

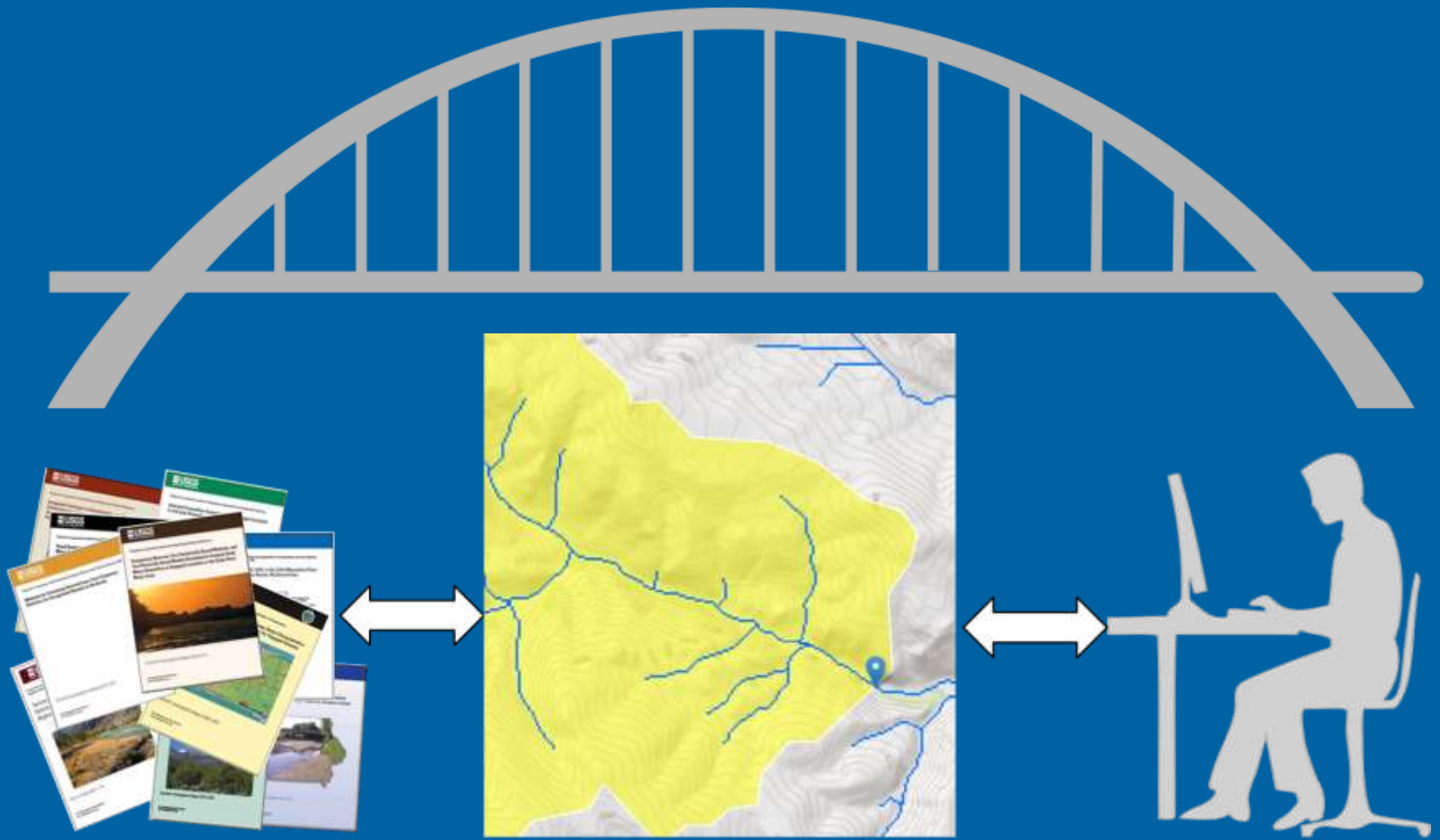
# StreamStats Version 4



# Today's Topics

- What is StreamStats and who uses it?
- How is StreamStats developed?
- User interface and demonstration
- Customizations and future developments
- Questions

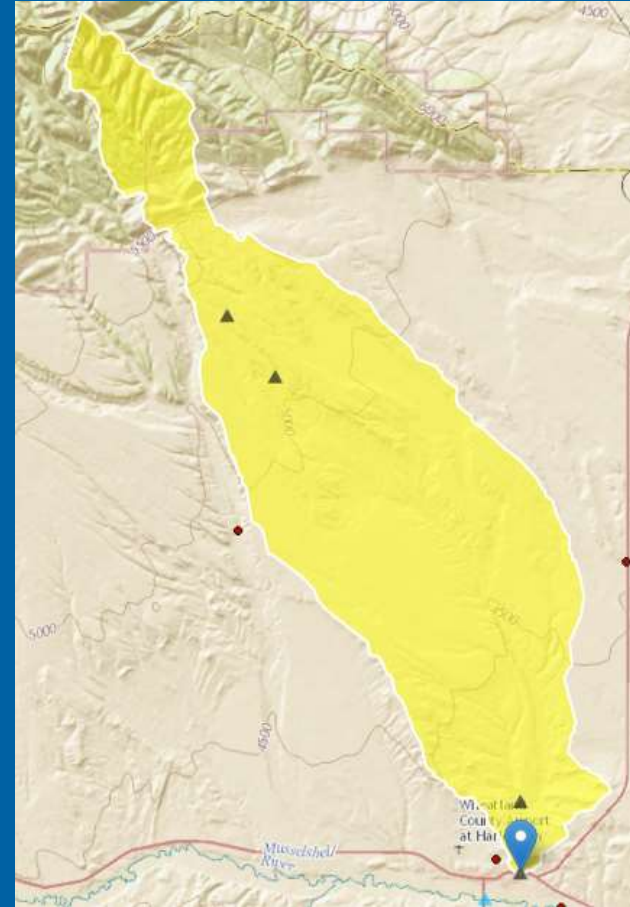
# What is StreamStats?



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



# What is StreamStats?

- Ways to summarize streamflow statistics
  - Basic summary statistics
    - Range (e.g. max, min)
    - Mean (e.g. daily, monthly)
  - Flow-duration analyses (e.g. exceedance flows)
  - Frequency analyses (1-percent flood)
- Intended use determines type of analyses and data period

30Q2

100-year flood

90% exceedance flow

7Q10

mean monthly flow

# Who developed StreamStats?

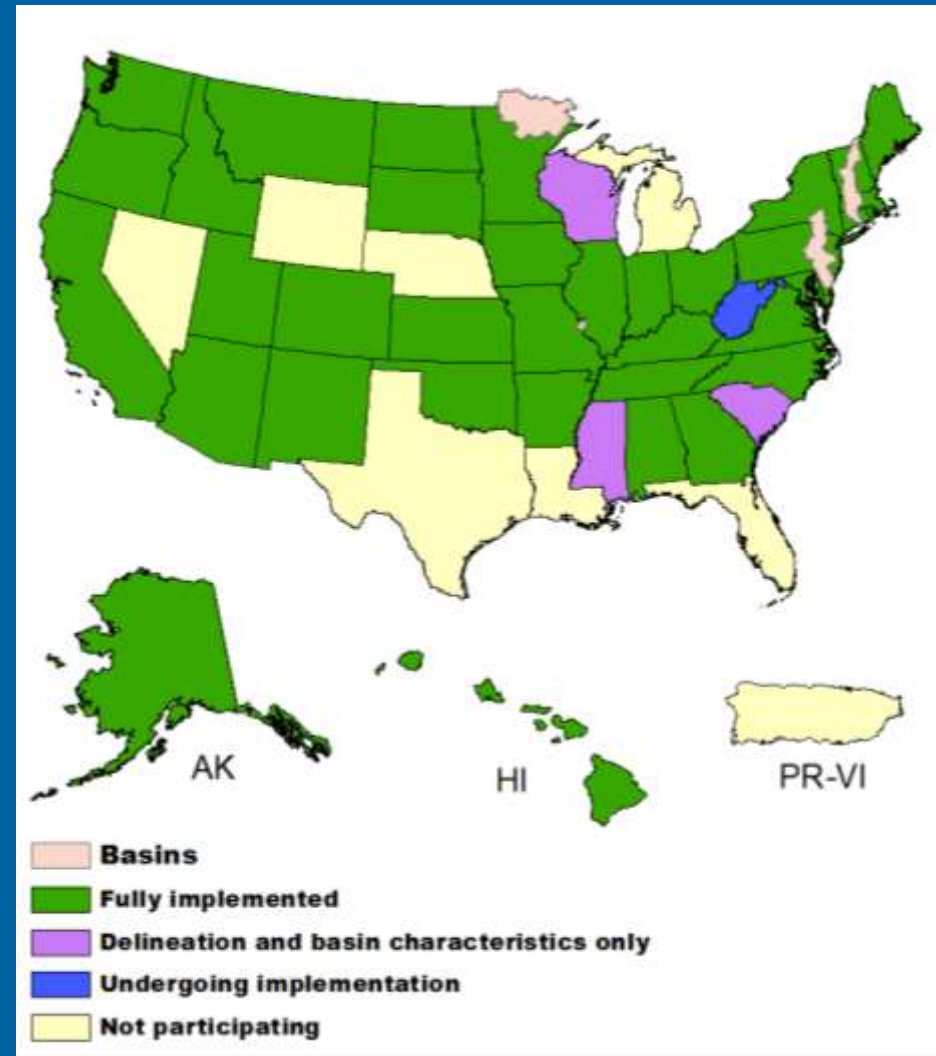
- StreamStats application developed by USGS StreamStats development team
- Data, analyses, and equations prepared locally (USGS Water Science Centers) in cooperation with federal, state, and local cooperators





