H&H Program Update

Texas Department of Transportation

April 15, 2025


HELP
#EndTheStreakTX
End the streak of daily deaths on Texas roadways.
TxDOT.gov
#EndTheStreakTX Toolkit

Turn Around, Don't Drown

On average, over 50% of flood fatalities occur in vehicles.

Purpose of the DES H&H Section

The H&H Section leads the statewide practice of hydrology & hydraulics through:

- *development of policy and guidance*
- *providing training and specialized project support*
- *maintaining expertise at the leading edge of the state of practice and the state of knowledge.*
- *cultivating a community of technical collaborators*

The Relationship of Divisions and Districts

Leading TxDOT in providing and growing design and project development expertise, through collaborative efforts and quality customer service, to effectively and efficiently deliver a safer transportation system for Texas.

Ensure the Districts know what they need to know and have what they need to have maximize successful program delivery

The DES H&H Team

Ab Maamar-Tayeb

Davis Magenheimer

Edra Brashear

Badal Mahalder

Harrison Smith

Maria Thomas

Trenton Ellis

Zenia De Leon

Rose Marie Klee

District H&H Points of Contacts

Ab Maamar-Tayeb
amaamart@txdot.gov

14 - Austin
19 - Atlanta

Badal Mahalder
badal.mahalder@txdot.gov

5 - Lubbock
12 - Houston
13 - Yoakum
16 - Corpus Christi

Gabrielle Lott
Gabrielle.Lott@txdot.gov

4 - Amarillo
11 - Lufkin

Edra Brashear
Edra.Brashear@txdot.gov

17 - Bryan
18- Dallas
20 - Beaumont

Harrison Smith
Harrison.Smith@txdot.gov

1 - Paris
3 - Wichita Falls
6 - Odessa
10 - Tyler

Maria Thomas
Maria.Thomas@txdot.gov

7 - San Angelo
23 - Brownwood
24 - El Paso

Trenton Ellis
Trenton.Ellis@txdot.gov

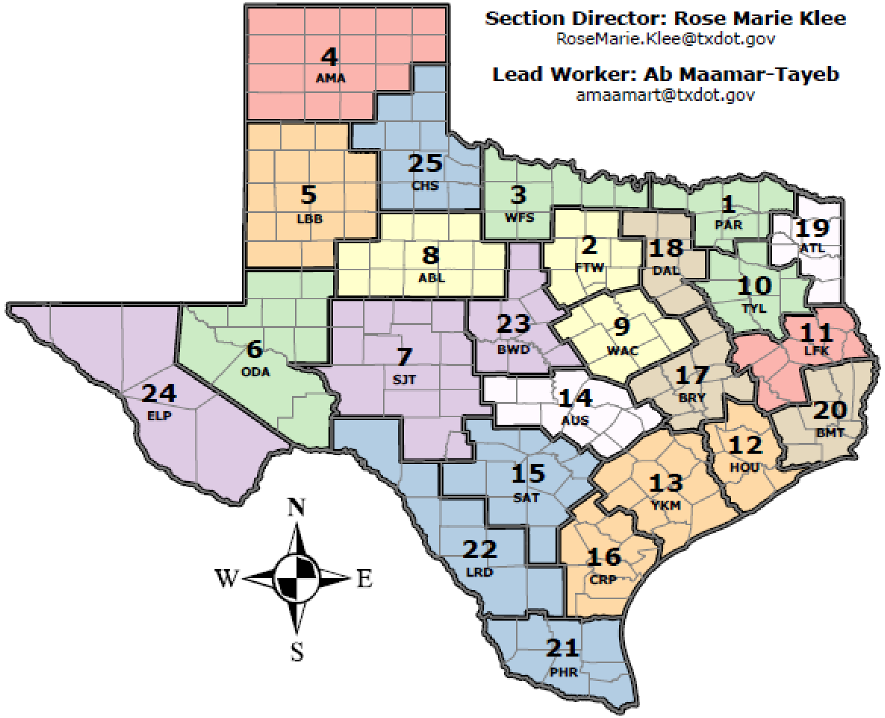
2 - Fort Worth
8 - Abilene
9 - Waco

Zenia De Leon
Zenia.Deleon@txdot.gov

15 - San Antonio
21 - Pharr
22 - Laredo
25 - Childress

Section Director: Rose Marie Klee
RoseMarie.Klee@txdot.gov

Lead Worker: Ab Maamar-Tayeb
amaamart@txdot.gov

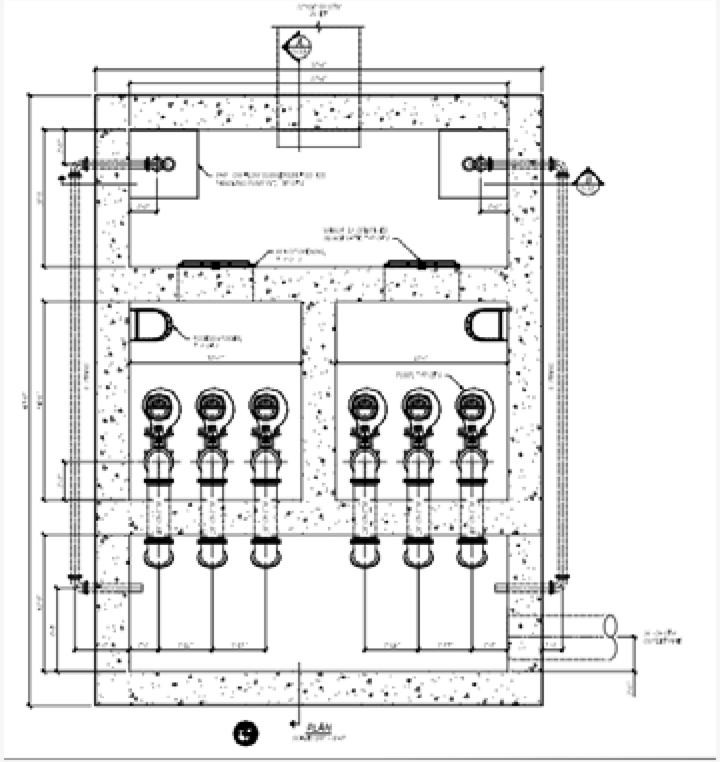


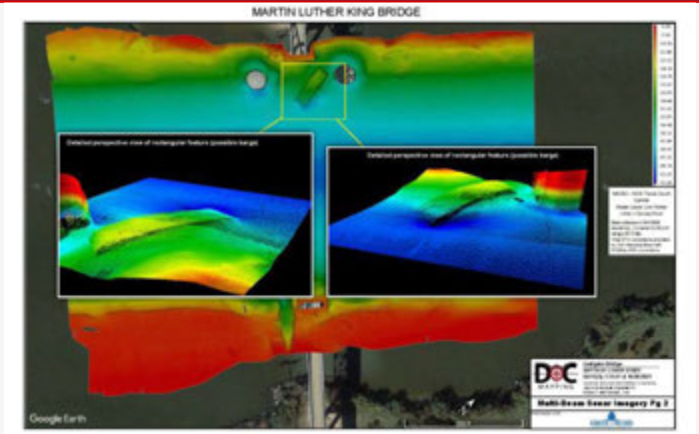
Examples of District Collaborations

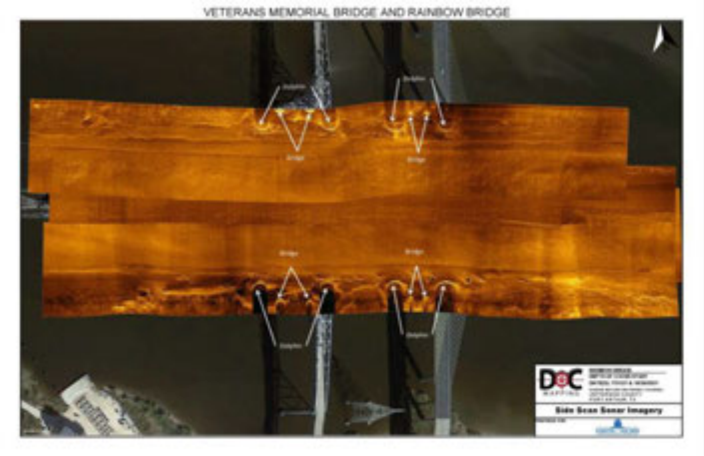
West Texas Hydrology – Lubbock District

Flooding Complaints

Special Technical Reviews





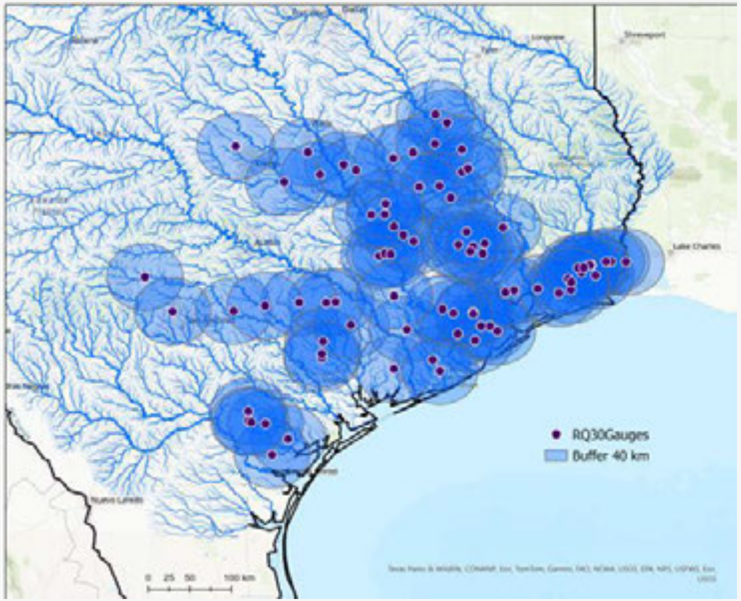


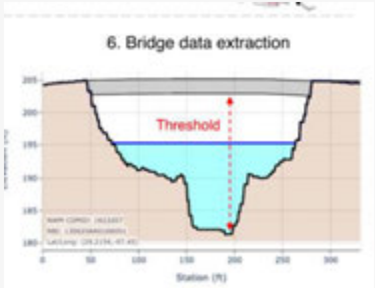
Fluvial Geomorphology

Unique Collaborations

Ongoing and Upcoming Projects

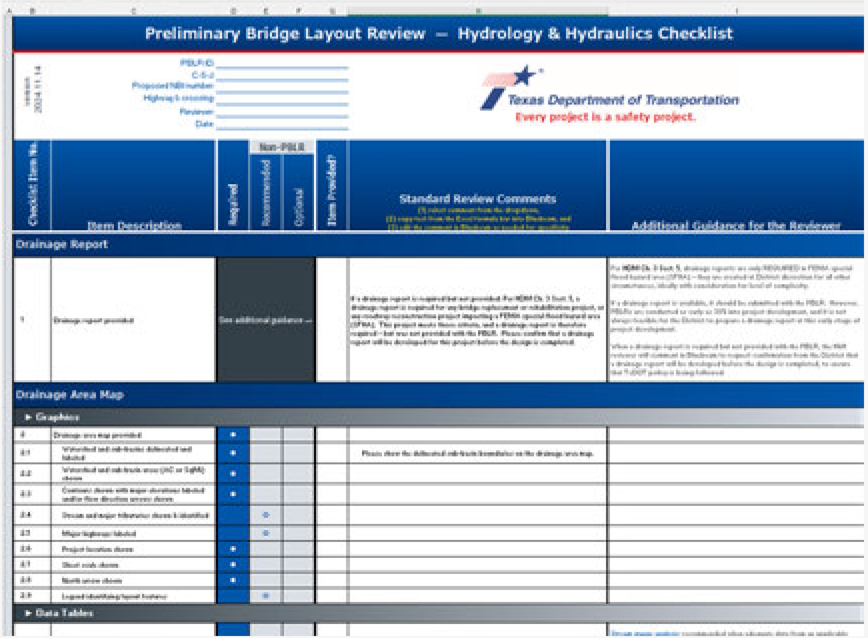
- Research Projects
  - Streamflow III (#Basins and #Gages)
  - Gaps in Scour Knowledge (Cohesive Soils under pressure)
  - Synthesis on Training
  - Nature-Based Solutions





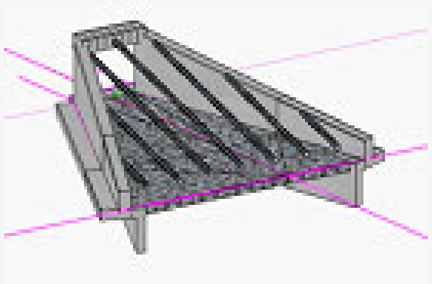
Ongoing and Upcoming Projects

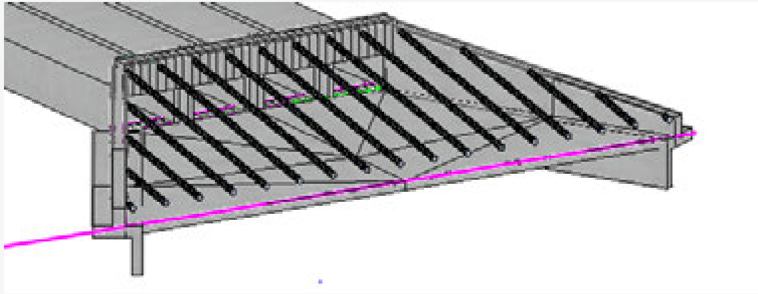
- StreamStats
- PBLR Checklist and H&H Go-by Sheets
- Hydraulics Design Manual Procurement Wave 2 2026

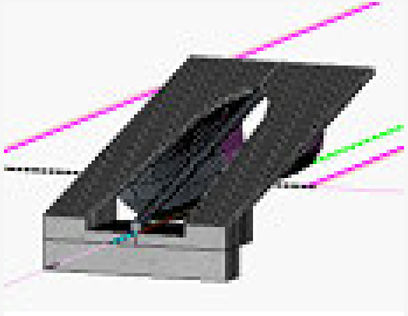


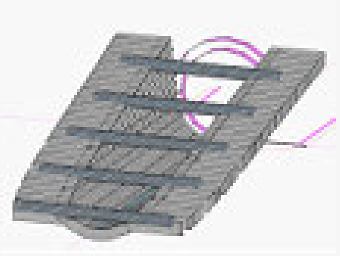
ORD DU Update

- Recent release of update to ORD workspace brings TxDOT closer to Digital Delivery
- Civil Cells for Headwalls
  - Workflow Manual
- Pre-cast Base minimum height adjusted for cell
- Plastic Pipe
- Review of Bentley OpenFlow capabilities
  - Civilstorm – (Unsteady flow)
  - PondPak – (detention Ponds)
  - SewerGems – (Pump Stations)



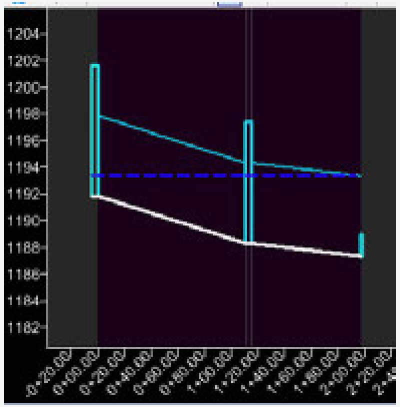


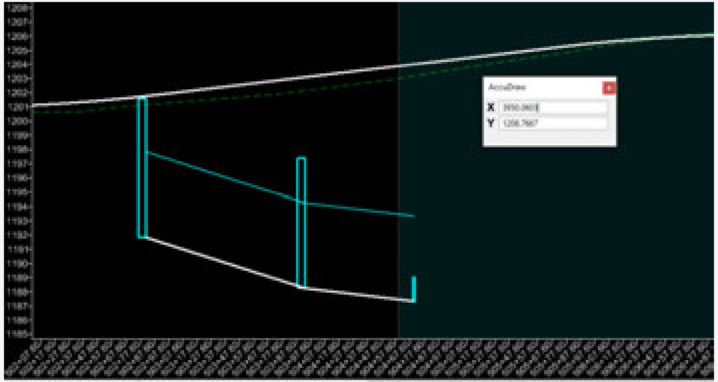




ORD DU 10.12 Known Issues

- HGL does not project to Alignment
- Drainage Areas not updating with changes or when adding inlets
- DU Culvert Calculator gives different results than HY-8. Do not use DU for culvert analysis.
- PAZD head depth changes when using trapezoidal section when keeping flowrate constant.





Hydrology & Hydraulic Training Program Updates

Training Program Update

Mission

To deliver cutting-edge hydrology and hydraulics training that increases the expertise of TxDOT staff, equipping them with the skills and knowledge needed to excel in their roles.

Our Vision

To be a best-in-class hydrology and hydraulics training program, enhancing the expertise of TxDOT staff, driving innovation and critical thinking, and delivering comprehensive hydrology and hydraulics solutions that increase community resilience and encourage agile recovery in the face of environmental challenges.

