearning.org

US Army Corps of Engineers ®

U.S.ARMY

# THANK YOU

Liz Norrenberns
Project Manager
U.S. Army Corps of Engineers
St. Louis District
314-331-8351 (o)
618-920-2499 (c)
Elizabeth.a.Norrenberns@usace.army.mil

US Army Corps of Engineers ®

U.S.ARMY