# Who developed StreamStats?

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



# How is StreamStats developed?

## StreamStats

```
graph TD; A[StreamStats] --- B[GIS data and tools]; A --- C[Streamflow statistics]; A --- D[Regression equations]; B --- B1[Hydrography data]; B --- B2[GIS hydro tools]; B --- B3[GIS maps]; B --- B4[Land use]; B --- B5[Climate]; B --- B6[Elevation]; C --- C1[Streamflow statistics at streamflow gaging stations]; C --- C2[Flood frequencies]; C --- C3[Low flow frequencies]; C --- C4[Streamflow duration]; C --- C5[Other statistics?]; D --- D1[Regression equations to estimate statistics at ungaged locations]; D --- D2[Flood frequencies]; D --- D3[Low flow frequencies]; D --- D4[Streamflow duration];
```

### GIS data and tools

Hydrography data  
GIS hydro tools  
GIS maps

- Land use
- Climate
- Elevation

### Streamflow statistics

Streamflow statistics at streamflow gaging stations

- Flood frequencies
- Low flow frequencies
- Streamflow duration
- Other statistics?

### Regression equations

Regression equations to estimate statistics at ungaged locations

- Flood frequencies
- Low flow frequencies
- Streamflow duration

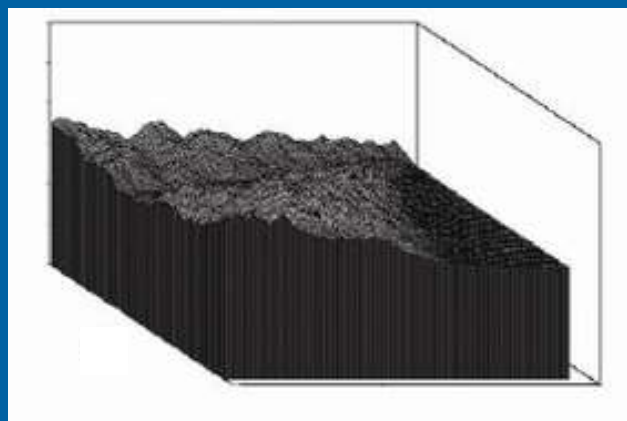
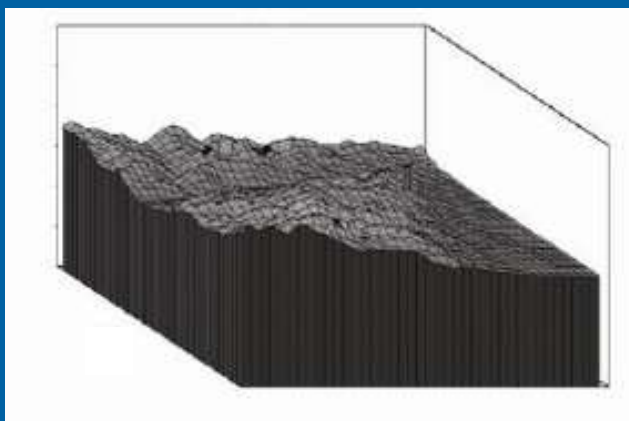
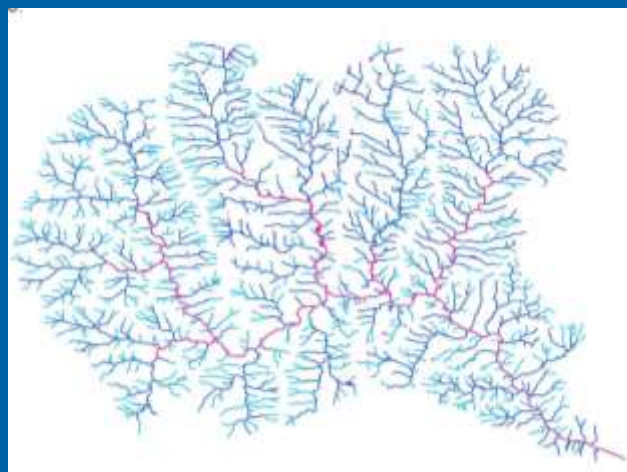
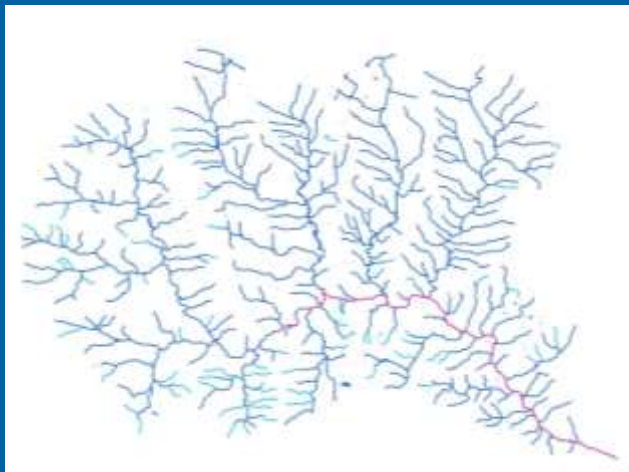


# How is StreamStats developed?

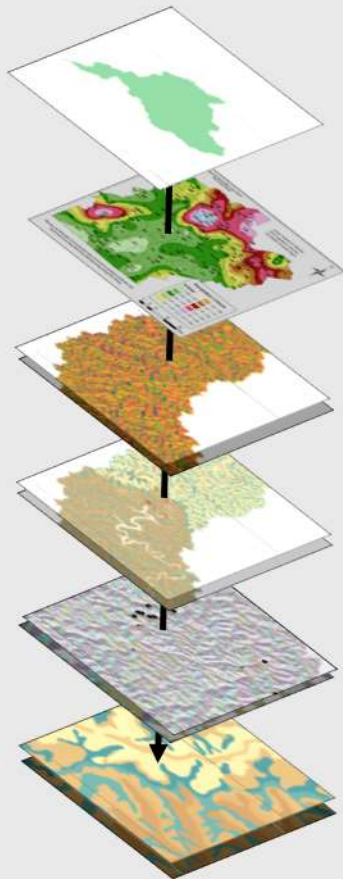
- Hydrography data that digitally represents stream features
  - National Hydrography Dataset (NHD)
    - Stream network represented by flowlines
    - Attributes of flow direction, length, name, and many others
  - Watershed Boundary Dataset (WBD)
    - Seamless national framework of drainage boundaries
  - Digital Elevation Model (DEM)
    - Raster (grid) data for elevations used to create flow accumulation and flow direction grids (for delineating basins)



# How is StreamStats developed?



# How is StreamStats developed?



- Drainage Area
- Mean Annual Precip
- % Area Underlain by Soil Type B (SURGO)
- % Area Underlain by Soil Type C (SURGO)
- % Area Underlain by Soil Type D (SURGO)
- Relative Stream Density
- Hydrograph Separation Analysis
- Stream-variability index

## Weighted-least-squares regression equations

$$D01=10^{-0.717} \text{DRNAREA}^{0.974} 10^{0.045(\text{PRECIP})} 10^{0.003(\text{SOILCSSURGO})}$$

$$D05=10^{-2.039} \text{DRNAREA}^{1.110} 10^{0.051(\text{PRECIP})} 10^{1.142(\text{RSD})}$$

$$D10=10^{-1.977} \text{DRNAREA}^{1.133} 10^{0.038(\text{PRECIP})} 10^{1.362(\text{RSD})}$$

$$D15=10^{-2.603} \text{DRNAREA}^{1.113} 10^{0.009(\text{HYSEP})} 10^{0.055(\text{PRECIP})}$$

$$D20=10^{-2.726} \text{DRNAREA}^{1.102} 10^{0.011(\text{HYSEP})} 10^{0.053(\text{PRECIP})}$$

$$D30=10^{-2.931} \text{DRNAREA}^{1.085} 10^{0.014(\text{HYSEP})} 10^{0.051(\text{PRECIP})}$$

$$D40=10^{-3.187} \text{DRNAREA}^{1.075} 10^{0.017(\text{HYSEP})} 10^{0.050(\text{PRECIP})}$$

$$D50=10^{-3.449} \text{DRNAREA}^{1.065} 10^{0.020(\text{HYSEP})} 10^{0.050(\text{PRECIP})}$$

$$D60=10^{-3.770} \text{DRNAREA}^{1.066} 10^{0.024(\text{HYSEP})} 10^{0.049(\text{PRECIP})}$$

$$D70=10^{-4.083} \text{DRNAREA}^{1.079} 10^{0.027(\text{HYSEP})} 10^{0.047(\text{PRECIP})}$$

$$D80=10^{-0.883} \text{DRNAREA}^{1.179} 10^{-2.050(\text{STREAM\_VAR})} 10^{0.006(\text{SOILBSSURGO})}$$

$$D85=10^{-0.888} \text{DRNAREA}^{1.207} 10^{-2.365(\text{STREAM\_VAR})} 10^{0.006(\text{SOILBSSURGO})}$$

$$D90=10^{-0.970} \text{DRNAREA}^{1.241} 10^{-2.716(\text{STREAM\_VAR})} 10^{0.007(\text{SOILBSSURGO})}$$