Highlights

- Course Updates
- Resource Updates

Course Updates: H & H Training Course Flow Paths

- Overall Flow Path
- Drainage Review and Senior Level Flow Path
- H & H Software Modeling Flow Path
- Roadway Drainage Flow Path

TxDOT CrossRoad ACCESS ONLY

Flow Charts

Hydrology & Hydraulic Training Course Flow Path for Roadway Drainage

COURSE	SUBJECT	PRE-REQUISITE COURSE	THEORY COURSE	SUBTITLE	COURSE		
DES 601 Basic Fundamentals of Hydrology & Hydraulics for TxDOT Drainage Design	ROADWAY DRAINAGE	**NHI 135092[1]** Highway Hydrology: Basic Concepts and Methods (WBT) **NHI 135091[1]** Basic Hydraulic Principles Review (WBT)	DES 613 NHI 135065 Intro to Highway Hydraulics	STORM SEWER	**DES 607** NHI 135027 Urban Drainage Design (Option 1 Day Stormwater Pump Station)	**DES 750** Openroads Designer for Plan Development	**DES 752** Openroads Designer for Drainage Utilities
				CULVERTS	**NHI 135094[1]** Culvert and Hydraulic Analysis and Design Program (HY-8) (WBT)	**DES 608** NHI 135056 Culvert Design	
		NHI 135087[1] Scour at Highway Bridge: Concept & Definitions (WBT)		BRIDGES	**DES 821** NHI 135090 Hydraulic Design of Safe Bridges		
		NHI 135086[1] Stream Stability Factors and Concepts **NHI 135091[1]** Basic Hydraulic Principles Review (WBT)		STREAM STABILITY	**DES 805** NHI 135046 Stream Stability at Scour at Highway Bridges	**DES 807** NHI 135048 Countermeasure Design for Bridge Scour and Stream Instability	

Course Updates

NHI Updates

New Virtual Course Options

- DES 607 Urban Drainage Design FHWA-NHI-135027
  - Course updated to 4th edition HEC-22 Manuel (2024)
- DES 608 Culvert Design FHWA-NHI-135056
- DES 800 Two-Dimensional Hydraulic Modeling of Rivers at Highway Encroachments FHWA-NHI-135095
- DES 805 Stream Stability and Scour at Highway Bridges FHWA-NHI-135046
- DES 807 Countermeasure Design for Bridge Scour and Stream Instability FHWA-NHI-135048

Course Updates

On Demand Training

- DES 601 Basic Hydrology & Hydraulics
- DES 611 Intro to HEC-HMS
- DES 612 Intro to HEC-RAS
- DES 617 Fundamental Concepts of GIS & ArcGIS for H & H
- DES 618 Advanced Concepts of GIS & ArcGIS for H & H
- DES 621 Advanced HEC-HMS
- DES 622 1D Unsteady using HEC-RAS
- DES 624 1D_2D HEC-RAS
- DES 798 TxDOT Scour Analysis

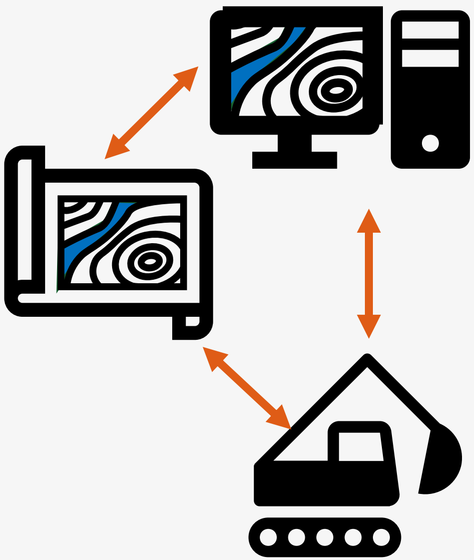
TxDOT CrossRoad ACCESS ONLY

On Demand Training

Course Updates

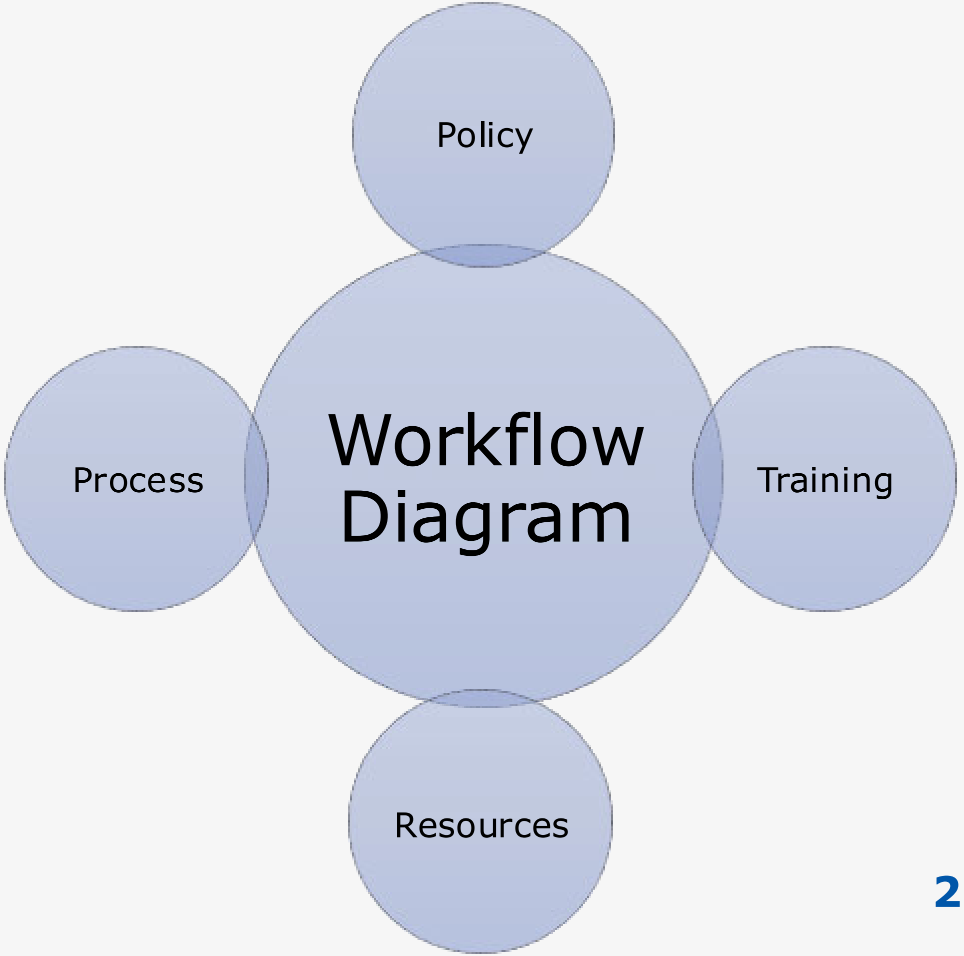
NEW Drainage Review Training

- Drainage Review Training
  - Module 1: Cross Drainage Review Training
  - Module 2: HEC-RAS Review Training
  - Module 3: HEC-HMS Review Training
  - Module 4: EPA SWMM Review Training
- Virtual & live courses
- 1 - 2 day training session
- Start Date: FY 2026



Resource Updates

Workflow Diagram



Rational Method Workflow (TxDOT HDM Ch4, Section 12)

Hydrology Flowchart 001B

Process Overview	Primary Steps – General description/ overview for each step.	Sub Task Detail - additional detail/clarifications for primary steps	Training Resources and Tools
Start Here			
1. Data Collection	❑ Ensure the watershed characteristics align with the assumptions of the Rational Method, see TxDOT HDM Chapter 4, Section 12 (pg. 4-48). ❑ Identify point(s) to compute discharge (i.e. bridge, culvert, channel junctions). ❑ Obtain most current contour map with aerial (preferred).	• No significant surface storage, such as ponds or lakes with a controlled outlet. • Drainage area smaller than 200 acres. • Analysis primarily for urban storm drain systems, small roadside & median ditches, or driveway culverts where no significant surface storage is present.	Rational Method Video Tutorial
2. Delineate Drainage Area(s)	❑ Distribute flow arrows at spread out locations in the contour map (flow direction is always perpendicular to contours). ❑ Trace any possible streams. ❑ Identify high points and berms. ❑ Trace drainage area. ❑ Verify uncertain areas. ❑ Verify selected hydrologic analysis method is appropriate based on watershed characteristics using the **Hydrologic Method Selection Flowchart, Hydrology Flowchart 001**.	• Uncertain areas refer to drainage area boundary sections not easily defined using available contour data and/or areas where an existing structure may be directing additional area runoff to point of interest. • Multiple drainage areas may be needed for varying soil types or land uses, varying types of land cover, or other factors that would influence runoff coefficients and infiltration rate.	Delineate a Watershed in ArcGIS PRO
3. Estimate the Time of Concentration	❑ Determine Time of Concentration from the most remote point in the watershed to the outlet using the Kerby-Kirpich method or the National Resources Conservation Service (NRCS) method (TxDOT HDM Ch 4, Section 11). • One good practice is to run both methods concurrently and compare results. • Consider antecedent moisture conditions, channel characteristics, and flow paths. • Minimum time of concentration is 10 minutes (see TxDOT HDM pg. 4-51)	**Kerby-Kirpich Method** • Applicable to watersheds ranging from 0.25 square miles to 150 square miles, main channel lengths between 1 and 50 miles, and main channel slopes between 0.002 and 0.02 (ft/ft). • Obtain the input variables for the Kerby Method TxDOT HDM Equation 4-14 to calculate overland flow travel time. • Obtain the input variables for the Kirpich Method TxDOT HDM Equation 4-15 to calculate channel flow travel time. • Combine overland flow travel time and channel flow travel time to obtain total time of concentration. **National Resources Conservation Service (NRCS) method** • Applicable for small watersheds, in which the majority of flow is overland. • Obtain the input variables for the Sheet Flow TxDOT HDM Equation 4-17 to calculate sheet flow travel time • Obtain the input variables for the Shallow Concentrated Flow TxDOT HDM Equation 4-18 to calculate shallow concentrated flow travel time. • Obtain the input variables for the Channel Flow TxDOT HDM Equation 4-19 to calculate channel flow travel time. • Combine sheet flow travel time, shallow concentrated flow travel time, and channel flow travel time to obtain total time of concentration.	Time of Concentration Guidance Document Time of Concentration Spreadsheet
Continue to next page			

Questions

Ab Maamar-Tayeb
amaamart@txdot.gov

Edra Brashear
edra.brashear@txdot.gov

TxDOT Resources for Scour Analyses and PBLRs

Trenton Ellis, P.E. | TxDOT Design Division | Hydrology & Hydraulics Section

H&H Community of Practice

TxDOT Roadway Design and Bridge Conference

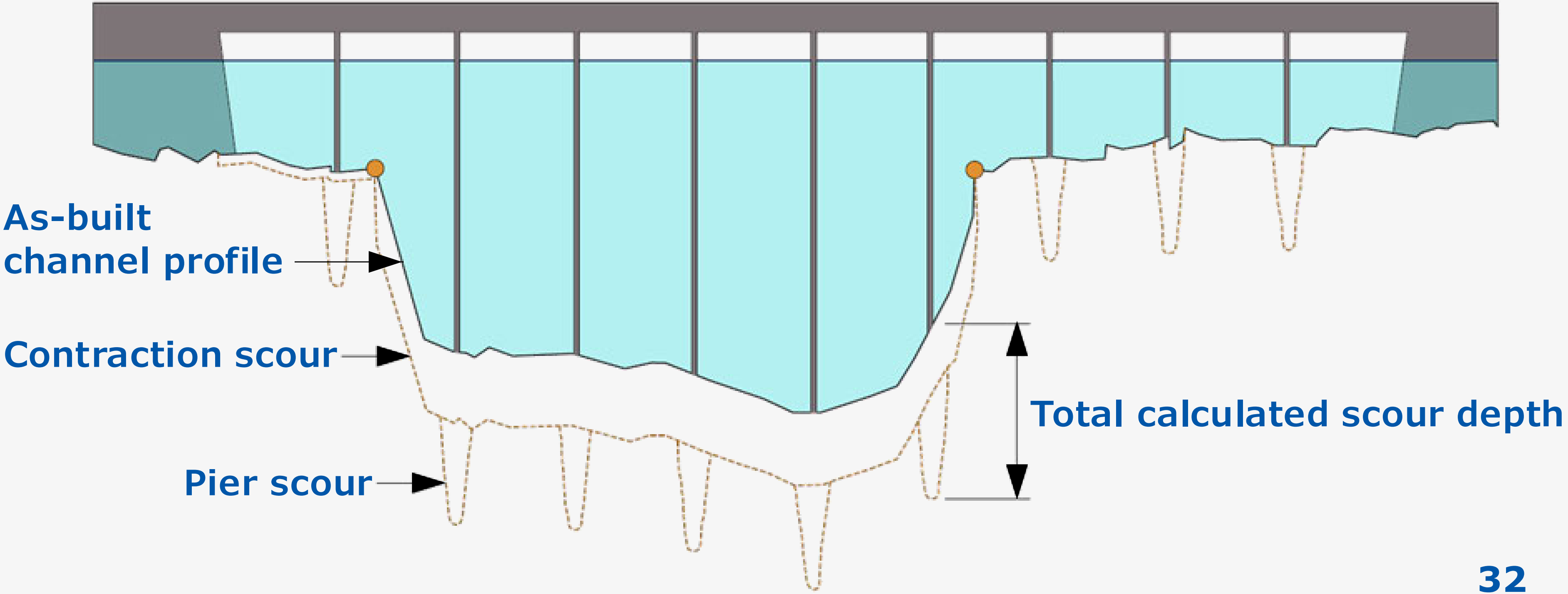
Table of Contents

texashighways.com

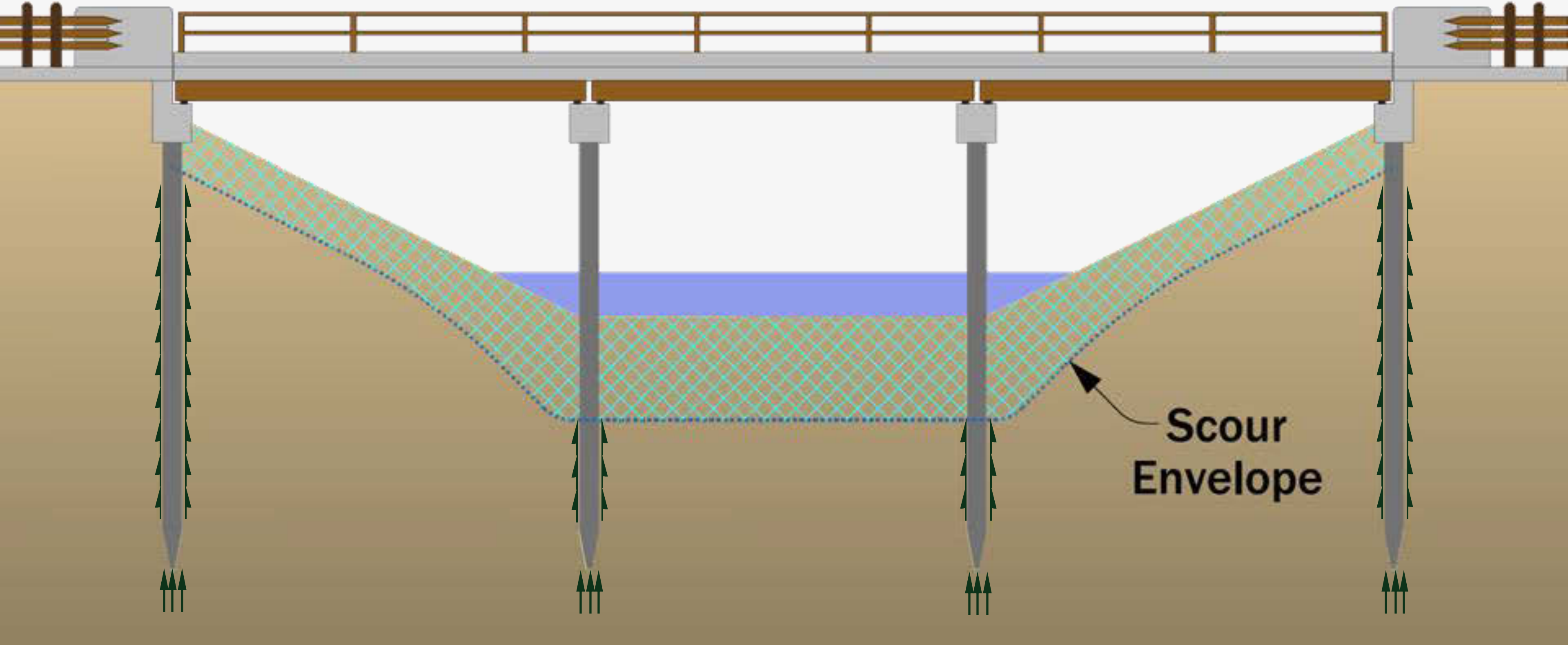
What is bridge scour?

- **The most common cause of bridge failures**
- Erosion of streambed or bank material due to flowing water; often considered as being localized:
  - Contraction scour
    - removal of materials **across all or most of the channel width** caused by a reduction in flow area
  - Pier scour
    - removal of material **localized around piers** caused by obstruction to flow

What is a scour analysis? A data-driven prediction

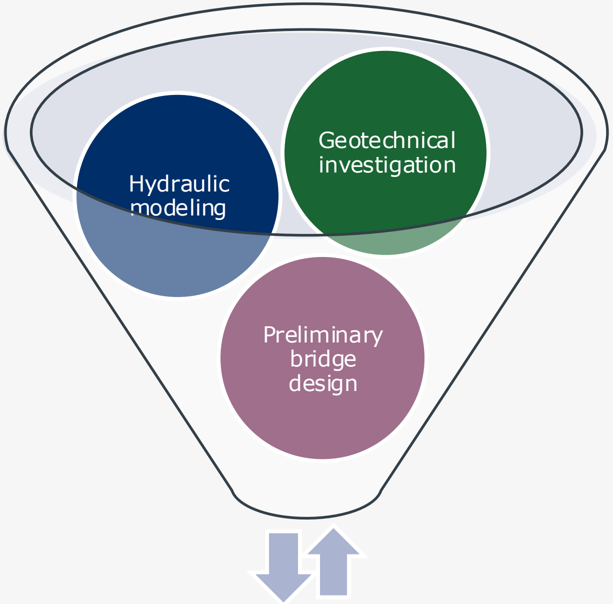


Why is bridge scour the leading cause of bridge failures?