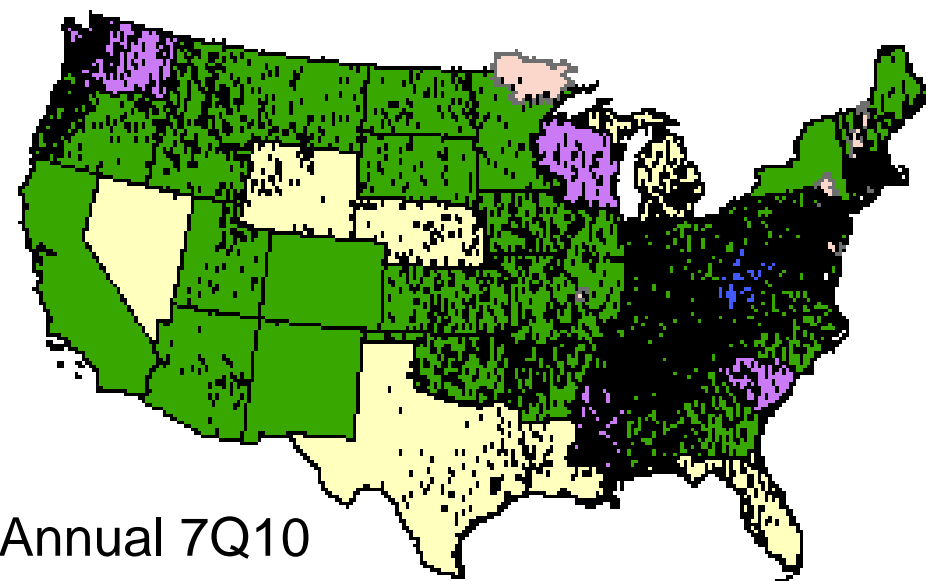
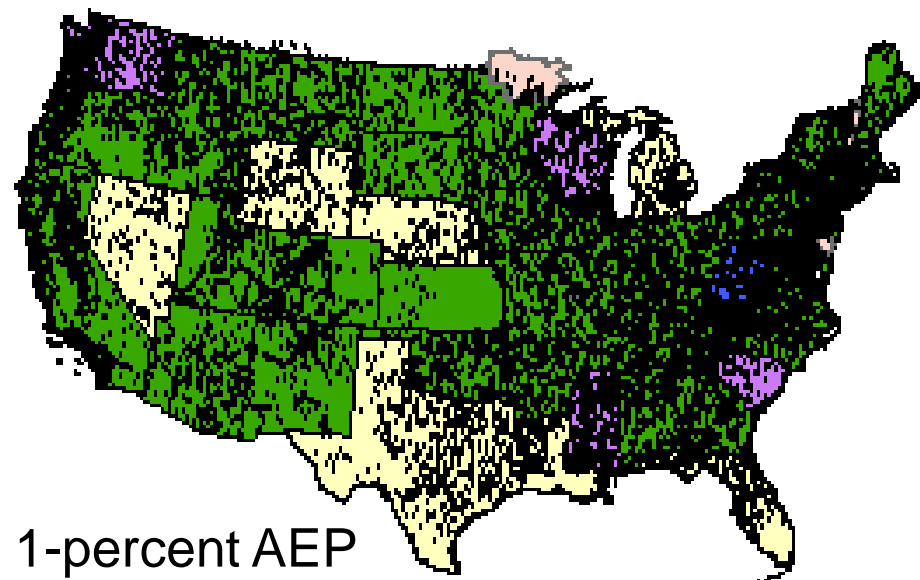
$$D95=10^{-1.225} \text{DRNAREA}^{1.317} 10^{-3.170(\text{STREAM\_VAR})} 10^{0.008(\text{SOILBSSURGO})}$$

## Left-censored regression equation

$$D99=10^{-0.18302282} \text{DRNAREA}^{1.37420784} 10^{-4.60344452(\text{STREAM\_VAR})} 10^{-0.01341188(\text{SOILDSSURGO})}$$

# Streamflow Statistics

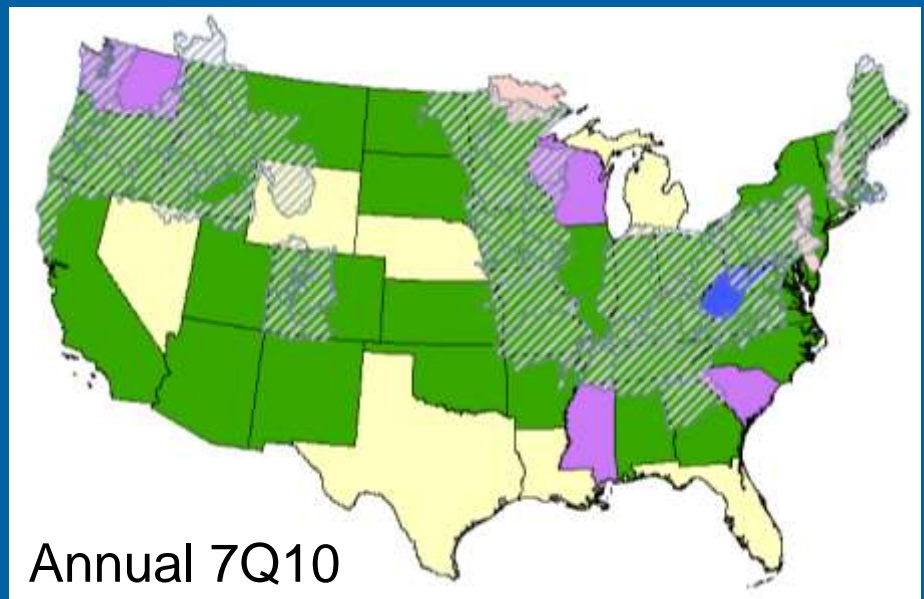
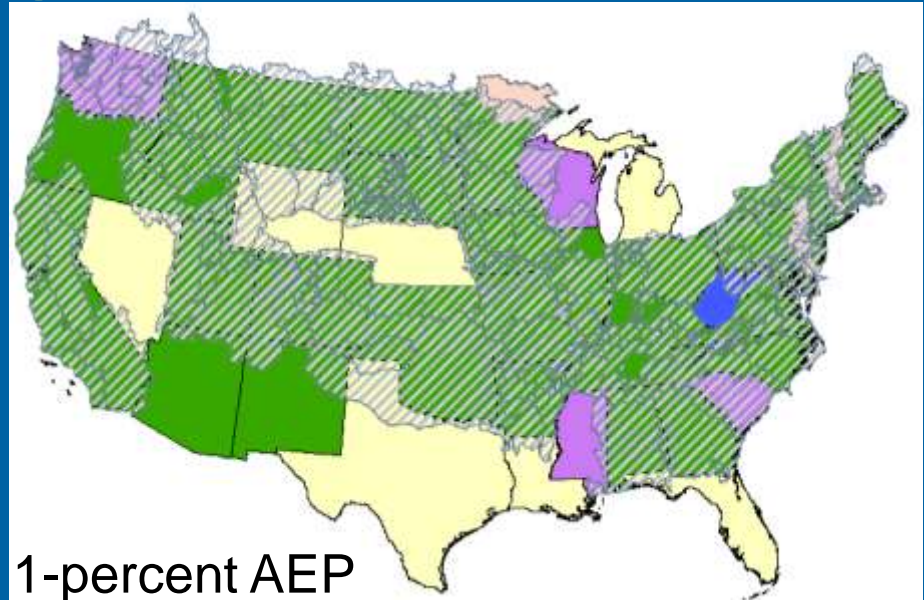
- StreamStats DB
  - 2.28 million statistics
  - 36,670 Streamgages
  - 3,561 types of statistics
  - 316 cited reports



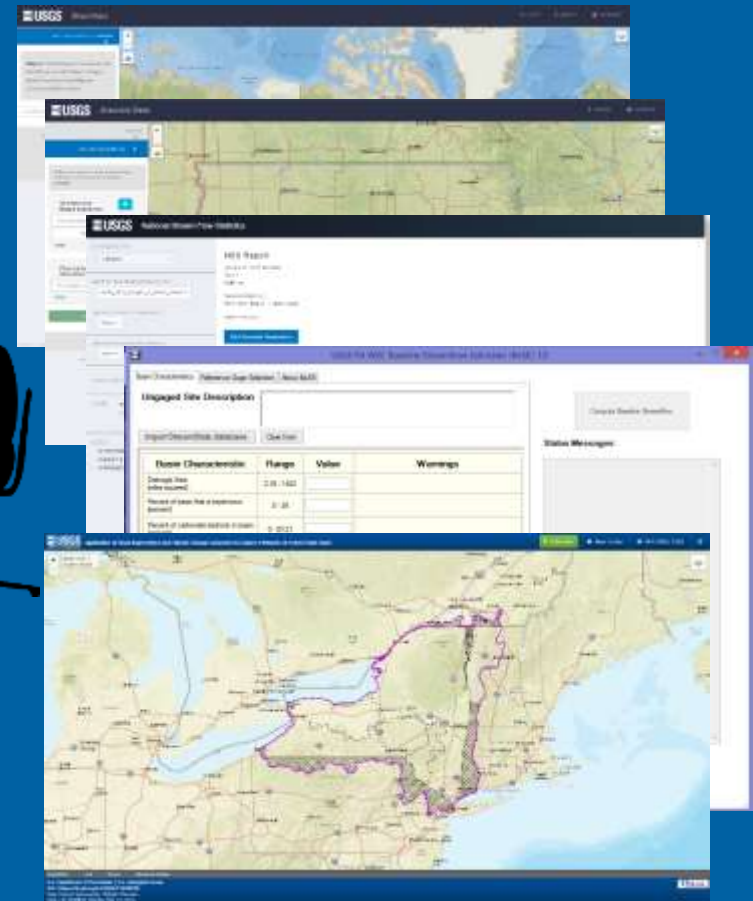
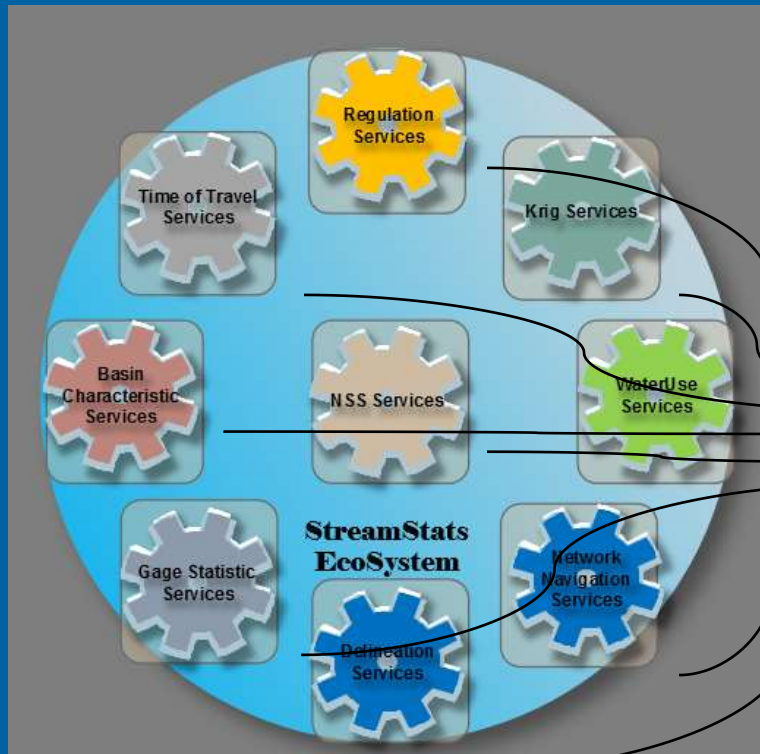


# Regional equations

- StreamStats DB
  - 7,051 equations
  - 742 regions
  - 597 unique dependent variables
  - Standard error of predictions
  - Confidence intervals

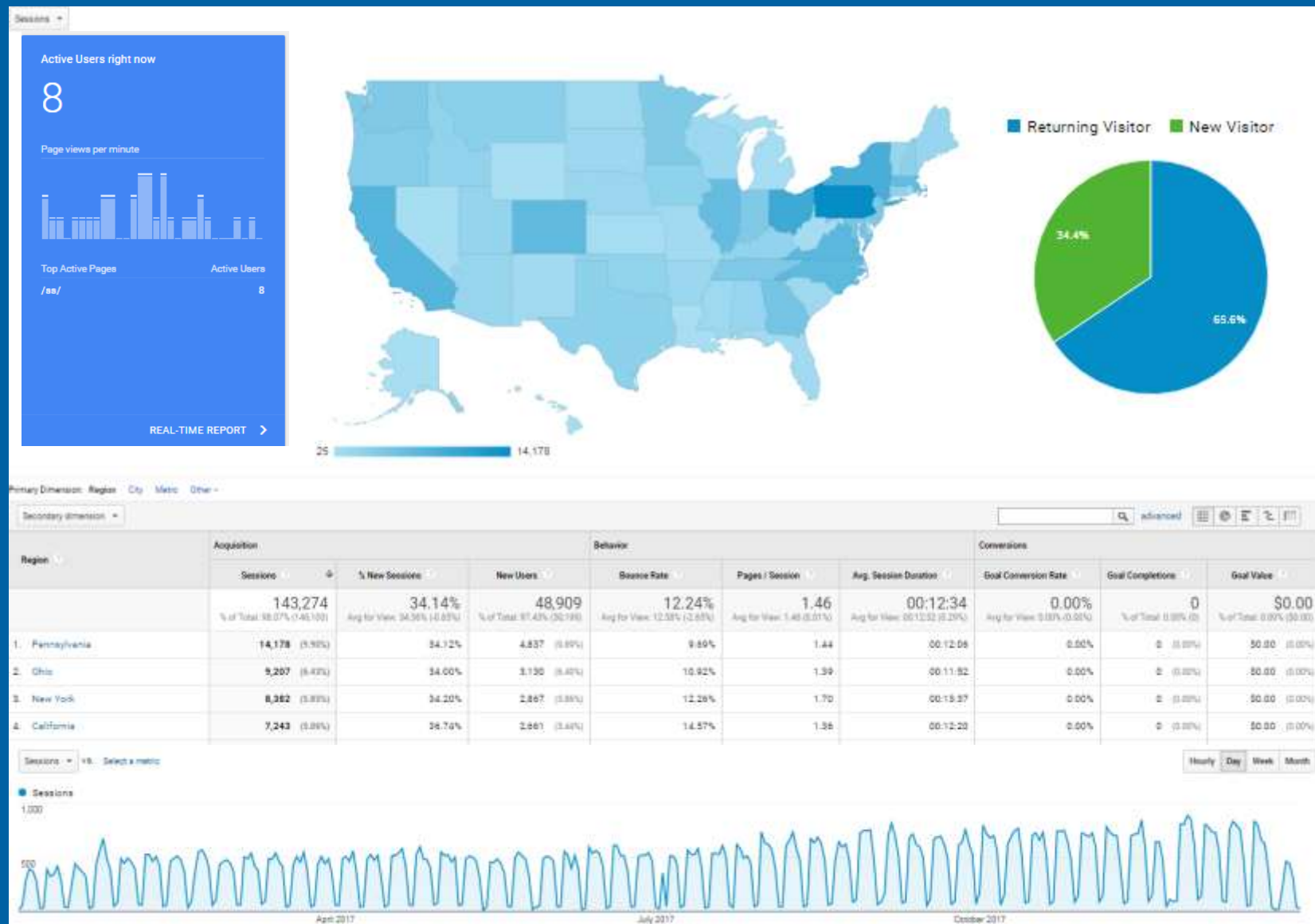


# How is StreamStats developed?





# Who's using StreamStats?



# StreamStats Implementation

- Home page <https://streamstats.usgs.gov>
  - News
  - Documentation
  - Web services
  - Batch tool
  - Help

Welcome to StreamStats



StreamStats version 4 is a Web application that provides access to an assortment of Geographic Information Systems (GIS) 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 for user-selected sites on streams, and then get basin characteristics and estimates of flow statistics for the selected sites anywhere this functionality is available. StreamStats users also can select the locations of U.S. Geological Survey data-collection stations, shown as triangles on the StreamStats map, and get flow statistics and other information for the stations. The types of flow statistics that are available vary from State to State. A variety of tools additional are available for discovering information about streams and the activities along them. Click on the blue button above to access the StreamStats user interface.

[News](#) [StreamStats Home](#) [StreamStats Application](#) [Documentation](#) [Web Services](#) [Batch Tool](#) [Help](#)

# StreamStats Implementation

- Application <https://streamstats.usgs.gov/ss>
  - User interface
    - Map frame
    - Side bar
    - Exploration tools
    - Report
    - About
    - Help
    - Legend