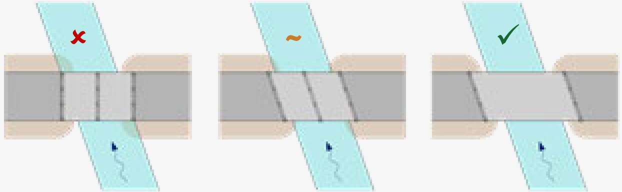


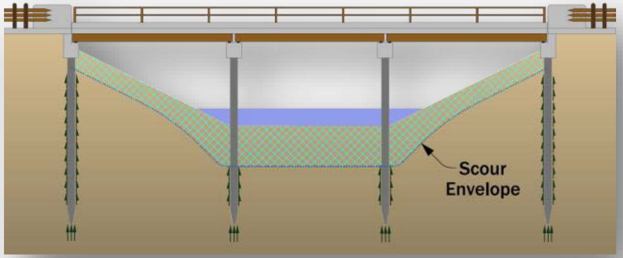
What is a scour analysis? A multidisciplinary collaboration

- Hydraulic data
  - Flow (Q)
  - Velocity (V)
  - Hydraulic depth (y)
- Geotechnical
  - Stratigraphy
  - USCS classification & D_{50}
- Structural details
  - Span layout
  - Substructure geometry
  - Angle of attack



scour envelope

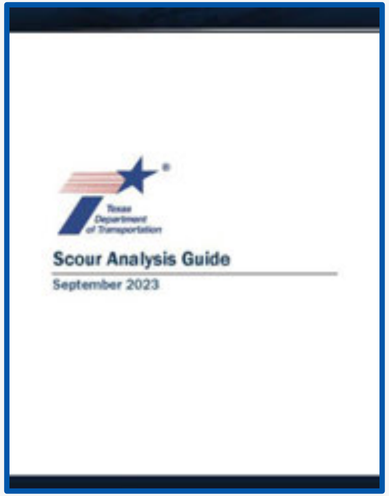




new bridges designed to resist damage resulting from scour

The vocabulary of bridge scour resources at TxDOT

- A scour evaluation considers both predicted and observed scour conditions
  - The least stable of the two conditions governs the overall condition rating



Scour evaluation

Scour analysis (predicted)

hydraulic

Scour assessment (observed)

structural

TxDOT Scour Analysis Guide

- Hydrologic design criteria for scour analyses

Table 2-1 – Scour Design and Scour Design Check Flood Return Periods

Hydraulic Design Flood[1]	Scour Design Flood	Scour Design Check Flood
< 10-year	2, 5, 10, and 25-year	50-year
10-year	25-year	50-year
25-year	50-year	100-year
50-year	100-year	200-year
100-year	200-year	500-year

[1] Refer to most recent version of TxDOT Hydraulic Design Manual.

https://ftp.txdot.gov/pub/txdot-info/des/guides/scour-guide.pdf

TxDOT Scour Analysis Guide

- Hydrologic design criteria for scour analyses
- Hydraulic modeling guidance

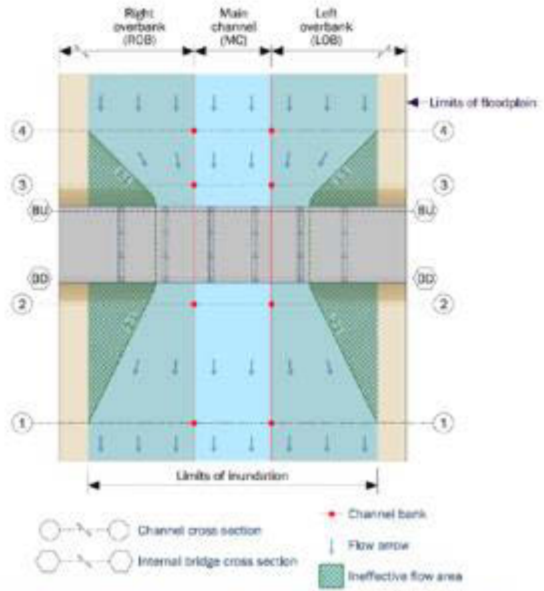
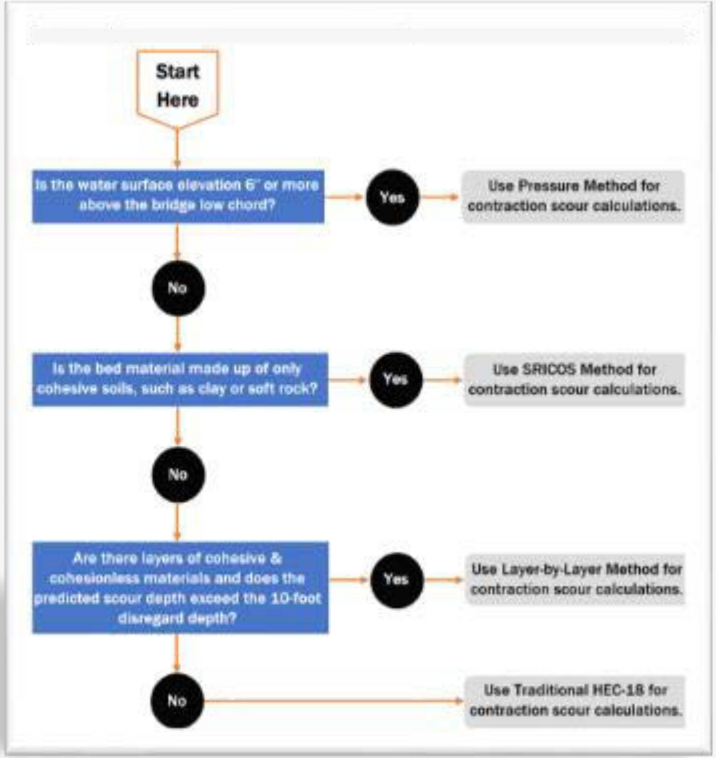


Figure 2-1 – Standard Cross Sections for 1D Bridge Modeling and Scour Analysis

https://ftp.txdot.gov/pub/txdot-info/des/guides/scour-guide.pdf

TxDOT Scour Analysis Guide

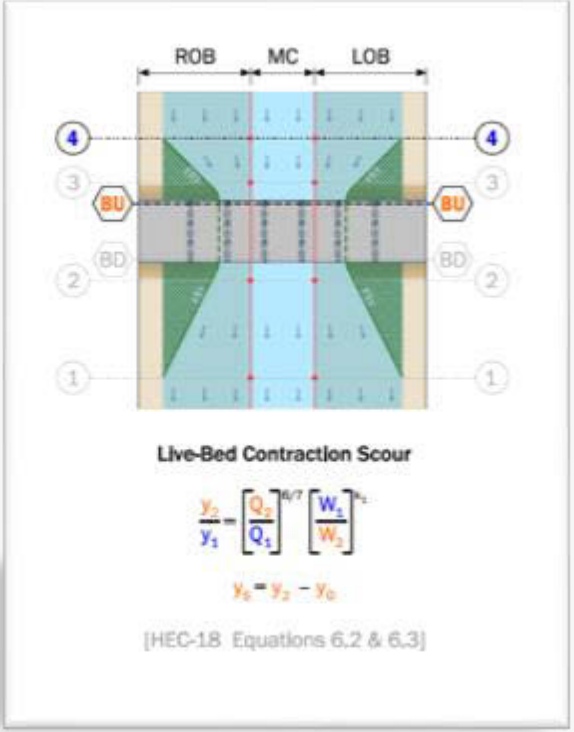
- Hydrologic design criteria for scour analyses
- Hydraulic modeling guidance
- Scour analysis method selection



https://ftp.txdot.gov/pub/txdot-info/des/guides/scour-guide.pdf

TxDOT Scour Analysis Guide

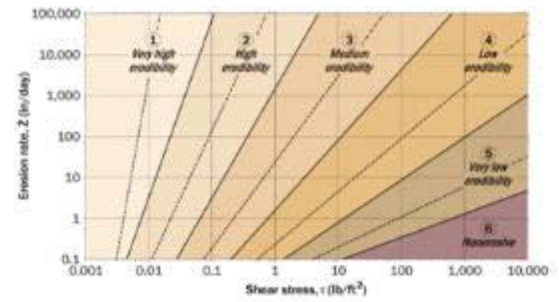
- Hydrologic design criteria for scour analyses
- Hydraulic modeling guidance
- Scour analysis method selection
- Detailed guidance for scour analysis equations



https://ftp.txdot.gov/pub/txdot-info/des/guides/scour-guide.pdf

TxDOT Scour Analysis Guide

- Hydrologic design criteria for scour analyses
- Hydraulic modeling guidance
- Scour analysis method selection
- Detailed guidance for scour analysis equations
- Special topics
  - SRICOS



Appendix A – SRICOS Method for Contraction & Pier Scour

Erosion category	Upper bound (more erodible)	Expected value (dashed line in figure)	Lower bound (less erodible)
1 Very high erodibility	N/A	$\dot{Z} = (6.07E+20)\tau^{6.00}$	$\dot{Z} = (1.52E+9)\tau^{4.33}$
2 High erodibility	$\dot{Z} = (1.52E+9)\tau^{4.33}$	$\dot{Z} = (2.68E+5)\tau^{3.28}$	$\dot{Z} = (1.47E+3)\tau^{2.67}$
3 Medium erodibility	$\dot{Z} = (1.47E+3)\tau^{2.67}$	$\dot{Z} = (23.7)\tau^{2.10}$	$\dot{Z} = (1.59)\tau^{1.71}$
4 Low erodibility	$\dot{Z} = (1.59)\tau^{1.71}$	$\dot{Z} = (0.232)\tau^{1.29}$	$\dot{Z} = (7.25E-2)\tau^{1.04}$
5 Very low erodibility	$\dot{Z} = (7.25E-2)\tau^{1.04}$	$\dot{Z} = (3.60E-2)\tau^{0.739}$	$\dot{Z} = (2.46E-2)\tau^{0.572}$
6 Nonerosive	$\dot{Z} = (2.46E-2)\tau^{0.572}$	$\dot{Z} = 0$	$\dot{Z} = 0$

Figure A-1 – Erosion Rate-Shear Stress Relationships for SRICOS Erosion Categories (adapted from Briaud et al., 2017)

https://ftp.txdot.gov/pub/txdot-info/des/guides/scour-guide.pdf

TxDOT Scour Analysis Guide

- Hydrologic design criteria for scour analyses
- Hydraulic modeling guidance
- Scour analysis method selection
- Detailed guidance for scour analysis equations
- Special topics
  - SRICOS
  - Lacustrine scour

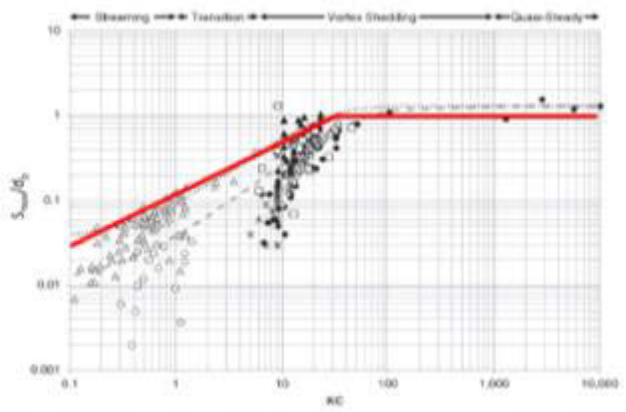


Figure 3.1. The upper bound line for wave scour wave scour around piles. (Webb and Matthews, 2014)

https://ftp.txdot.gov/pub/txdot-info/des/guides/scour-guide.pdf

TxDOT Scour Analysis Guide

- Hydrologic design criteria for scour analyses
- Hydraulic modeling guidance
- Scour analysis method selection
- Detailed guidance for scour analysis equations
- Special topics
  - SRICOS
  - Lacustrine scour
  - Parallel bridges

Case 1: Shared embankment

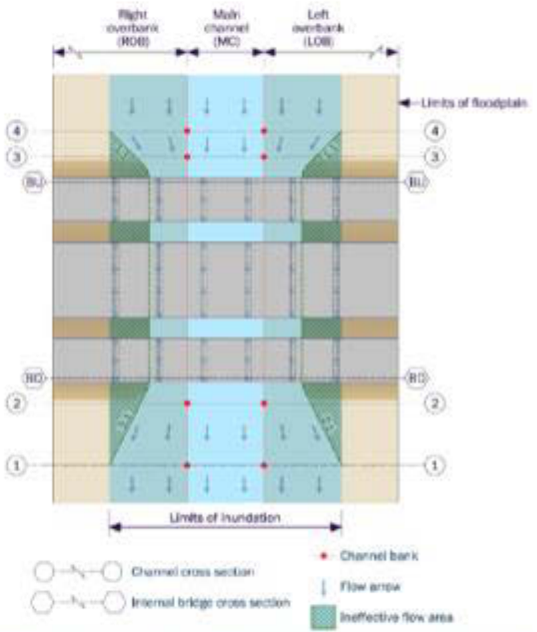


Figure B-49 – Parallel Bridges on Shared Embankment: Idealized Cross Section Layout

https://ftp.txdot.gov/pub/txdot-info/des/guides/scour-guide.pdf

TxDOT Scour Analysis Guide

- Hydrologic design criteria for scour analyses
- Hydraulic modeling guidance
- Scour analysis method selection
- Detailed guidance for scour analysis equations
- Special topics
  - SRICOS
  - Lacustrine scour
  - Parallel bridges

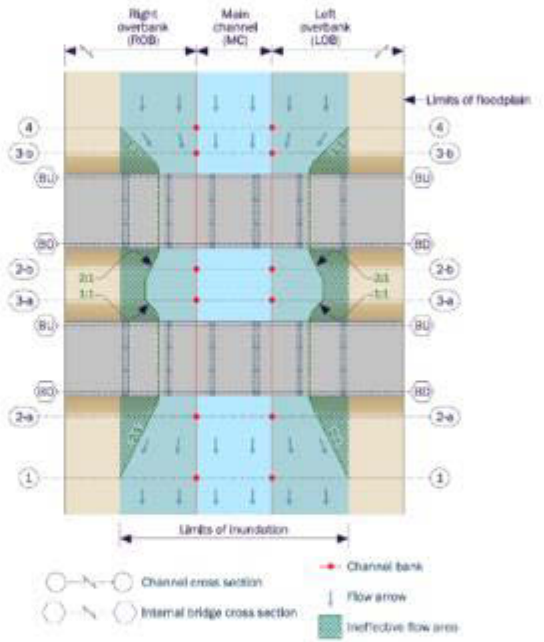
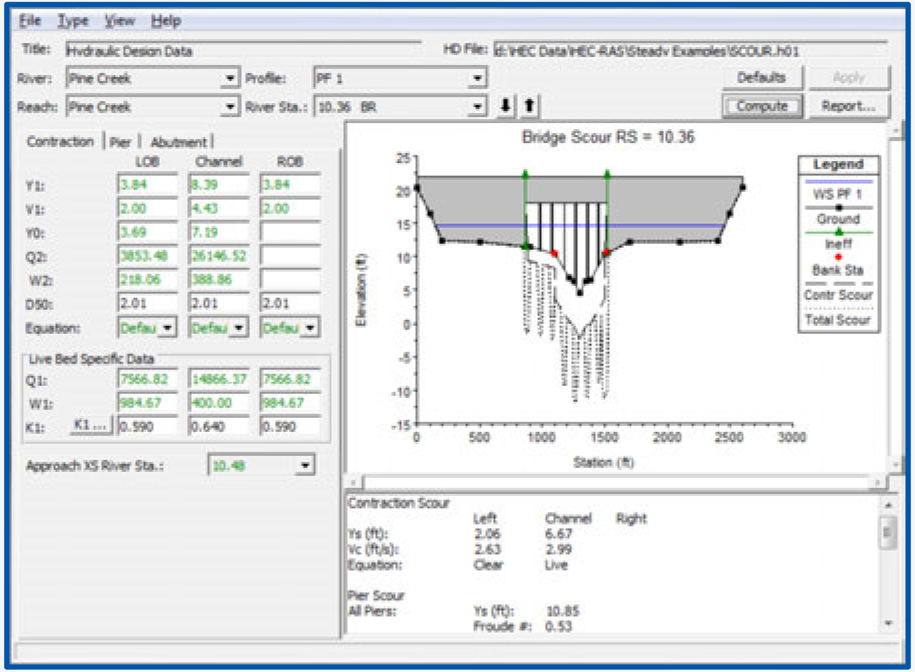


Figure B-54 – Parallel Bridges on Separate Embankments: Idealized Cross Section Layout

https://ftp.txdot.gov/pub/txdot-info/des/guides/scour-guide.pdf

Scour Analysis Software

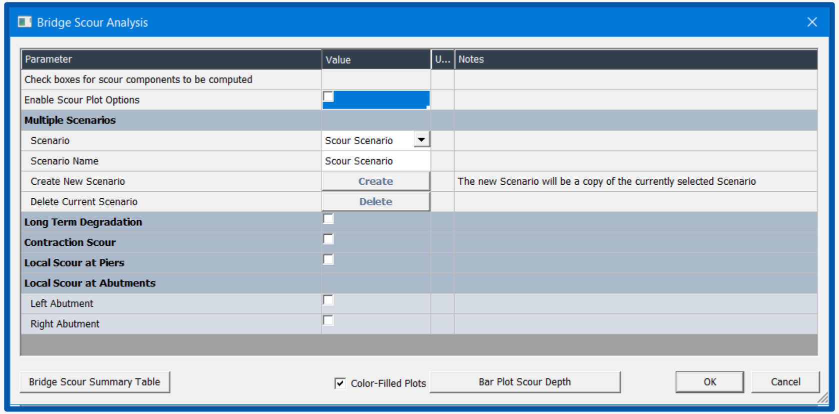
- HEC-RAS scour calculations (not recommended)
  - Automated routine doesn't always choose the right cross section for input parameters
  - Calculations not updated to latest HEC-18 procedures



https://www.hec.usace.army.mil/software/hec-ras/

Scour Analysis Software

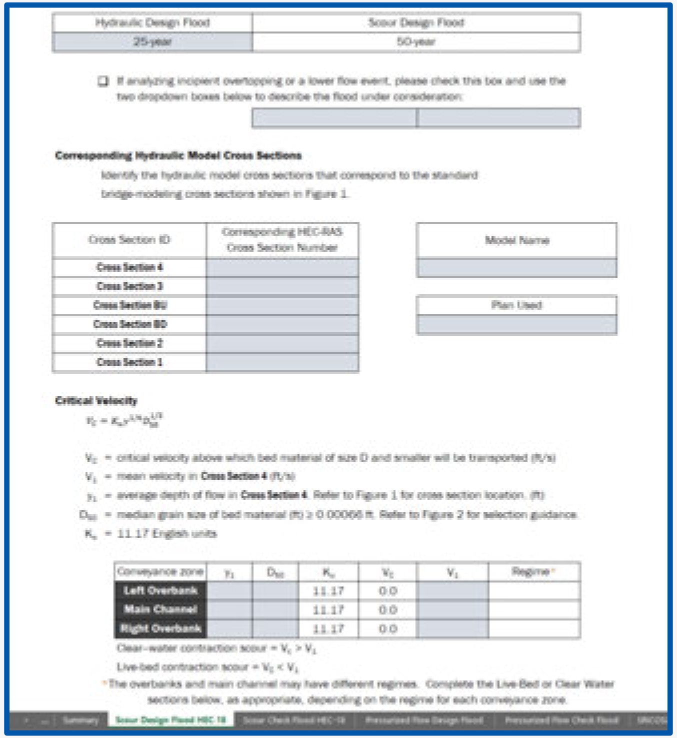
- HEC-RAS scour calculations (not recommended)
  - Automated routine doesn't always work
  - Inconsistencies with HEC-18 5th Ed.
- FHWA Hydraulic Toolbox (acceptable)
  - Lacks detailed guidance for users



https://www.fhwa.dot.gov/engineering/hydraulics/software/toolbox404.cfm

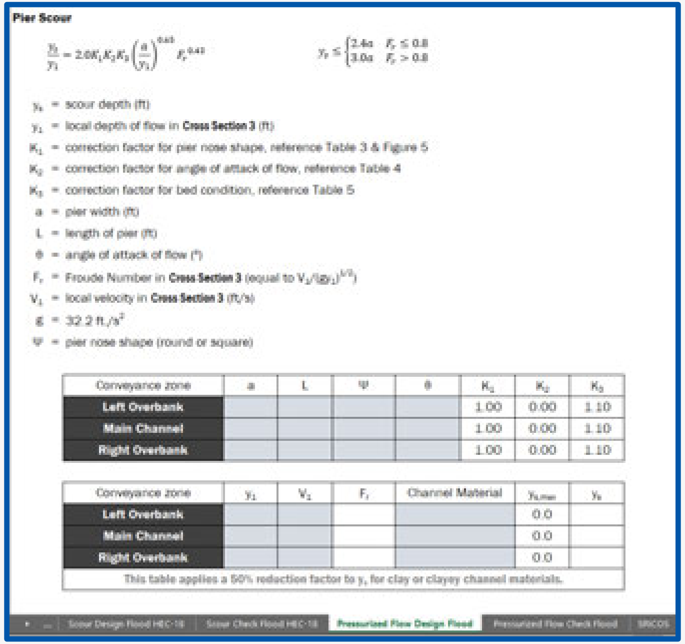
Scour Analysis Software

- HEC-RAS scour calculations (not recommended)
  - Automated routine doesn't always work
  - Inconsistencies with HEC-18 5th Ed.
- FHWA Hydraulic Toolbox (acceptable)
  - Lacks detailed guidance for users
- TxDOT Scour Analysis Spreadsheet (recommended)
  - Consistent with HEC-18 and TxDOT guidance
  - Available to everyone on TxDOT.gov