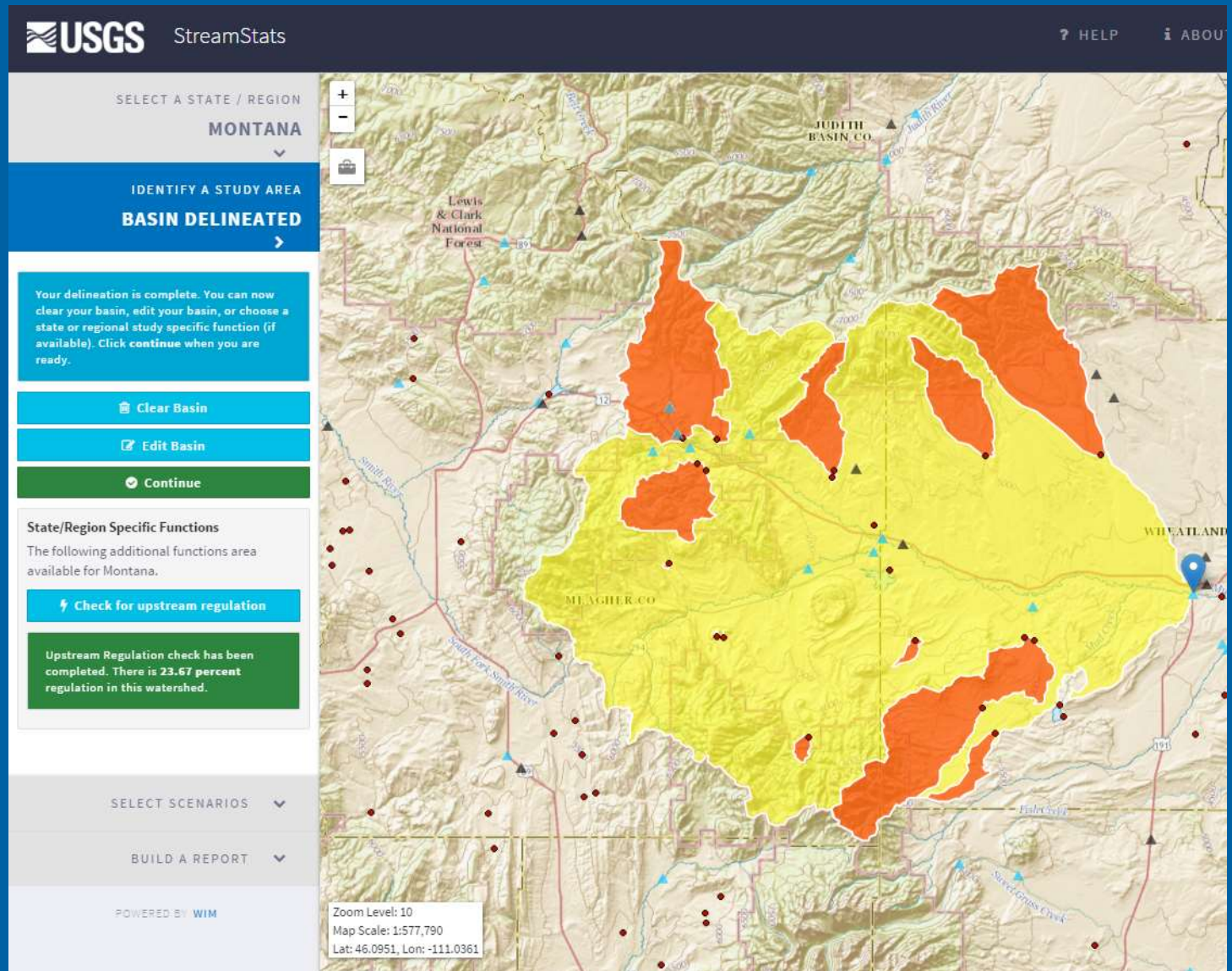


# Customizations

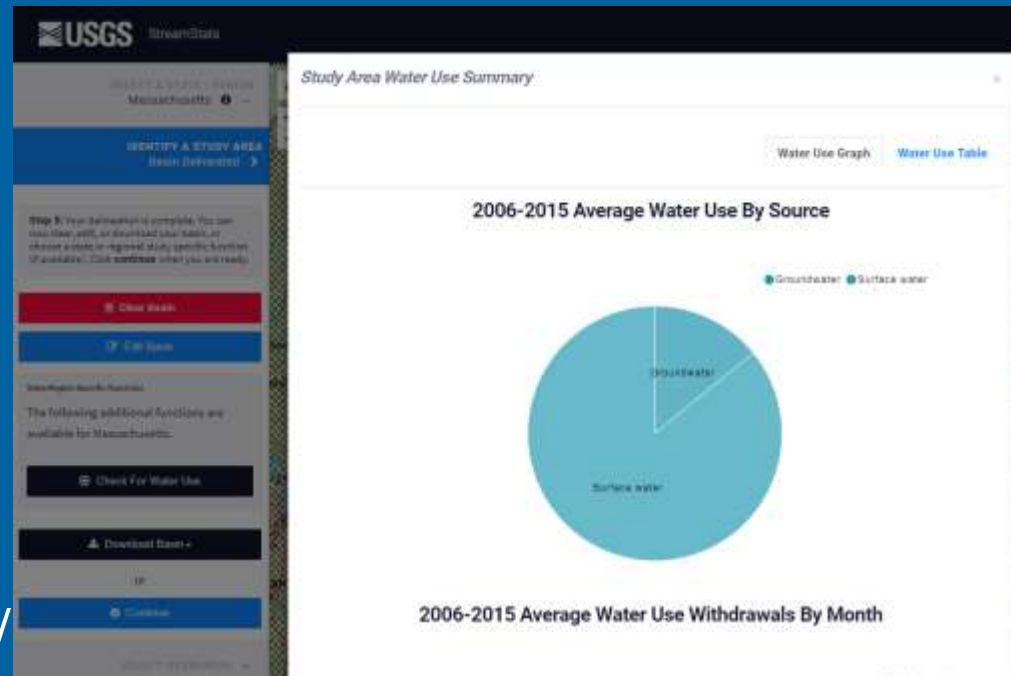
- Regulation
- Water use
- Hydraulic geometry (i.e. bank full width)
- State specific layers (i.e. bridges)
- Coordinated flows (Indiana)
- Network navigation (NLDI, NHD, local)
- Daily flow estimation methods
- Storm Drains (St. Louis Metropolitan area)
- Peak flow for small basins
- **National StreamStats**
- **Time of Travel**



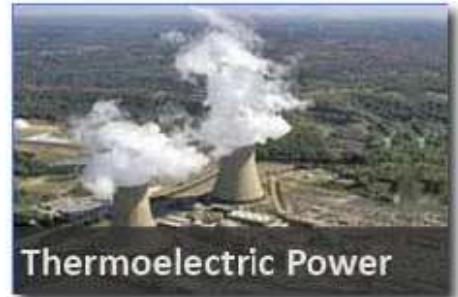
# Regulation



# Water Use

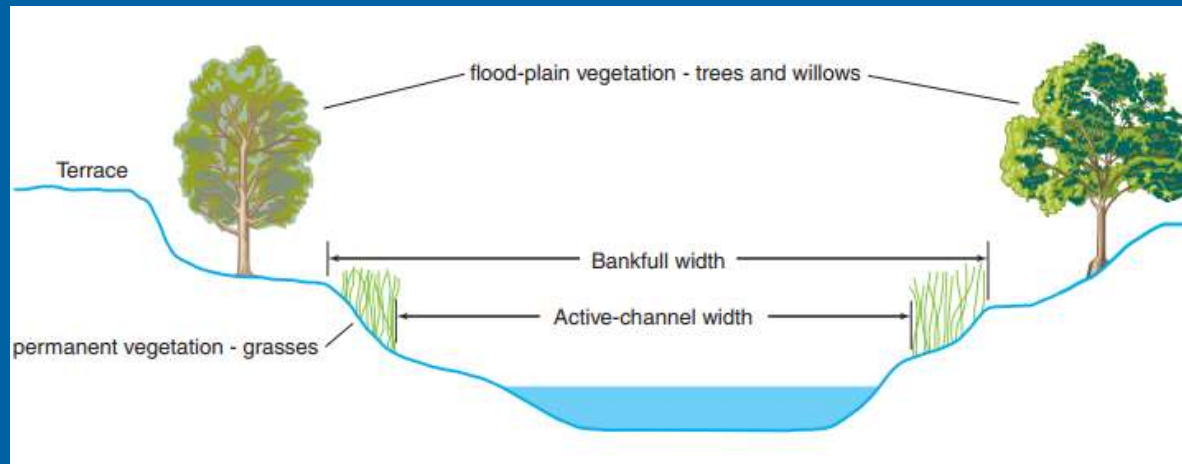


<https://water.usgs.gov/watuse/>  
**Categories of water use**





# Hydraulic Geometry



*Quantitative measurement of some of the hydraulic factors that help to determine the shape of natural stream channels: depth, width, velocity, and suspended load, and how they vary with discharge as simple power functions. Their interrelations are described by the term “hydraulic geometry.”*



Prepared in cooperation with the  
Massachusetts Department of Environmental Protection  
Bureau of Resource Protection  
Wetlands and Waterways Program and  
Massachusetts Environmental Trust