TxDOT Scour Analysis Spreadsheet

- Developed by TxDOT to promote accuracy and consistency
- Includes key figures and tables from Scour Analysis Guide for quick reference
- Requires input from hydraulic modeling results
- Easy-to-print documentation



Pier Scour

$$\frac{y_s}{y_1} = 2.0K_1K_2K_3\left(\frac{a}{y_1}\right)^{0.65} F_r^{0.43} \qquad y_s \le \begin{cases} 2.4a & F_r \le 0.8 \\ 3.0a & F_r > 0.8 \end{cases}$$

y_s = scour depth (ft)
y_1 = local depth of flow in **Cross Section 3** (ft)
K_1 = correction factor for pier nose shape, reference Table 3 & Figure 5
K_2 = correction factor for angle of attack of flow, reference Table 4
K_3 = correction factor for bed condition, reference Table 5
a = pier width (ft)
L = length of pier (ft)
θ = angle of attack of flow (°)
F_r = Froude Number in **Cross Section 3** (equal to $V_1/(gy_1)^{1/2}$)
V_1 = local velocity in **Cross Section 3** (ft/s)
g = 32.2 ft./s^2
Ψ = pier nose shape (round or square)

Conveyance zone	a	L	Ψ	θ	K_1	K_2	K_3
Left Overbank					1.00	0.00	1.10
Main Channel					1.00	0.00	1.10
Right Overbank					1.00	0.00	1.10

Conveyance zone	y_1	V_1	F_r	Channel Material	$y_{s,max}$	y_s
Left Overbank					0.0	
Main Channel					0.0	
Right Overbank					0.0	
This table applies a 50% reduction factor to y_s for clay or clayey channel materials.						

Scour Design Flood HEC-18 | Scour Check Flood HEC-18 | Pressurized Flow Design Flood | Pressurized Flow Check Flood | SRICOS

https://www.txdot.gov/content/dam/docs/design/txdot-scour-analysis-spreadsheet-2024-05-31.xlsx

TxDOT Scour Analysis Training

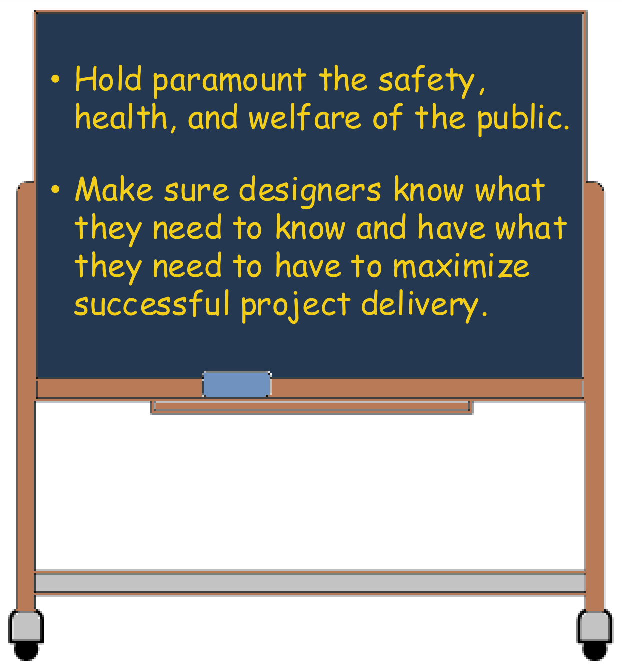
- DES 798 – TxDOT Bridge Scour Analysis
  - Instructor-led, virtual training
  - Covers the Scour Analysis Guide
  - Guided examples using TxDOT Scour Analysis Spreadsheet
- Free, 12-hour course
  - Open to TxDOT and outside learners; no sessions currently scheduled
  - On-demand content available in SharePoint

What is a PBLR?

- **Preliminary Bridge Layout Review**
  - Multi-disciplinary review administered by Bridge Division
  - Purpose is to ensure TxDOT and FHWA policies are being followed BEFORE commencing major structural design work
    - Typically, 30% - 60% PS&E completion

Challenges we wanted to address

- Address inconsistency among H&H reviewers
- Support rapid pace of project development
- Establish consistent practice for impact analyses
- And in general, we wanted to clarify the intention and guidance for each checklist item



New H&H Checklist for PBLRs

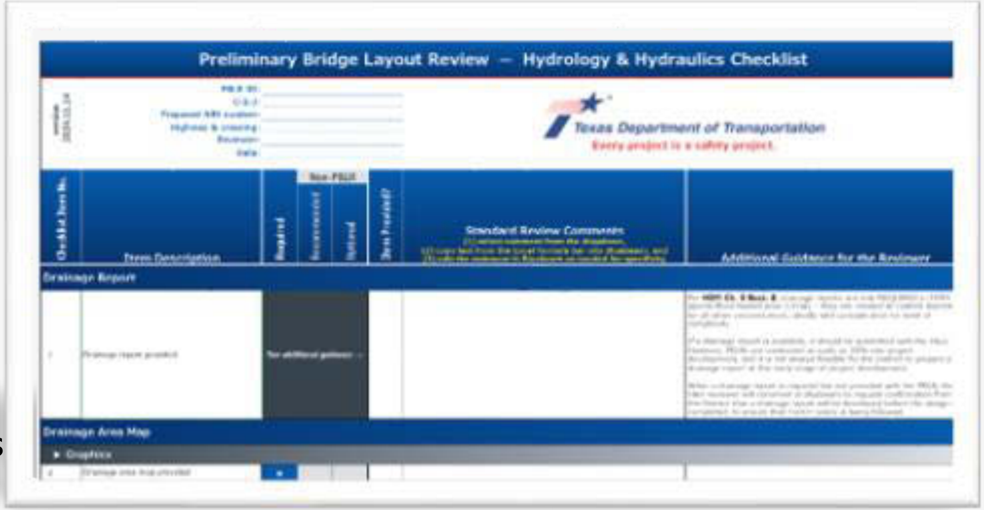
instructions | PBLR checklist | standard review comments

- **Instructions**
  - Detailed instructions for new reviewers and first-time users of the checklist
- PBLR checklist
- Standard review comments

General Instructions		
Standard Review Comments	Standard review comments are provided for each checklist item to promote consistent feedback between reviewers for common issues. Please review the collection of standard comments (summarized in the **standard review comments** tab) before using this checklist for the first time.	After selecting a standard response from the drop-down i Column H of the **PBLR checklist tab**, the reviewer may copy the standard text from the formula bar in Excel into the Bluebeam session – and then edit the text in Bluebeam a needed for specificity.
Drainage Report	**HDM Ch. 3 Sect. 5**: A drainage report is required for any bridge replacement or rehabilitation project, or any roadway reconstruction project impacting a FEMA special flood hazard area (SFHA). **HDM Ch. 3 Sect. 5** applies to span bridges and bridge-class culverts. Drainage reports are only REQUIRED for projects in a FEMA SFHA; they are created at district discretion for all other circumstances, ideally with consideration for level of complexity.	A PBLR may be conducted before the associated drainage report has been completed. • The district must provide enough information for the DE HYD reviewer to verify methods and data. If additional information is needed to complete a review, the DES-HYD reviewer will request that information specifically. **• The H&H reviewer will not hold up PBLR approval solely because a drainage report has not yet been completed - we will accept District confirmation that report will be developed later in the design process.**
H&H Models	PBLRs do not include a detailed review of hydrology and hydraulics (H&H) models within the native digital format. Distrits may request detailed H&H model reviews, on a case-by-case basis, by contacting the Hydrology & Hydraulics Section i Design Division.	

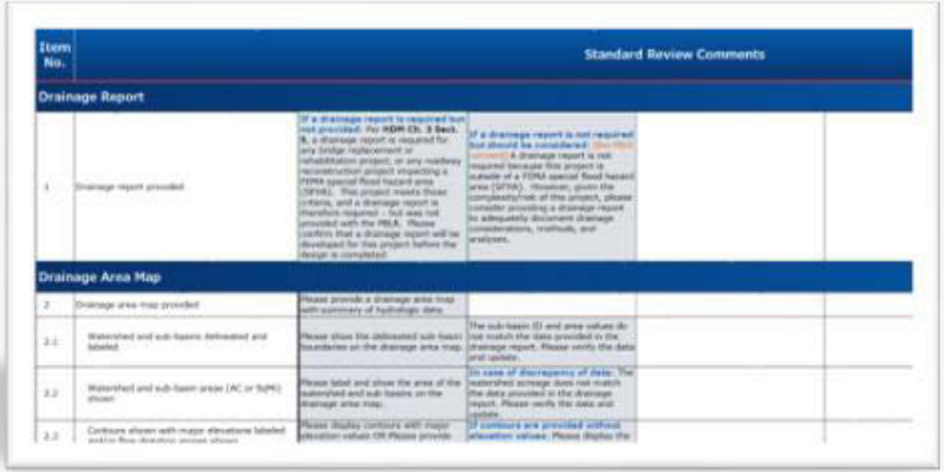
New H&H Checklist for PBLRs

- Instructions
- **PBLR checklist**
  - Review items enumerated, defined, and prioritized
  - Additional guidance provided as needed
  - Copy standard, pre-populated comments from Excel into Bluebeam
- Standard review comments



New H&H Checklist for PBLRs

- Instructions
- PBLR checklist
- **Standard review comments**
  - This tab summarizes all the standard comment responses that are pre-populated for each checklist item



Thank you! Any questions?

Scour Analysis Guide

https://ftp.txdot.gov/pub/txdot-info/des/guides/scour-guide.pdf

Scour Analysis Spreadsheet

https://www.txdot.gov/content/dam/docs/design/txdot-scour-analysis-spreadsheet-2024-05-31.xlsx

H&H Checklist for PBLRs

https://www.txdot.gov/content/dam/docs/design/h-h/2024-11-14-hyd-pblr-chklst.xlsx

Texas StreamStats

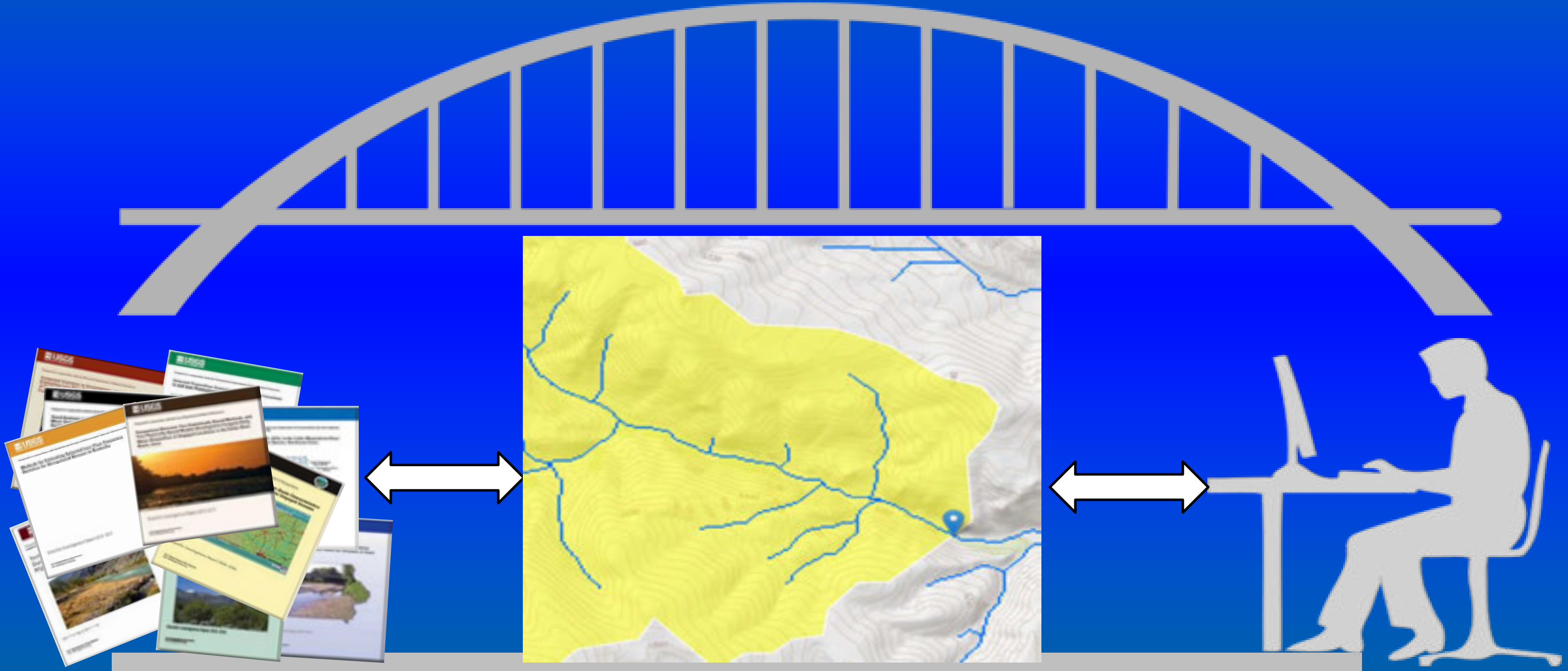
Delivering web-based geospatial and hydrologic information to the public

By Kristine Blickenstaff and Kara Garvin, USGS
April 15, 2025

In Cooperation with the Texas Department of Transportation

U.S. Geological Survey
Oklahoma-Texas Water Science Center
kgarvin@usgs.gov

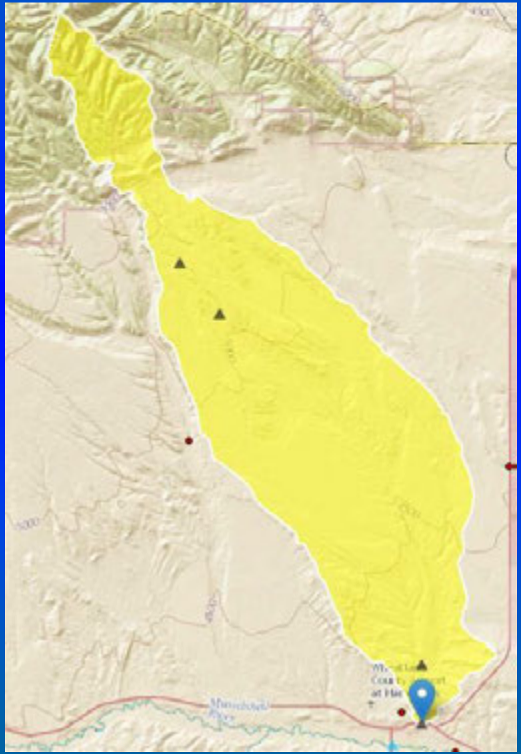
What is StreamStats?



Making complex science easily available and useful

What is StreamStats?

- Web-based map application for retrieving basin and streamflow characteristics
  - Delineates basins
  - Computes basin characteristics
  - Retrieves streamflow statistics
  - Solves regression equations for estimating streamflow statistics
- Plus other functionality and applications in an Ecosystem of Services



The Ecosystem of Services

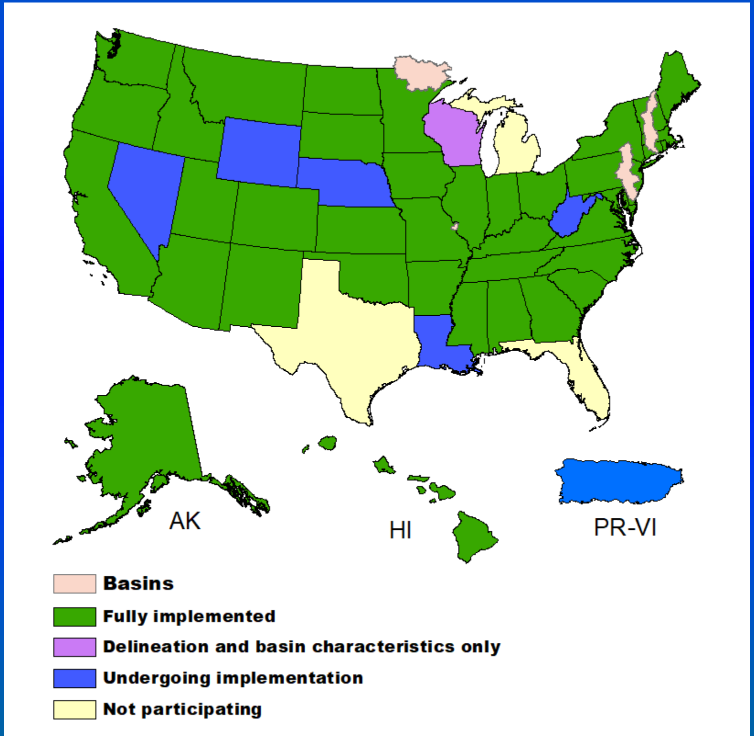
- Delineation
- Basin Edit Tools
- At-site statistics
- Ungaged estimates
- Regulation
- Rainfall runoff computations
- Hydraulic geometry
- State-specific layers (i.e. bridges)
- Coordinated flows (Indiana)
- Network navigation
- Similar gages
- Flow duration curve transfer
- StreamEST
- Storm drains
- Water Use and water availability
- International StreamStats (Rainy River Basin)
- PROSPER (Pacific Northwest)
- National Application
- Time of Travel (developing nationwide on NHDPlusV2.1)
- Fire hydrology tools and data
- Continuously solved regression equations
- NHDPlusHR Refresh
- Lidar-developed StreamStats
- Conditional hydrologic networks
- Hydraulic channel parameters
- Machine learning models (proposed)
- Sediment transport (proposed)

Who developed StreamStats?

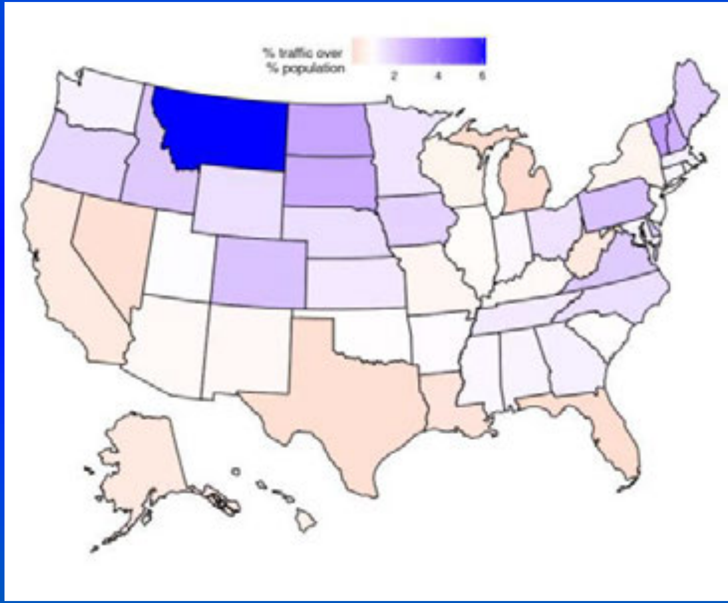
- StreamStats application developed by USGS StreamStats development team
- Data, analyses, and equations prepared locally (USGS Water Science Centers) in cooperation with federal, state, and local cooperators
- The StreamStats Team charge is to support the WSCs to implement data, methods, and functionality

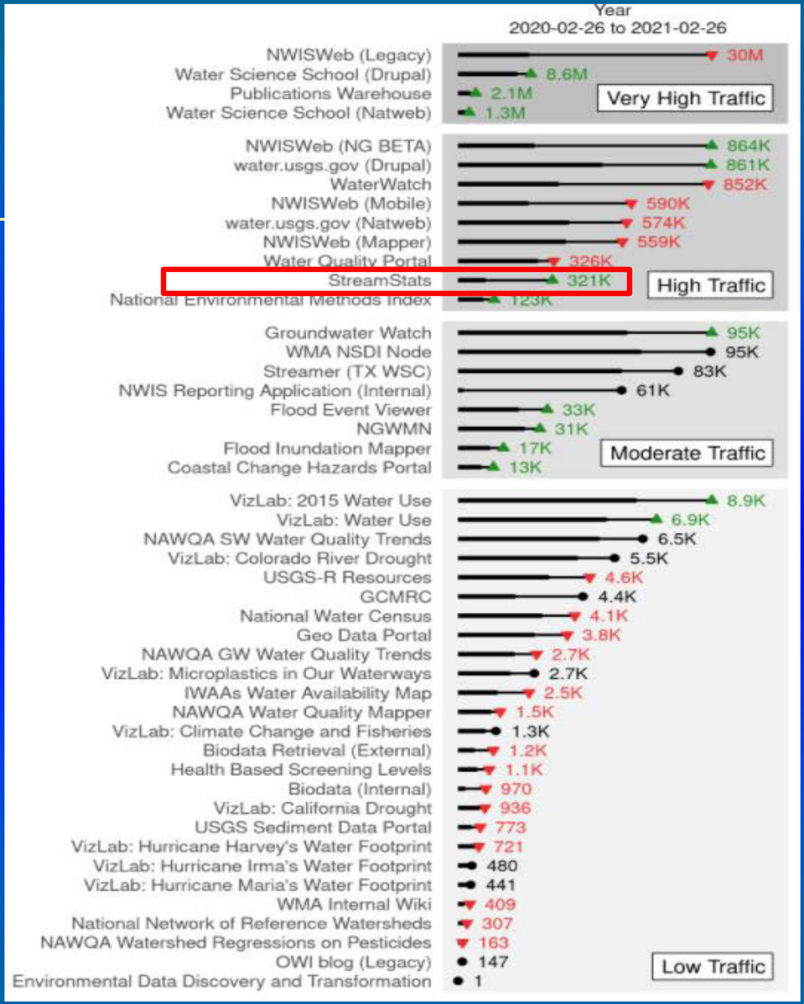
Who developed StreamStats?

- Data, applications, and availability of equations vary by state (or region)
- Innovations are everywhere
- Nearly all implemented states have flood frequency equations



Who's using StreamStats?





USGS

http://internal.wma.chs.usgs.gov/analytics/

South Carolina

"Over the next ten years, SCDOT anticipates a savings of $20,300,000 (20.3 million dollars) in engineering costs. Further, the research led SCDOT to modify the Requirement for Hydraulic Design Studies and designated StreamStats as the recommended method for delineating watersheds and obtaining discharges".-
abstract submitted to the American Association of State Highway and Transportation Officials (AASHTO) Research Advisory Committee's (RAC) Value of Research Task Force (written communication with Jimmy Clark 5/21/2020).

StreamStats was selected as a 2019 Sweet Sixteen High Value Research Project by AASHTO

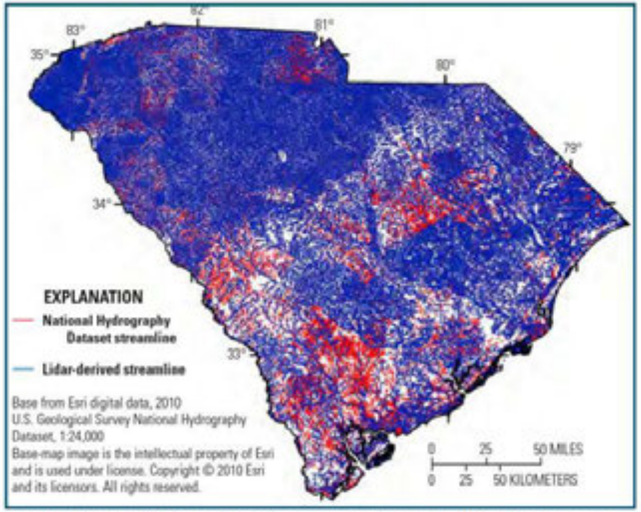
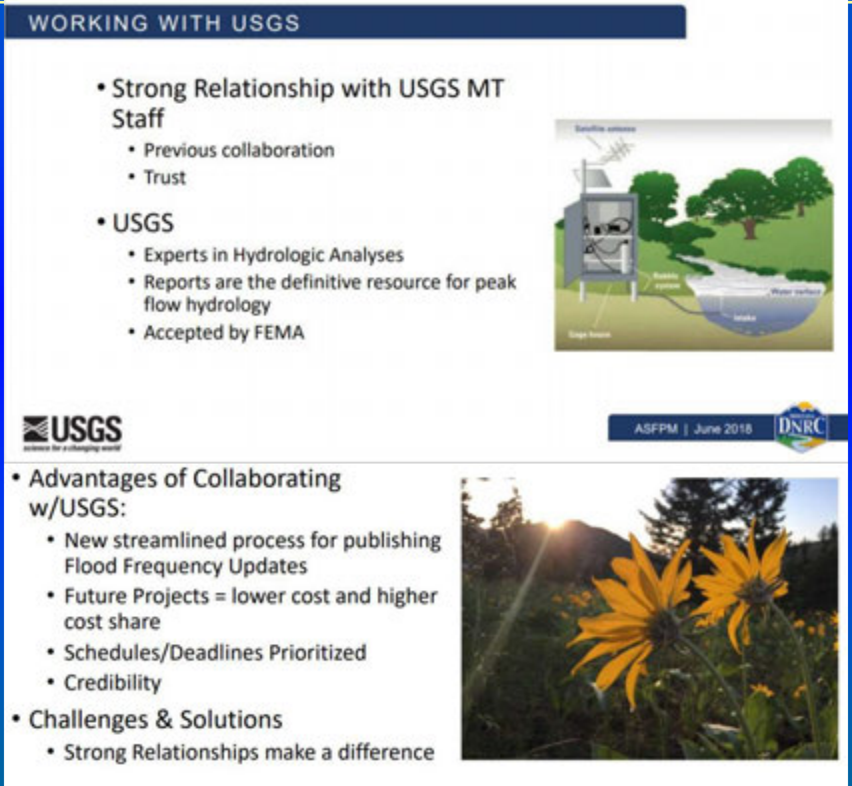


Figure 2. Light detection and ranging (lidar)-derived streamline coverage and National Hydrography Dataset coverage in South Carolina. Red lines show areas where the NHD is denser than the lidar coverage. Flow accumulation streamlines (fig. 1B) filled in these areas by adding to the lidar streamlines and continuing up stream channels.

https://www.scdot.scltap.org/wp-content/uploads/2019/12/SCDOT-Annual-Report.pdf

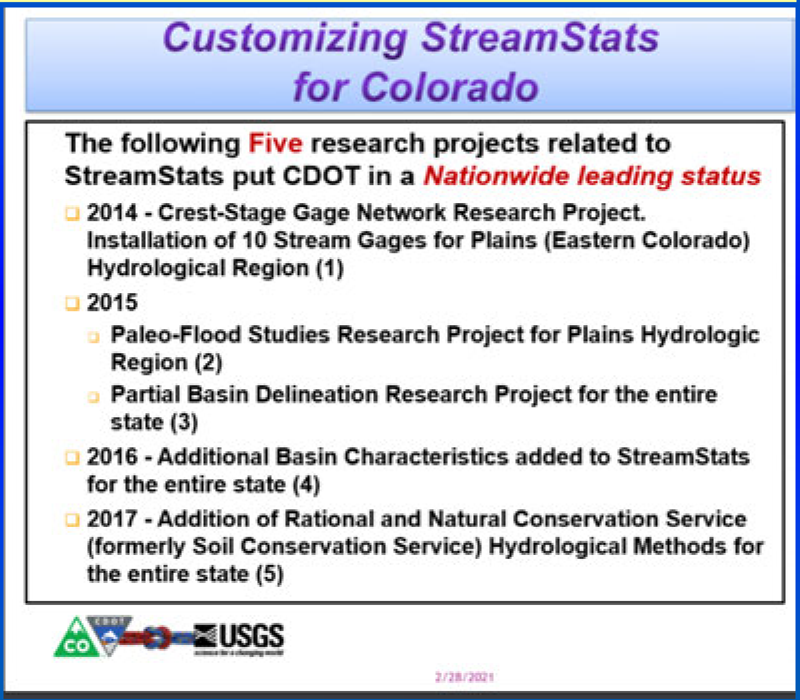
Montana

- 2018 Presentation to ASFPM “Advantages of Collaboration with USGS”
- Needs more thorough analyses
  - regulated,
  - unregulated,
  - record extension methods
  - USGS preferred analyses based on local expertise and research of flood history
- Built on strong relationships and trust
- Flood frequency equations based on channel widths
- >700 gages of which nearly 300 are CSGs, many of which cannot be represented by NHDPlusV2



Colorado

- Colorado DOT requested a proposal to upgrade Colorado to lidar data and use surveyed culvert locations to inform the processing
- Added datasets developed in Colorado to implement TR-55 and rational method

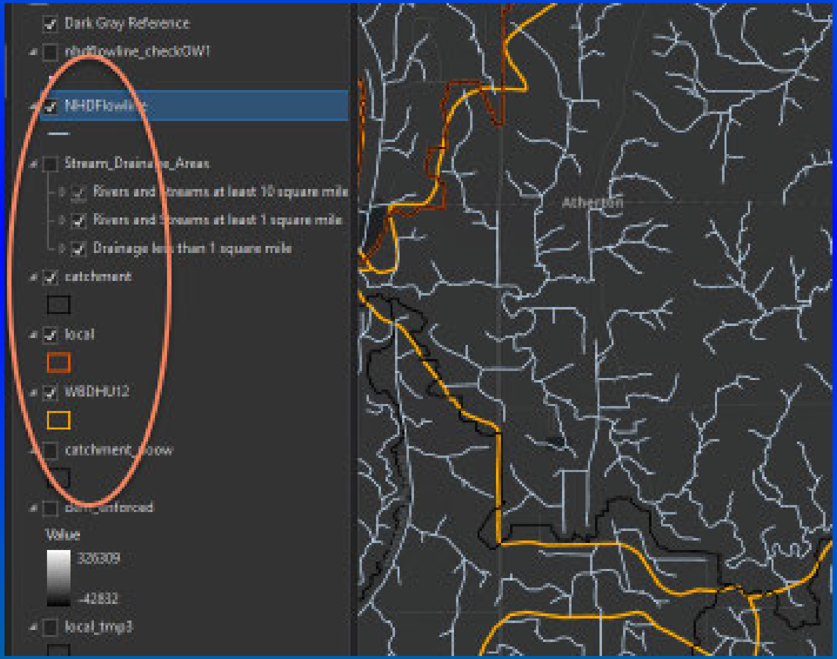


Dr. Mommandi of the Colorado Department of Transportation presentation at the 2016 AWRA Conference in Sacramento

Indiana

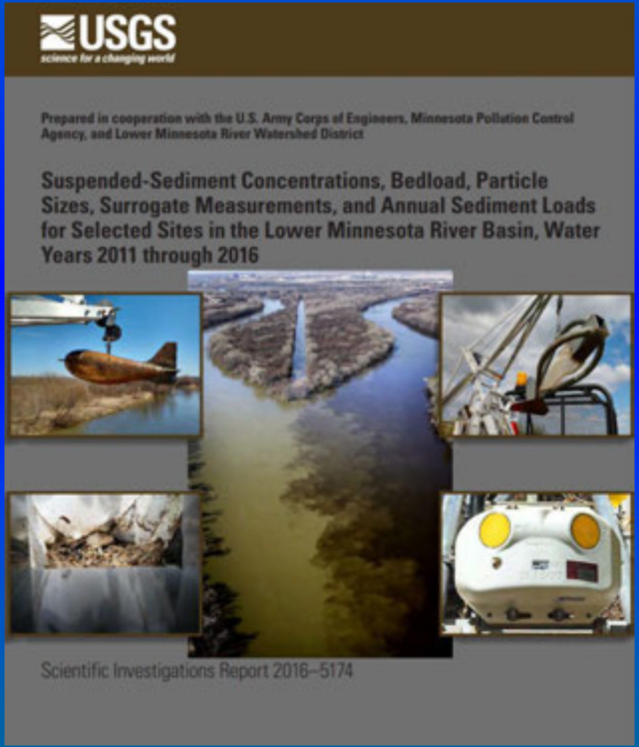
“…Streamstats is mission critical for us, we could not function without it at this point…” -David Knipe, Indiana Department of Natural Resources

- Coordinated discharge statistics based on multi-agency MOU
- Applications directly using StreamStats services
- NHD streams resolution greater resolution than NHDPlus could process
- New 3-meter lidar derived StreamStats application in process



Minnesota

- Sediment transport data
- Calibrated machine learning models as services (proposed)
- Combine machine learning models, QPPQ methods, and sediment transport to get daily sediment transport estimates anywhere

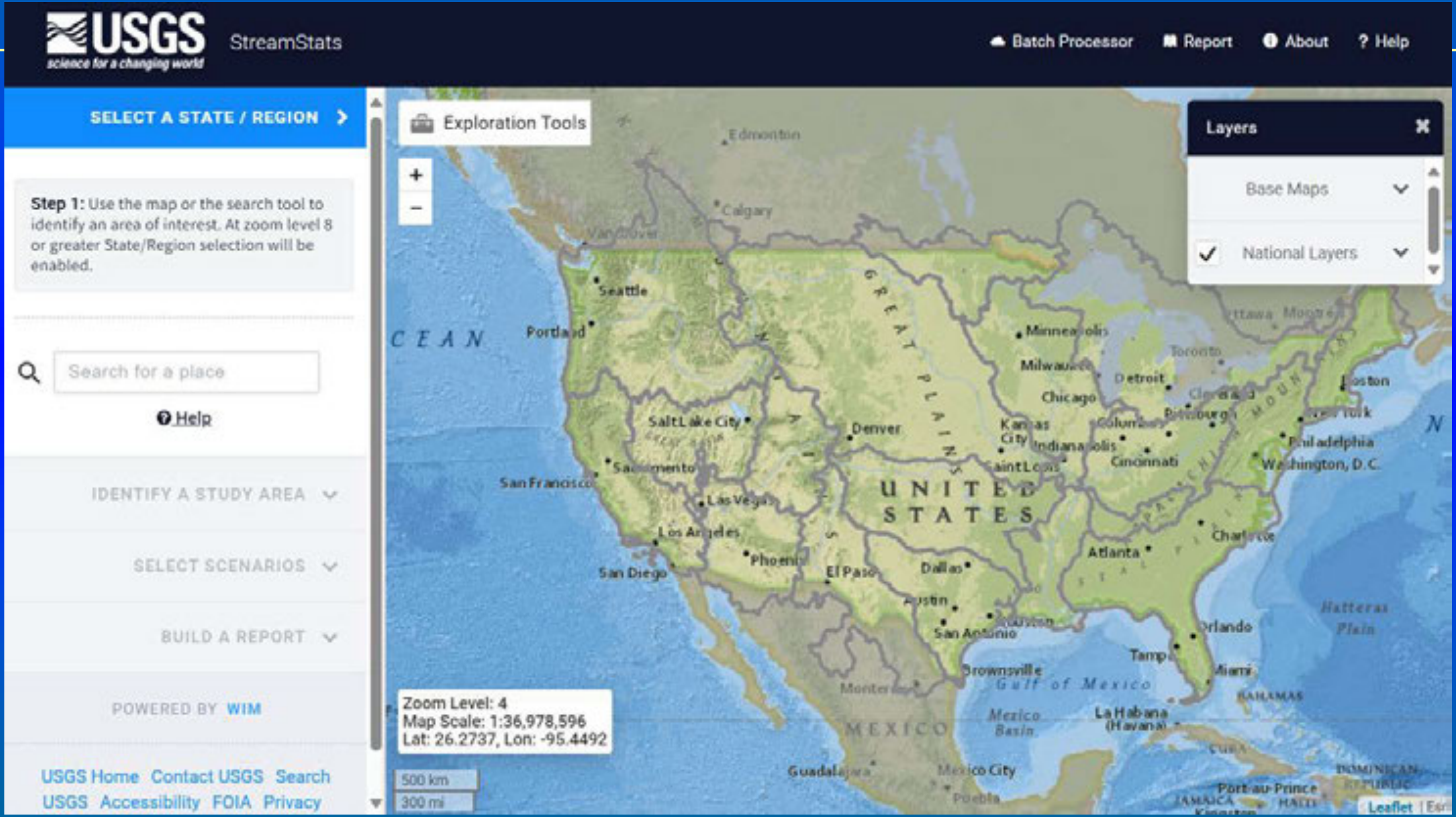


USGS

StreamStats for Texas - Data at Your Fingertips

- Streamflow statistics, watershed basin boundaries, and basin characteristics such as land use aren't readily available to users at gaged and ungaged sites along a stream.