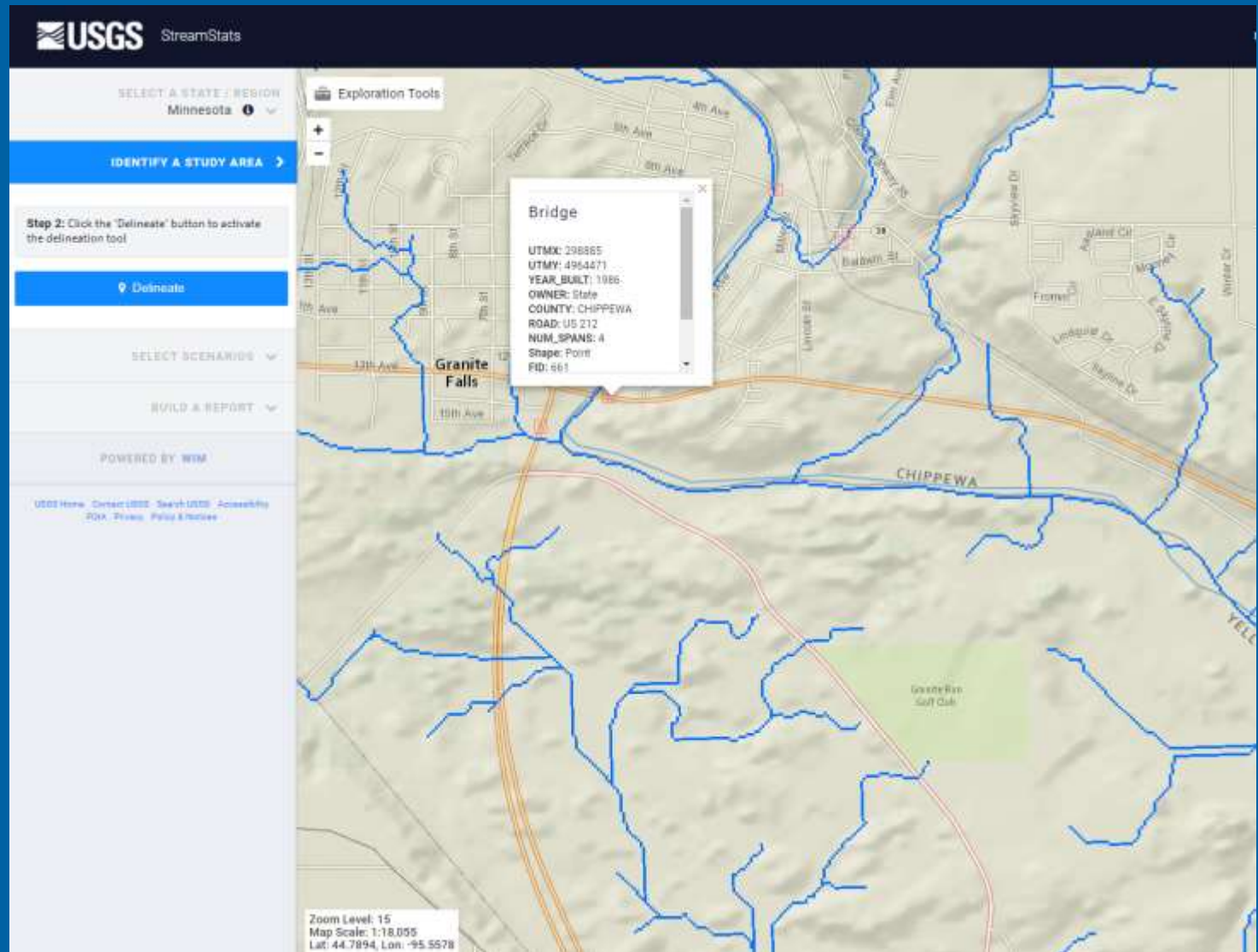
## Equations for Estimating Bankfull Channel Geometry and Discharge for Streams in Massachusetts



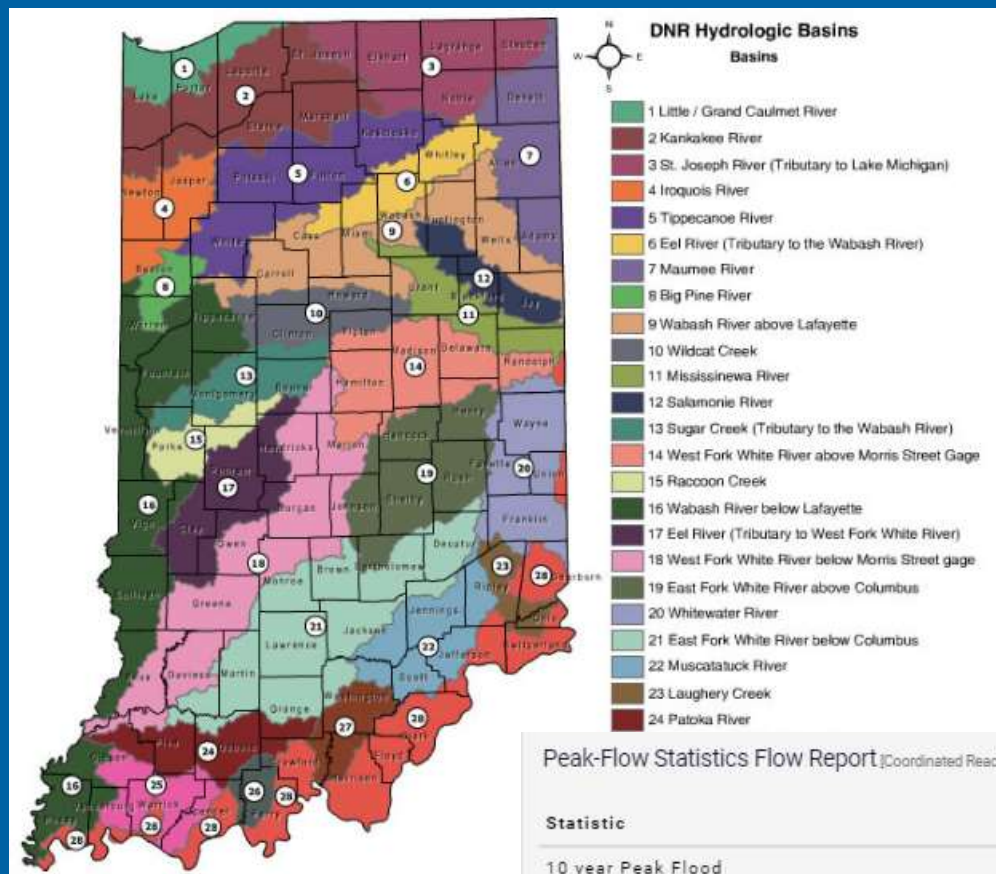
Scientific Investigations Report 2013-5155

U.S. Department of the Interior  
U.S. Geological Survey

# State specific layers



# Coordinated flows



Peak-Flow Statistics Flow Report [Coordinated Reach: WABASH RIVER (MODIFIED)]

Statistic	Value	Unit
10 year Peak Flood	46900	ft <sup>3</sup> /s
25 year Peak Flood	57300	ft <sup>3</sup> /s
50 year Peak Flood	65400	ft <sup>3</sup> /s
100 year Peak Flood	73500	ft <sup>3</sup> /s

## Peak-Flow Statistics Citations

Indiana DNR, Coordinated Discharges of Selected Streams in Indiana.



# Network Navigation



StreamStats [Development Version: Not for public consumption]

SELECT A STATE / REGION  
Montana

IDENTIFY A STUDY AREA

Step 1: Zoom in to level 15 or greater to enable the delineation tool.

Delineate

SELECT SCENARIOS

BUILD A REPORT

POWERED BY WIM

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[Accessibility](#) [FOIA](#) [Privacy](#) [Policy & Notices](#)

Exploration Tools

General

Measures Tool

Elevation Profile Tool

Show Your Location

Network Navigation

Flow (Raindrop) Path

Network Path

Network Trace

Zoom Level: 14  
Map Scale: 1:36,111  
Lat: 46.5911, Lon: -110.1567

Exploration Tools

Network Trace

Network trace Description.

Start point location (Required)

Latitude:

46.408673623402876

Longitude:

-109.70294952392578

Direction (Required)

downstream

upstream

Query Source (Required)

flowline

wqsite

gage

bridge

Limit (Optional)

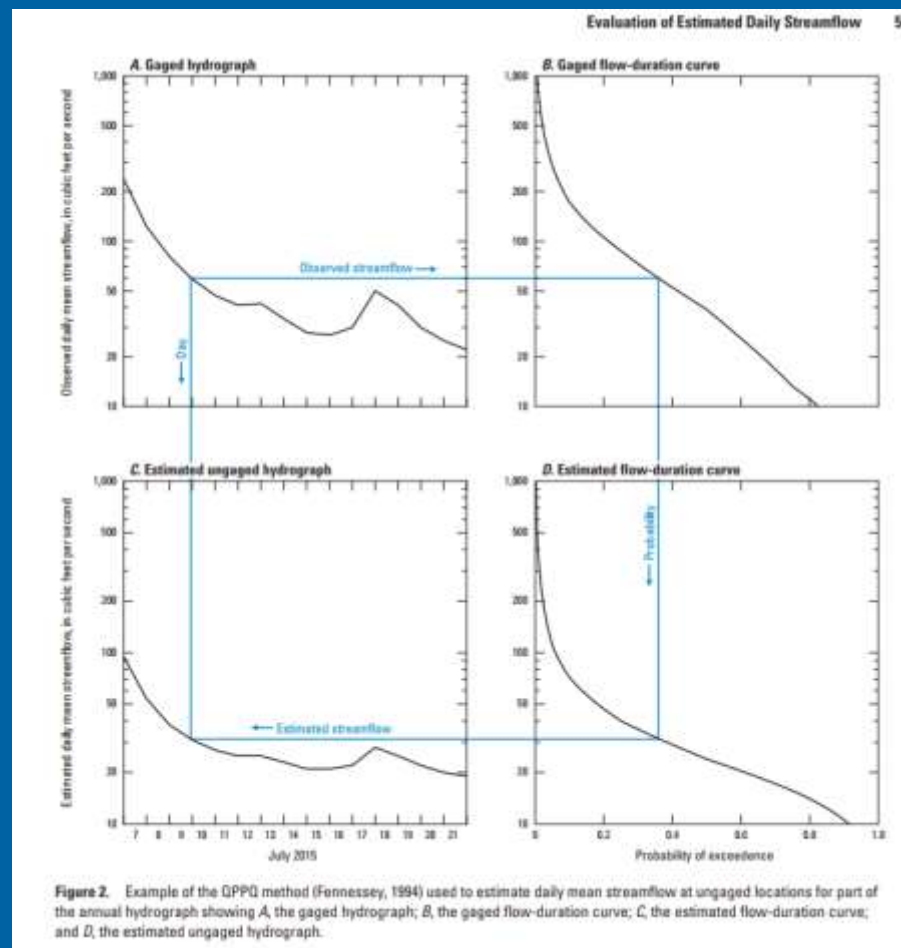
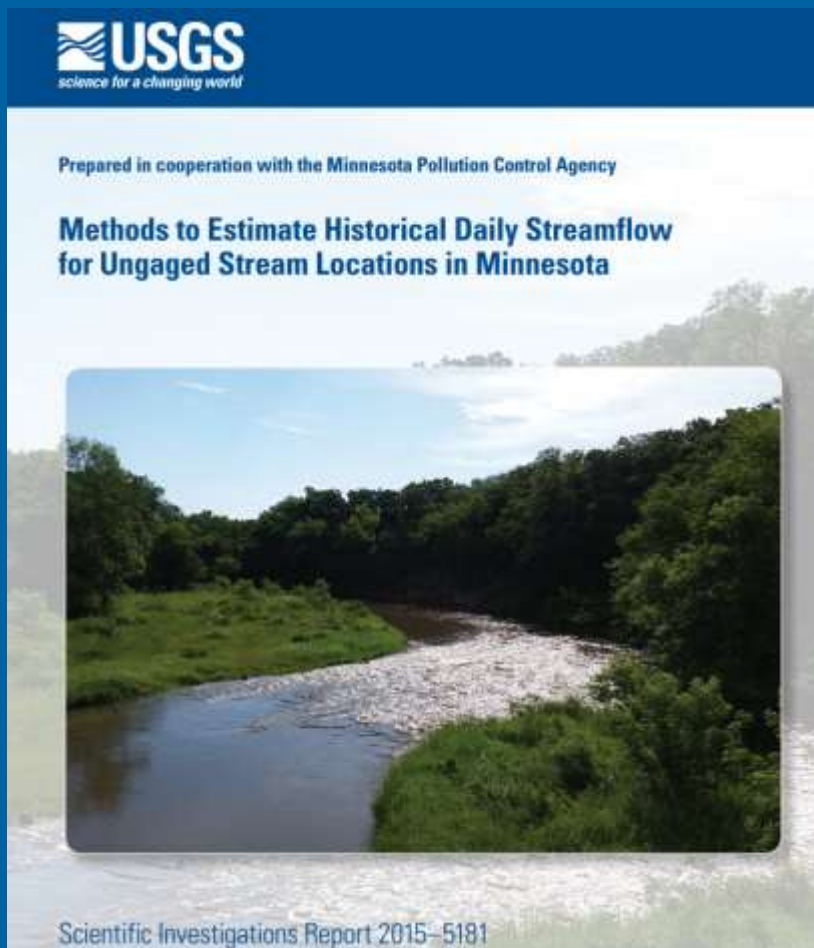
Distance (km) 10

Go

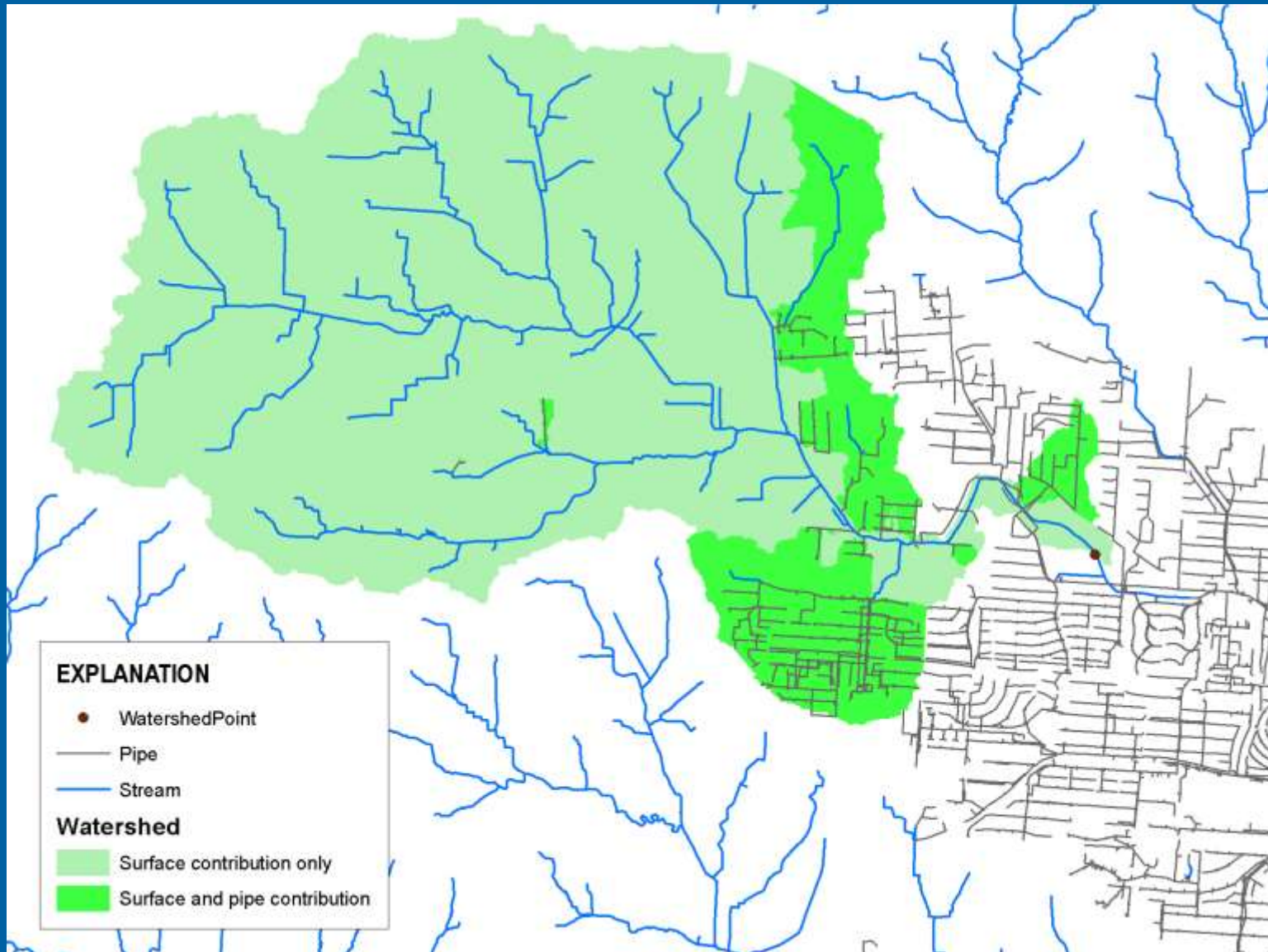
Close



# Daily Streamflows



# Storm drain





# Peak flow for small basins



Prepared in cooperation with the  
Maine Department of Transportation

## Comparison of Peak-Flow Estimation Methods for Small Drainage Basins in Maine



Scientific Investigations Report 2007-



Prepared in cooperation with the Virginia Department of Transportation

## Comparison of Peak Discharge and Runoff Characteristic Estimates from the Rational Method to Field Observations for Small Basins in Central Virginia



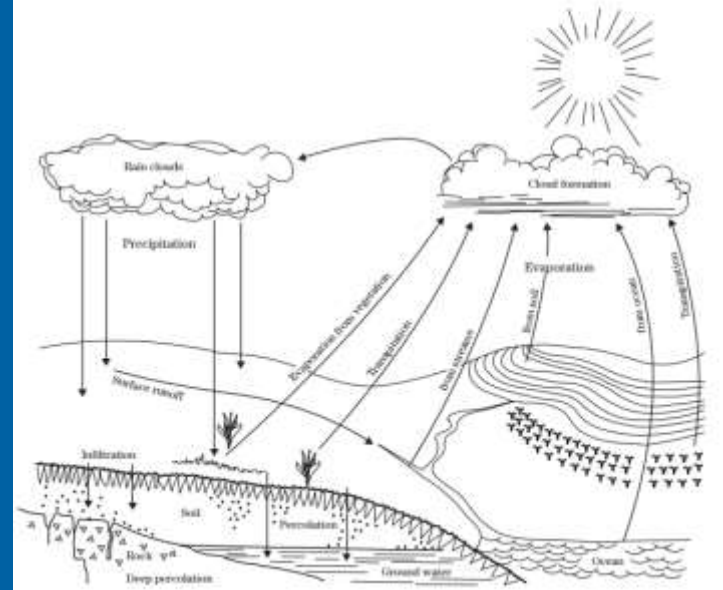
Scientific Investigations Report 2005-5254