USGS StreamStats Application



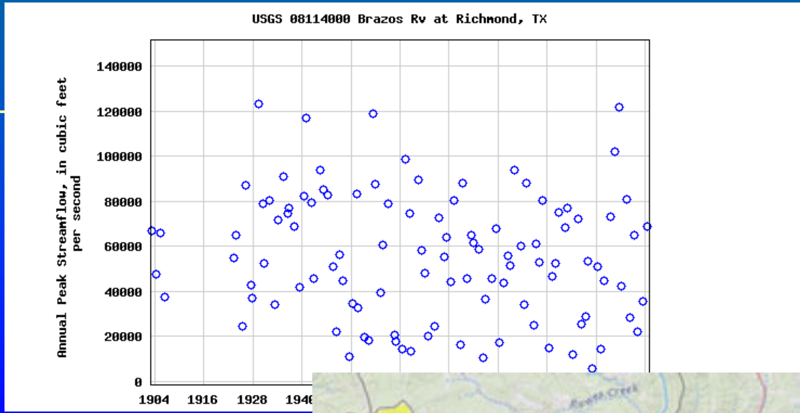
USGS StreamStats Application

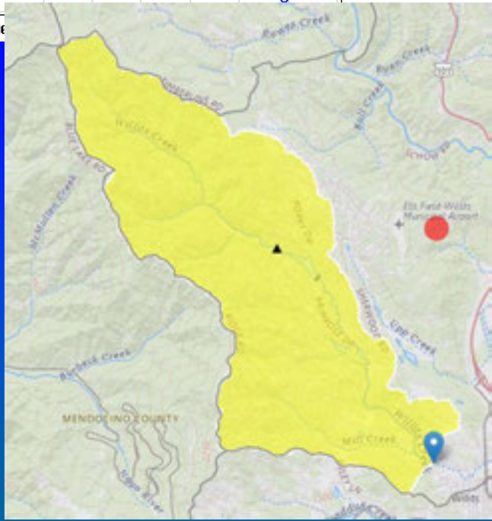
- StreamStats is a map-based web application that provides an assortment of analytical tools that are useful for water-resources planning and management, and engineering purposes
- StreamStats provides estimates of streamflow statistics for user selected ungaged sites on streams as well as for USGS streamgages

StreamStats Outputs

The Texas StreamStats application will provide automated tools to:

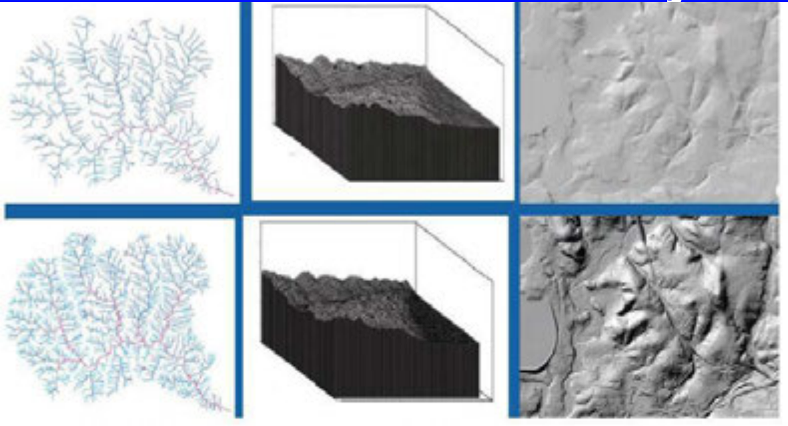
1) Delineate basins
2) Derive basin characteristics
3) Generate peak-flow flood frequency statistics
4) Create reports with tables and maps
5) Download geographic information system (GIS) basin boundary and spreadsheet files
6) Link to published USGS reports and data.





Digital Elevation Model

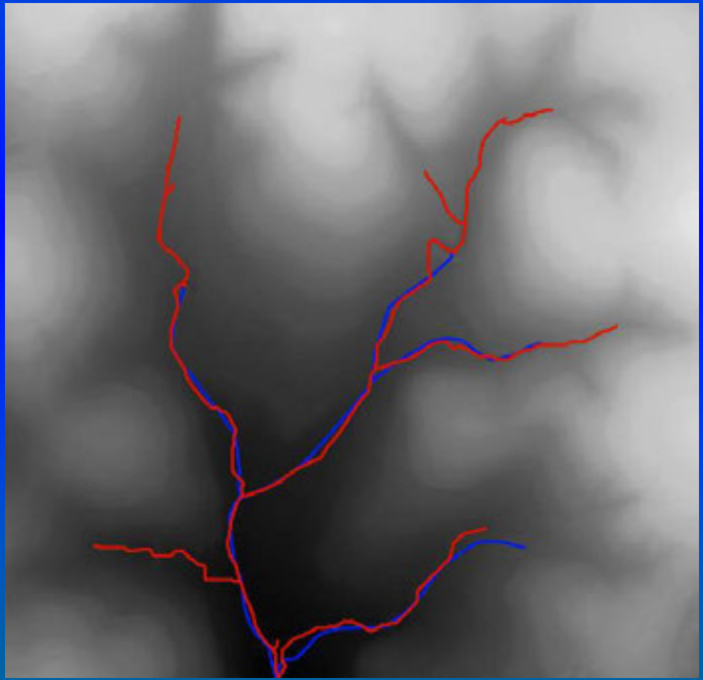
- Statewide 3-meter Lidar DEM dataset from Fathom
- Stream lines will be developed from the DEM data using geospatial tools
- Creating a new 3-meter statewide stream layer



Lidar Derived Streamlines

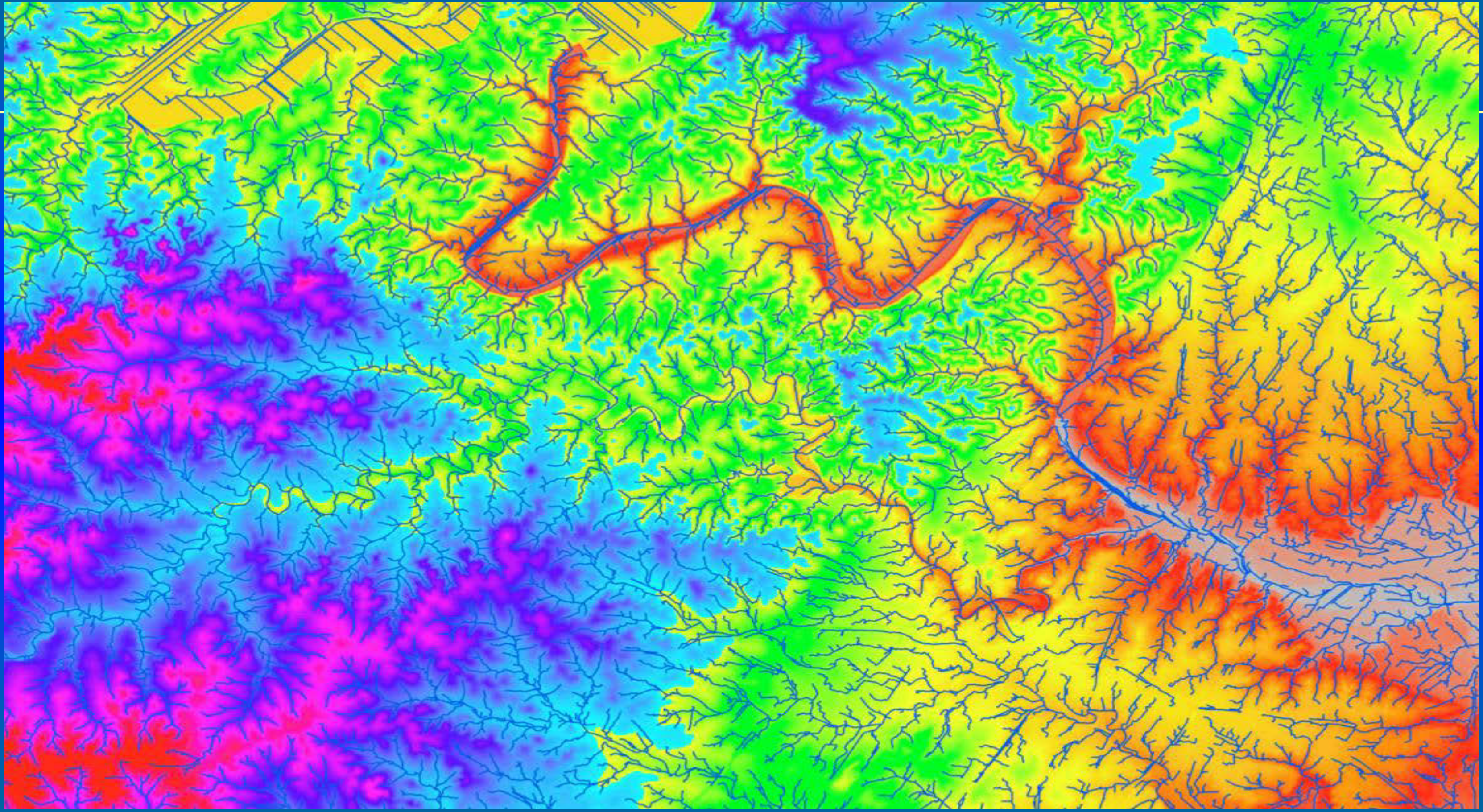
A 3-meter stream-line dataset will be created for Texas as a product of this project

- Cutting-edge methodology
- Created using lidar dem data
- Includes precise detail- only Texas and Florida using this updated method
- Streamlines will extend further upstream



USGS

Lidar Derived Streamlines

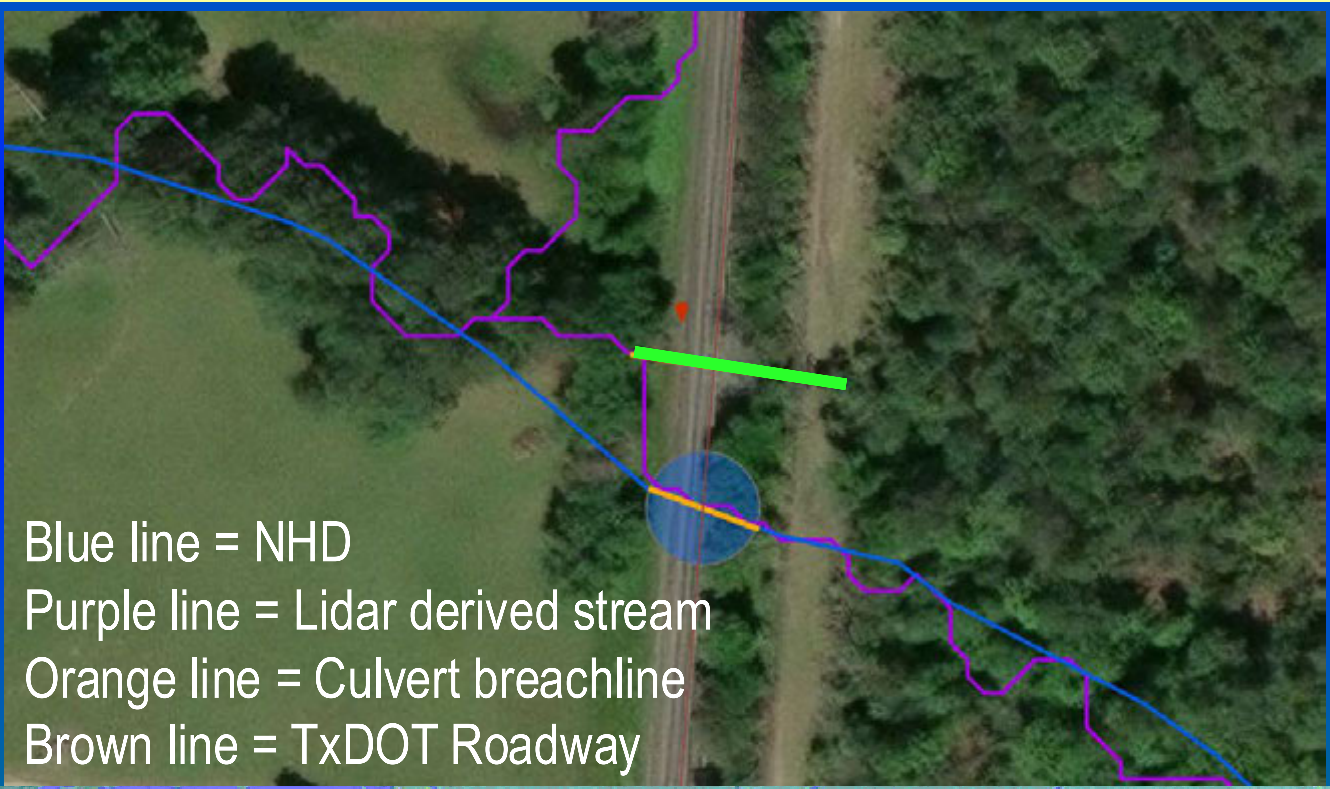


USGS

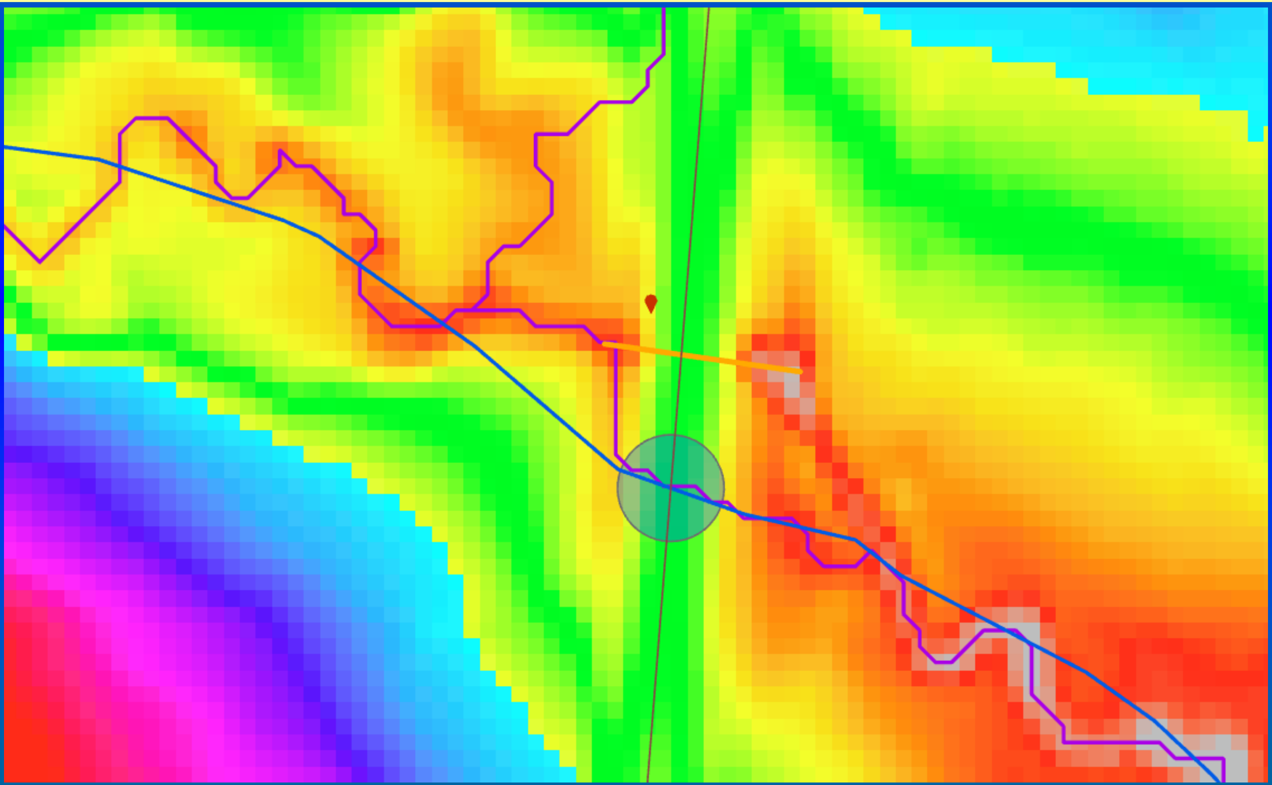
Culvert Breaching

- TxDOT Bridge-class culvert inventory dataset
- TxDOT Roadways
- National Hydrologic Database (NHD)

Culvert Breaching

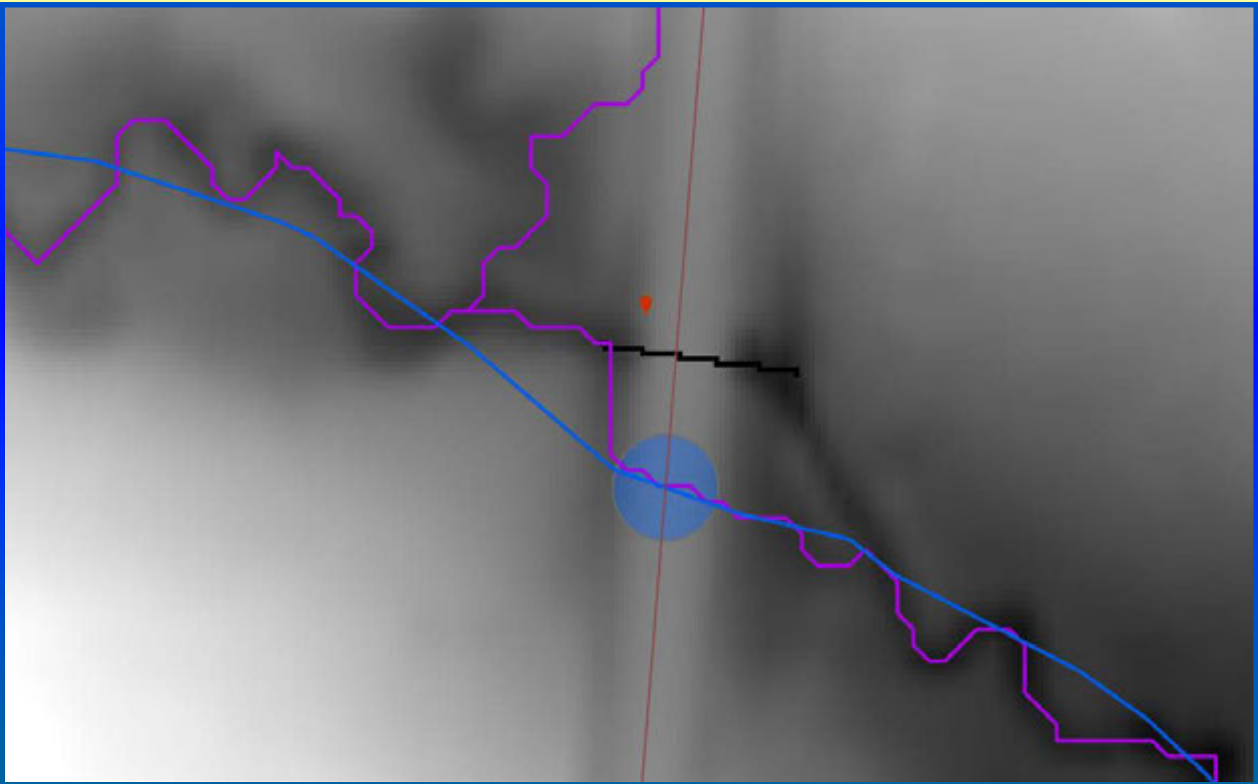


Culvert Breaching with 3-meter DEM

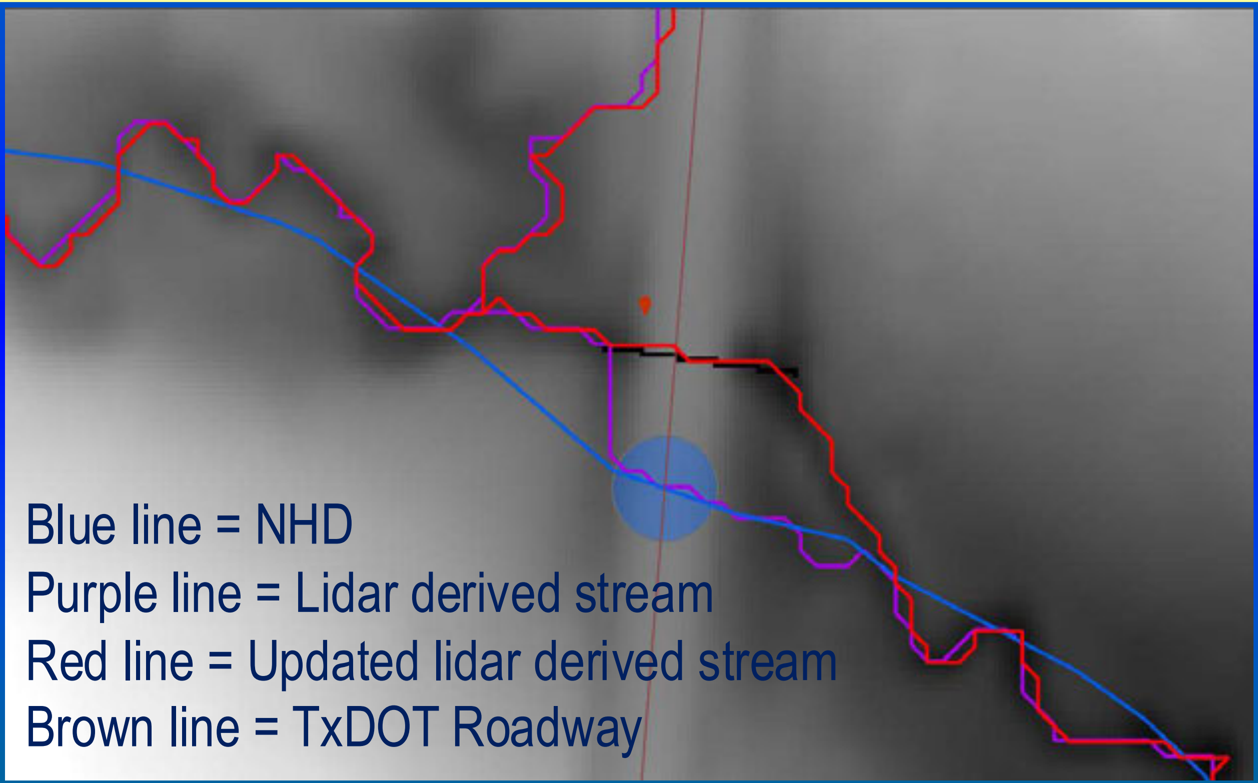


USGS

Culvert Breaching- DEM breached



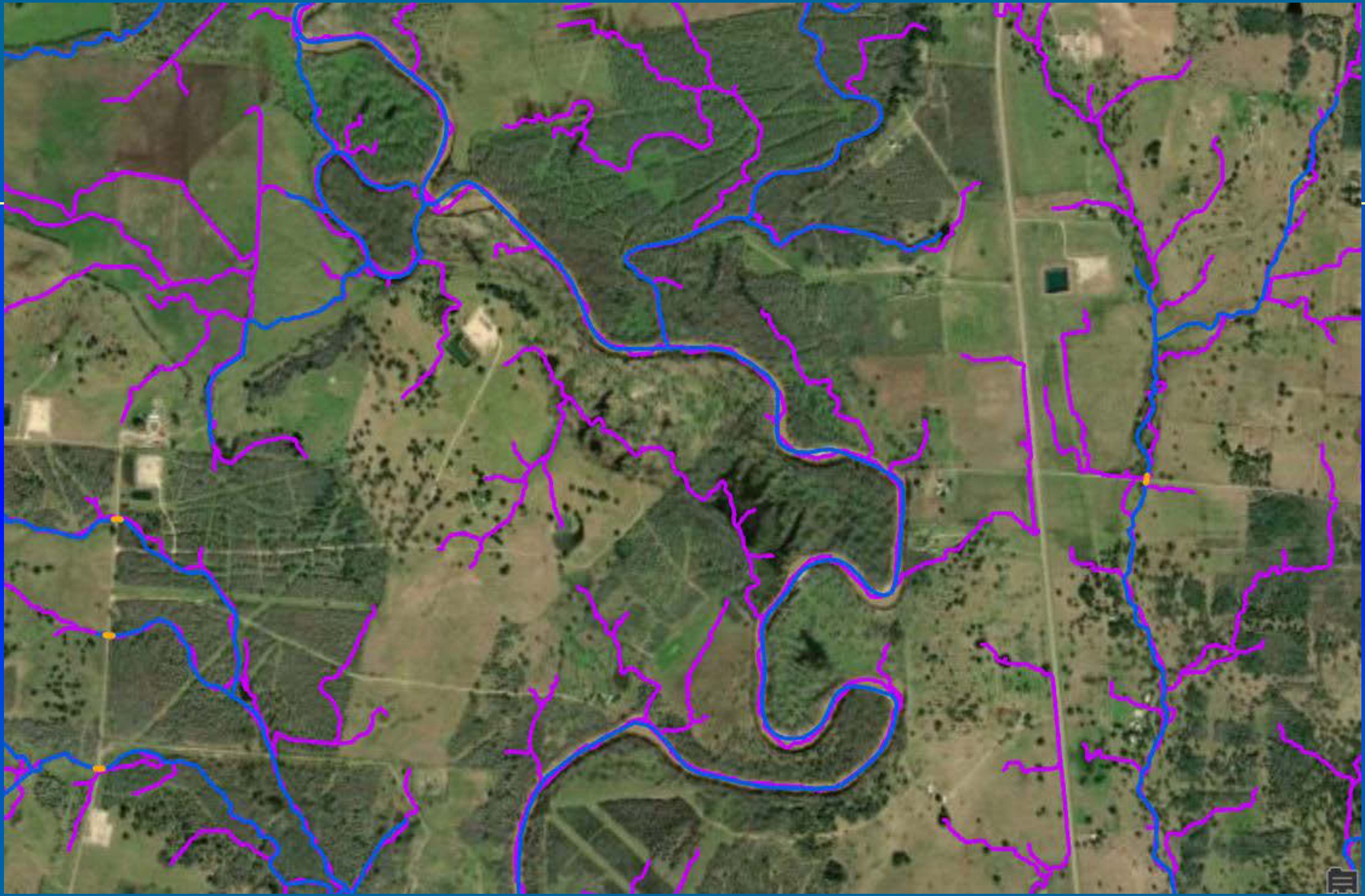
Culvert Breaching

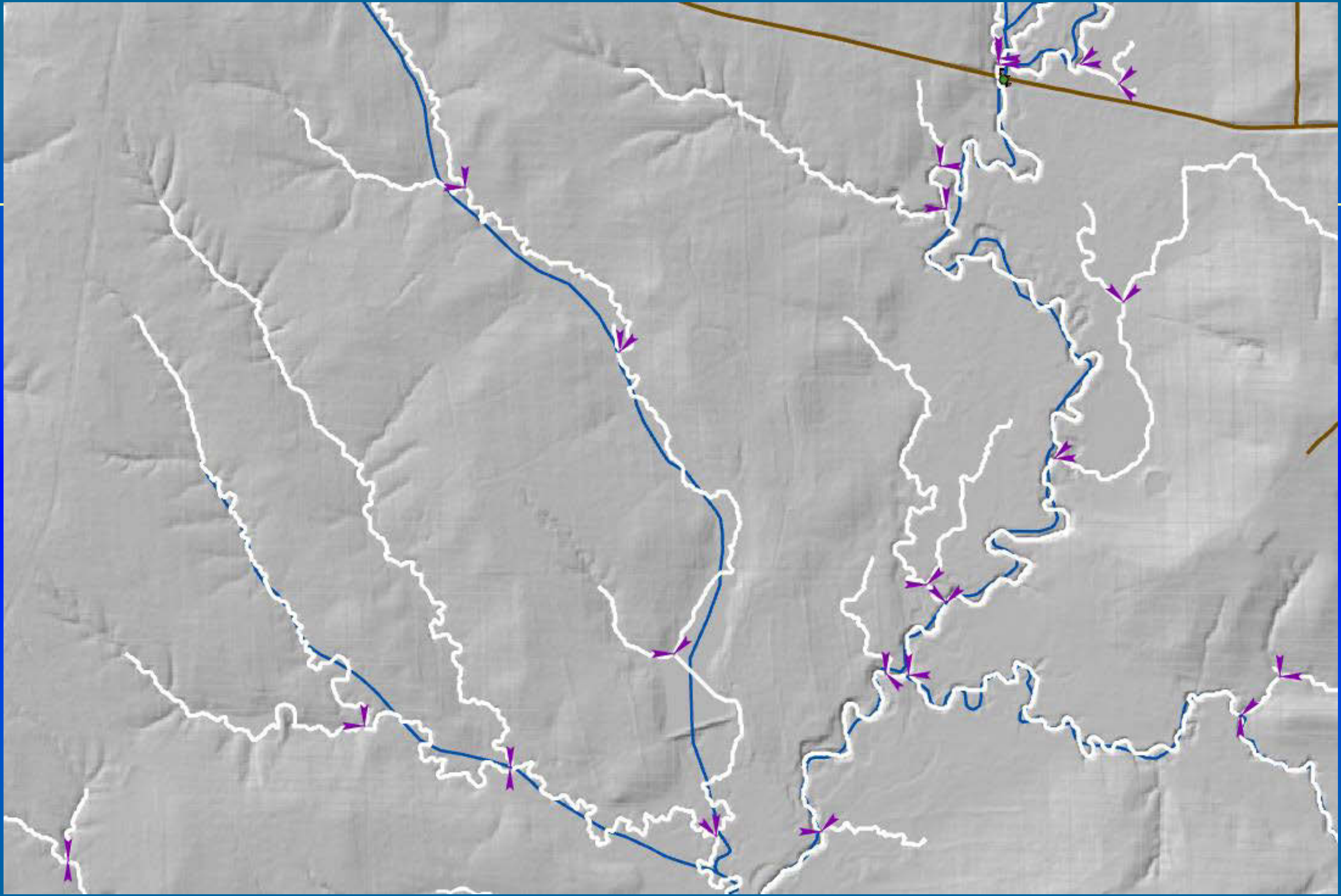


USGS

New Streamlines By The Numbers

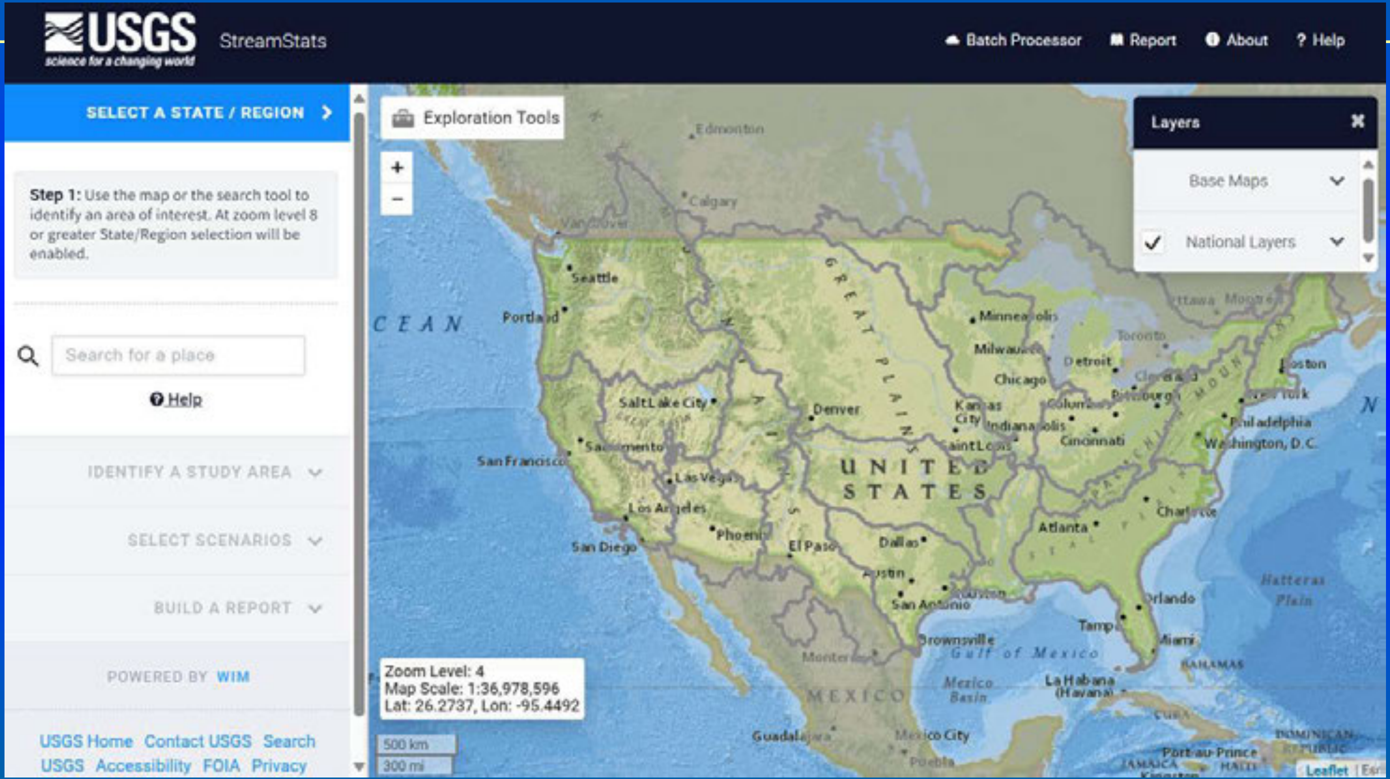
- HUC4- 1210 Central Texas Coast
- TxDOT culverts = 2,877 (21,433 total in statewide dataset)
- Breachlines created = 15,692
- NHD Streamline length = 36,691 miles
- New created str50k streamline length = 117,659 miles
- 3+ times more streamlines