United States  
Department of  
Agriculture  
  
Natural  
Resources  
Conservation  
Service

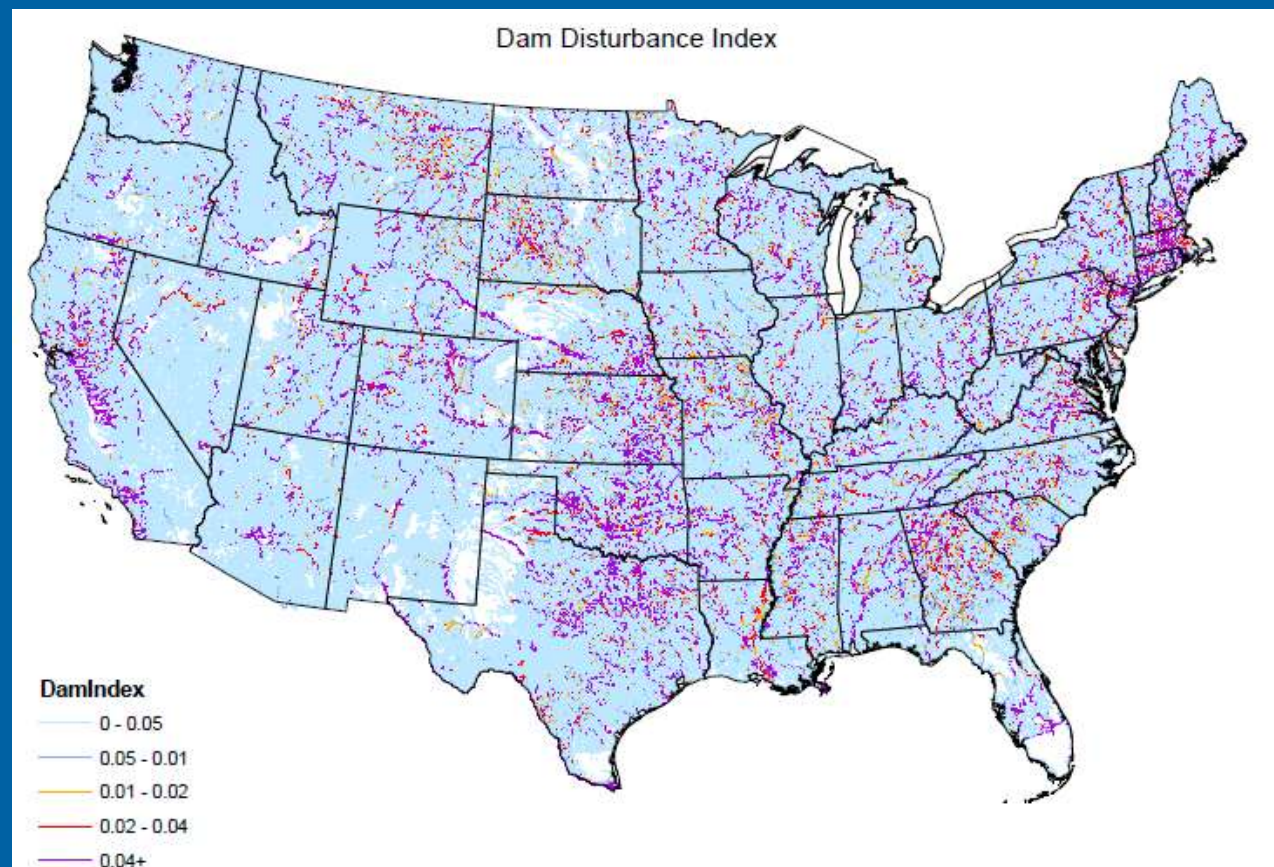
## Part 630 Hydrology National Engineering Handbook

### Chapter 15 Time of Concentration



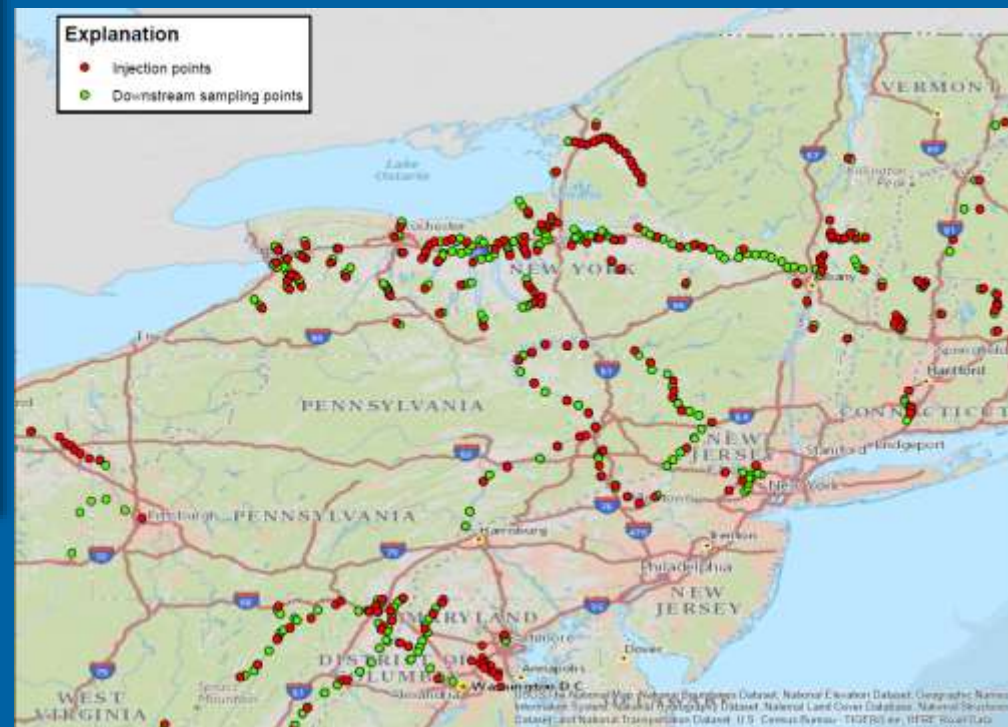
# National StreamStats

- Nationally consistent hydrography and elevation data (i.e. NHDPlus HR)
- Large suite of basin characteristics
- Results from large regional models
- Basis for other application development





# Time of Travel

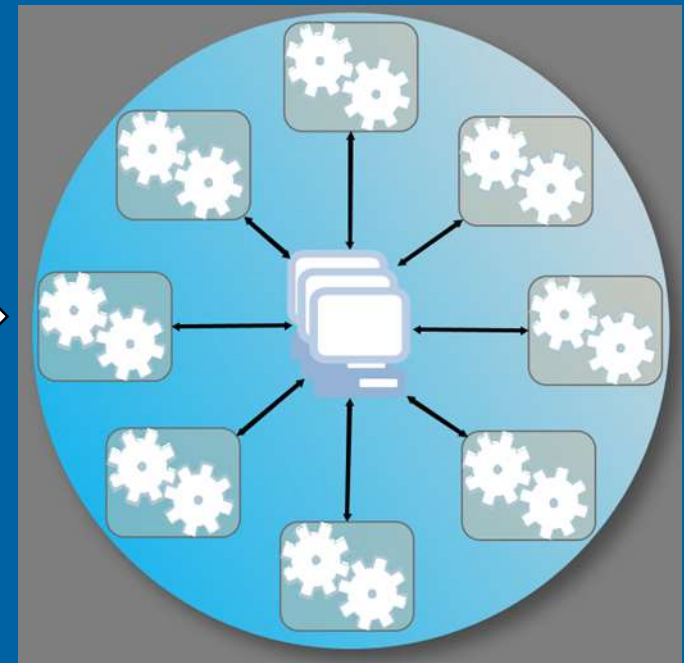


# Data qualifications, and limitations of a StreamStats determined discharge...

Streamflow data  
Streamflow trends  
Streamflow analyses  
Hydrography data  
Climatic data  
Digital elevation model  
Streamgage history  
Regulation data  
Regression equations

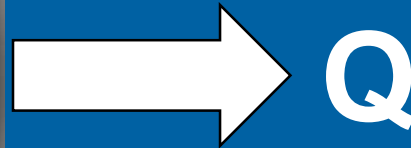
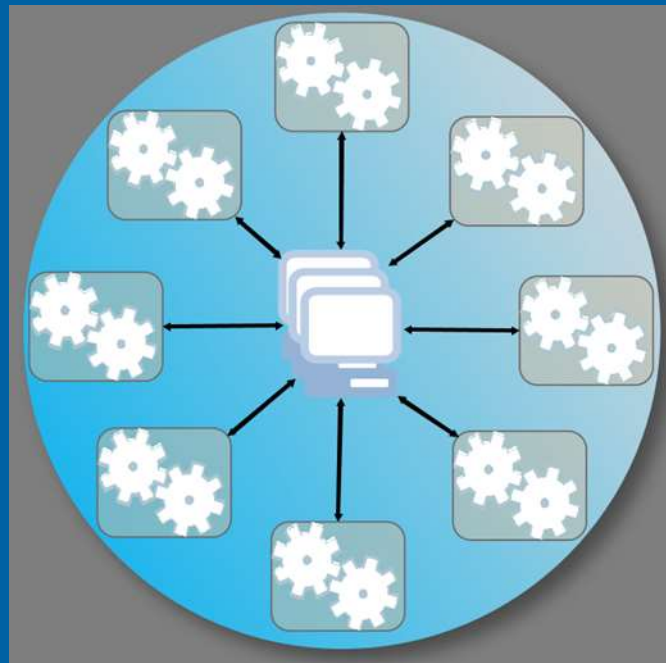


StreamStats



# ....are described in USGS Reports

## StreamStats





# Questions?



Clark Fork River at Milltown Dam, June 1908  
<http://www.floodsafety.noaa.gov/states/mt-flood.shtml>

$Q_{\text{peak}}=48,000\text{cfs}$