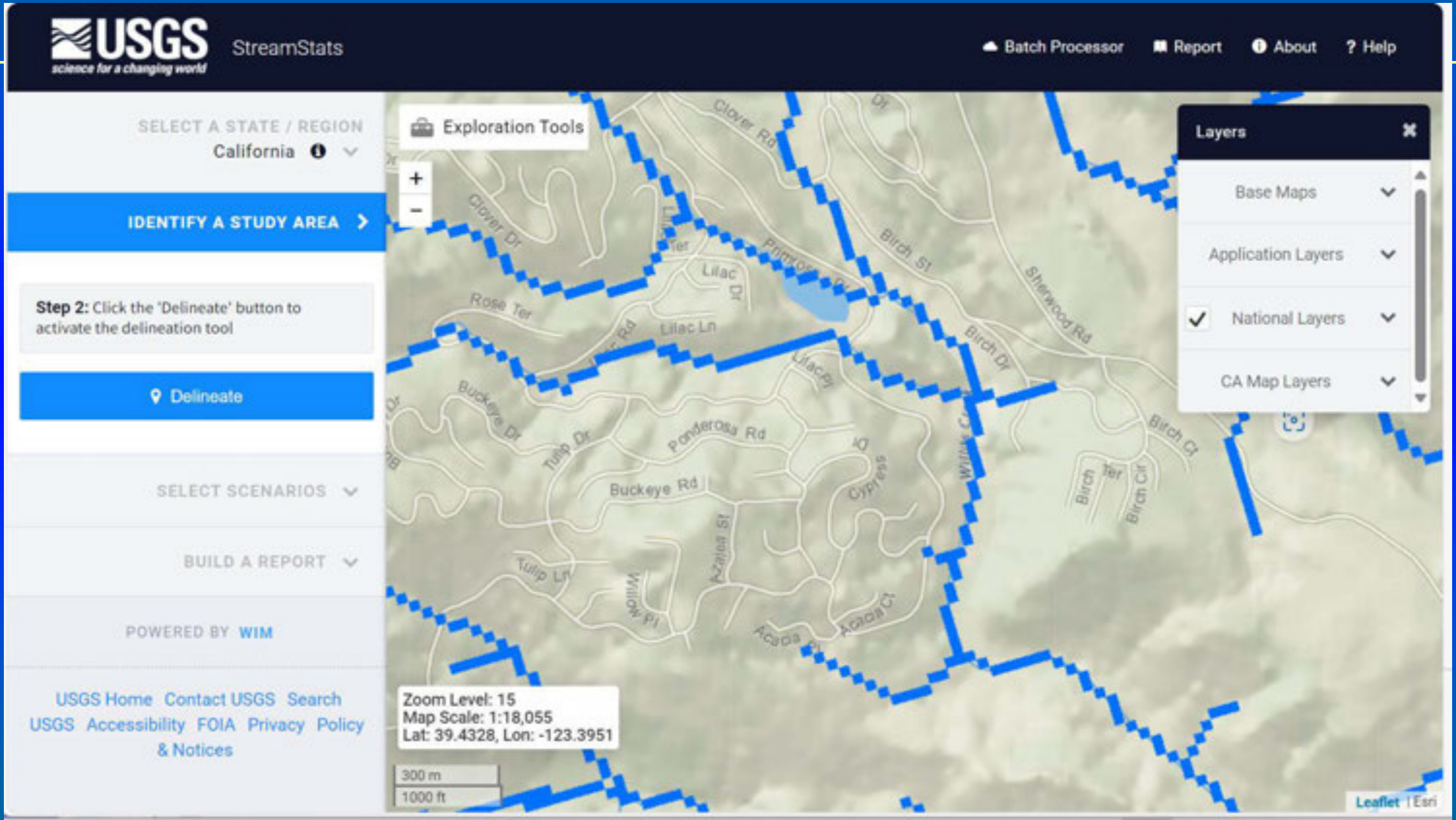
Playas

USGS StreamStats Application

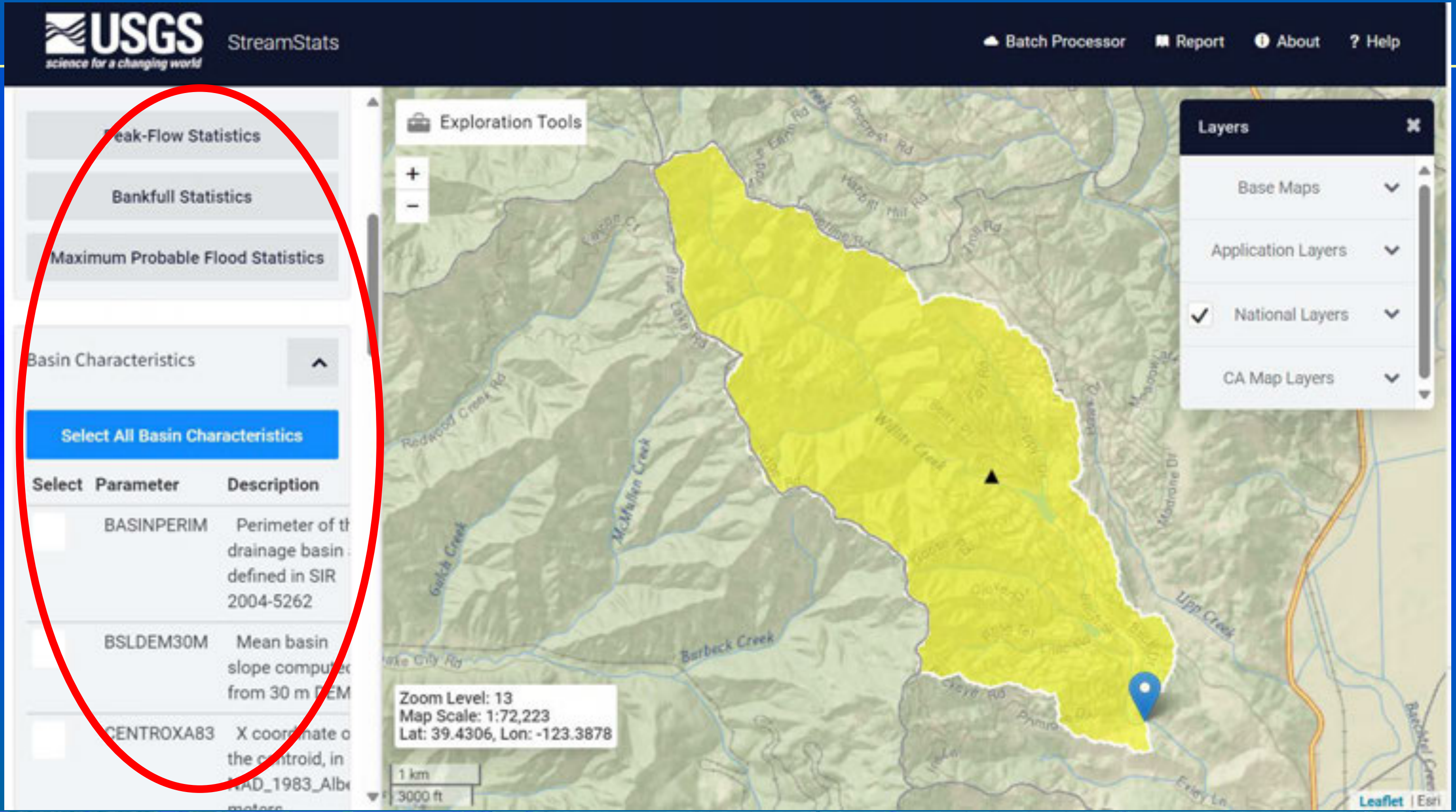


https://streamstats.usgs.gov

Streamlines



Basin Delineation



Report

StreamStats Report

Region ID:	CA
Workspace ID:	CA20240220183414088000
Clicked Point (Latitude, Longitude):	39.42363, -123.37749
Time:	2024-02-20 10:33:59 -0800

Collapse All

Computed Basin Characteristics

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	7	square miles
ELEV	Mean Basin Elevation	2018	feet
ELEVMAX	Maximum basin elevation	2811	feet
FOREST	Percentage of area covered by forest	64.5	percent
LAKEAREA	Percentage of Lakes and Ponds	0.17	percent
LC11DEV	Percentage of developed (urban) land from NLCD 2011 classes 21-24	13.6	percent
LC11IMP	Average percentage of impervious area determined from NLCD 2011 impervious dataset	0.4	percent
MINBELEV	Minimum basin elevation	1472	feet
OUTLETELEV	Elevation of the stream outlet in feet above NAVD88	1472	feet
PRECIP	Mean Annual Precipitation	57.8	inches

Texas Basin Characteristics

Name	Description
Drainage Area	Area that drains to a point on a stream
Stream Slope Blue Line Method	Change in elevation of the longest blue-line stream (not extended to the boundary) divided by stream length
Mean Annual Precipitation	Mean Annual Precipitation
Stream Density	Stream Density -- total length of streams divided by drainage area
Mean Basin Elevation	Mean Basin Elevation
Mean Basin Slope ft per mi	Mean basin slope determined by summing lengths of all contours in basin mulitplying by contour interval and dividing product by drainage area
Percent agriculture	Percent agriculture computed as total of grass, pasture, and crops, from current NLCD classes 71, 81 and 82
Percent Forest from NLCD	Percentage of forested area from current NLCD classes 41-43
Percent Storage from NLCD	Percentage of area of storage from current NLCD classes 11-12, 90, 95
Percent Developed from NLCD	Percentage of developed (urban) land from current NLCD classes 21-24
Percent_Impervious_NLCD	Average percentage of impervious area determined from current NLCD impervious dataset
Average Soil Permeability	Average Soil Permeability
Main Channel Sinuosity	Main Channel Sinuosity
Texas Ecological Regions (10)	Percentage of area within the 10 Texas Ecological Regions
Mean Monthly Precipitation (12)	Mean monthly precipiation for each of the twelve months

Estimated Peak Flows

Peak-Flow Statistics Parameters [2012 5113 Region 1 North Coast]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	7	square miles	0.04	3200
PRECIP	Mean Annual Precipitation	57.8	inches	20	125

Peak-Flow Statistics Flow Report [2012 5113 Region 1 North Coast]

PIL: Lower 90% Prediction Interval, PIU: Upper 90% Prediction Interval, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	PIL	PIU	ASEp
50-percent AEP flood	570	ft^3/s	234	1390	58.6
20-percent AEP flood	1040	ft^3/s	498	2170	47.4
10-percent AEP flood	1380	ft^3/s	686	2780	44.2
4-percent AEP flood	1820	ft^3/s	934	3550	42.7
2-percent AEP flood	2150	ft^3/s	1100	4200	42.7
1-percent AEP flood	2500	ft^3/s	1250	5000	44.3
0.5-percent AEP flood	2820	ft^3/s	1410	5650	44.4
0.2-percent AEP flood	3250	ft^3/s	1580	6670	46

Peak-Flow Statistics Citations

Gotvald, A.J., Barth, N.A., Veilleux, A.G., and Parrett, Charles,2012, Methods for determining magnitude and frequency of floods in California, based on data through water year 2006: U.S. Geological Survey Scientific Investigations Report

USGS

TX- Regional Regression Equations

- Using existing USGS developed estimating equations

- Asquith, W.H., and Roussel, M.C., 2009, *[http://pubs.usgs.gov/sir/2009/5087]*

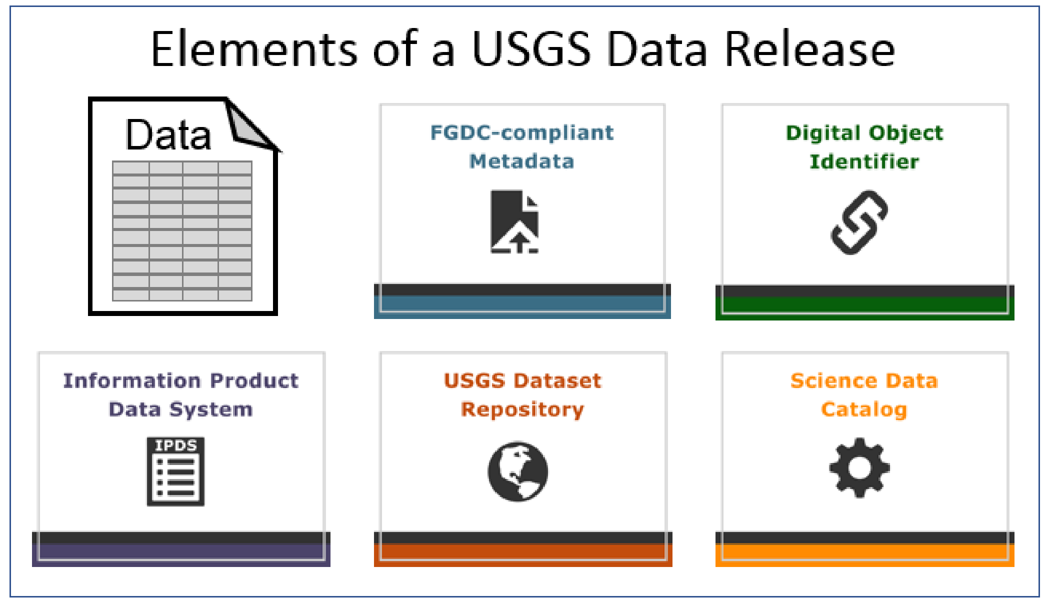
- *Asquith, W.H., Herrmann, G.R., and Cleveland, T.G., 2013, [https://doi.org/10.1061/(ASCE)HE.1943-5584.0000635]*

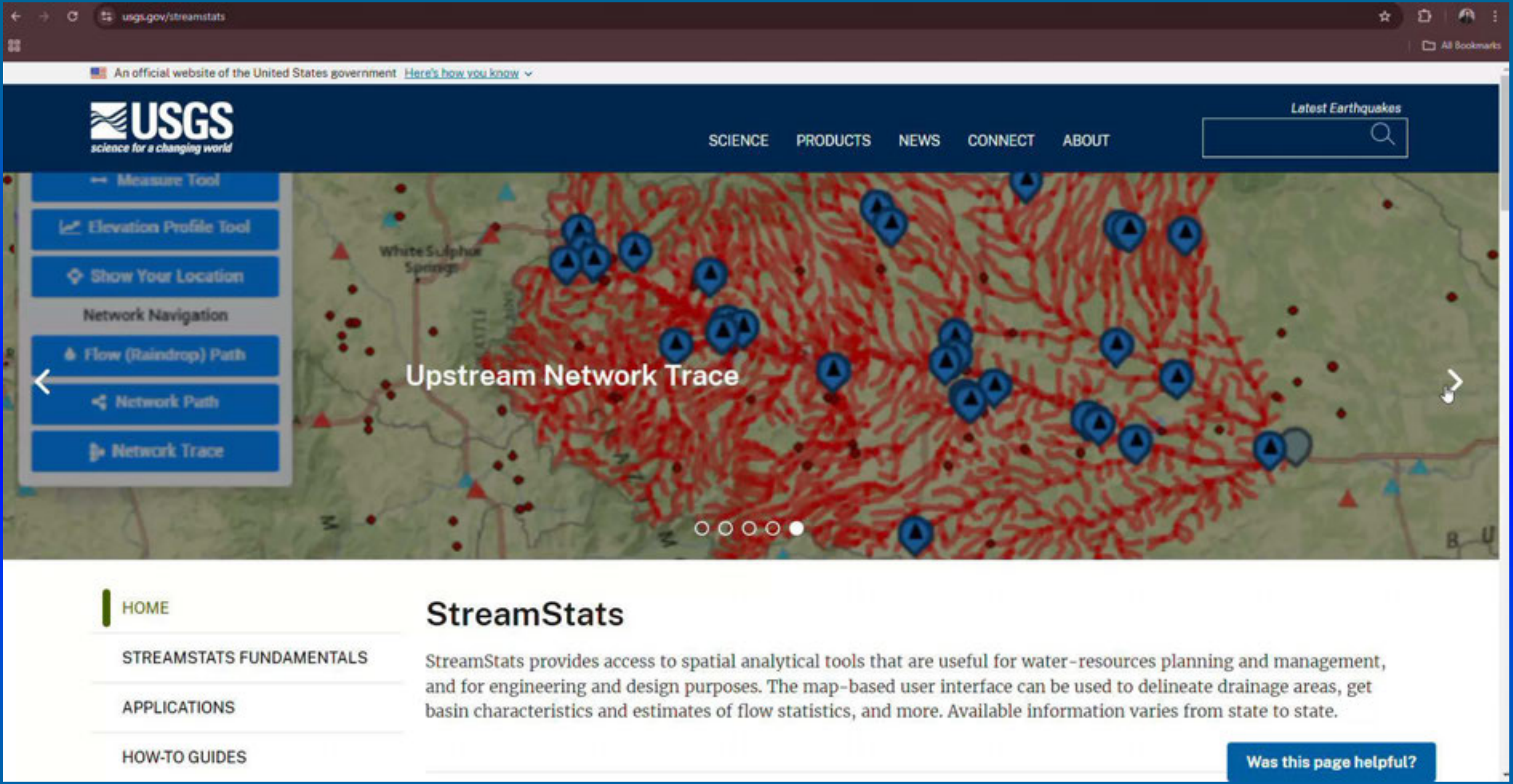
Benefits of StreamStats

- Use of higher-resolution datasets
  - Refined consistent estimates of streamflow
  - More detail to smaller basins
- Output of consistent basin characteristic values for and streamflow statistics
- Peak-streamflow frequency estimates are needed by planners, managers, and design engineers for flood-plain management; for objective assessment of flood risk; for cost-effective design of roads and bridges; and also for the design of culverts, dams, levees, and other flood-control structures.

USGS ScienceBase Data Release

- Digital elevation, flow direction, flow accumulation, and new streamline GIS data as well as basin characteristic datasets




usgs.gov/streamstats
All Bookmarks
An official website of the United States government Here's how you know
USGS
science for a changing world
Latest Earthquakes
SCIENCE
PRODUCTS
NEWS
CONNECT
ABOUT
Measure Tool
Elevation Profile Tool
Show Your Location
Network Navigation
Flow (Raindrop) Path
Network Path
Network Trace
White Sulphur Springs
Upstream Network Trace
HOME
STREAMSTATS FUNDAMENTALS
APPLICATIONS
HOW-TO GUIDES
StreamStats
StreamStats provides access to spatial analytical tools that are useful for water-resources planning and management, and for engineering and design purposes. The map-based user interface can be used to delineate drainage areas, get basin characteristics and estimates of flow statistics, and more. Available information varies from state to state.
Was this page helpful?

For more information on StreamStats:

https://www.usgs.gov/streamstats

USGS

Thank you!