

Prepared in cooperation with the Missouri Department of Natural Resources

Missouri StreamStats—A Water-Resources Web Application

Missouri StreamStats (<https://streamstats.usgs.gov>), a geographic information system-based web application, is a tool for calculating basin characteristics and selected streamflow statistics for user-selected sites on streams in Missouri.

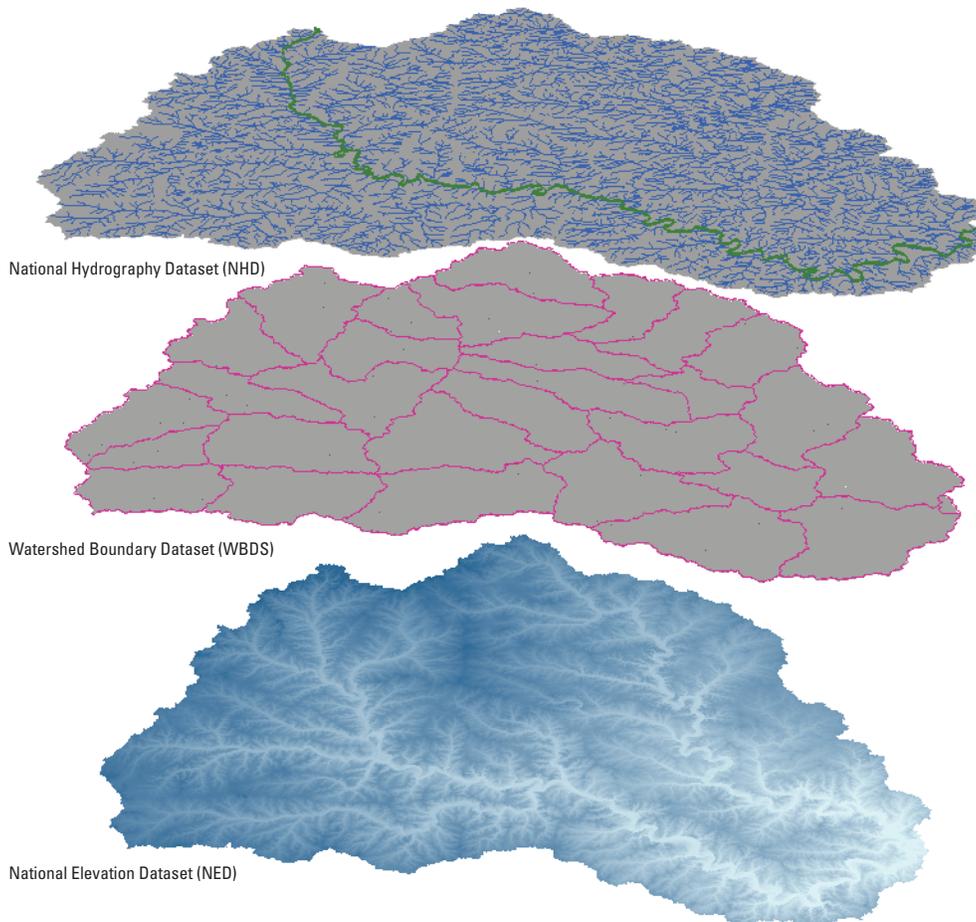


Figure 1. Missouri StreamStats underlying datasets.

Introduction

The U.S. Geological Survey (USGS) maintains and operates more than 8,200 continuous streamgages nationwide. Types of data that may be collected, computed, and stored for streamgages include streamgage height (water-surface elevation), streamflow, and water quality. The streamflow data allow scientists and engineers to calculate streamflow statistics, such as the 1-percent annual exceedance probability flood (also known as the 100-year flood), the mean flow, and the 7-day, 10-year low flow, which are used by managers to make informed water resource management decisions, at each streamgage location. Researchers, regulators, and managers also commonly need physical characteristics (basin characteristics) that describe the unique properties of a basin. Common uses for streamflow

statistics and basin characteristics include hydraulic design, water-supply management, water-use appropriations, and flood-plain mapping for establishing flood-insurance rates and land-use zones. The USGS periodically publishes reports that update the values of basin characteristics and streamflow statistics at selected gaged locations (locations with streamgages), but these studies usually only update a subset of streamgages, making data retrieval difficult. Additionally, streamflow statistics and basin characteristics are most often needed at ungaged locations (locations without streamgages) for which published streamflow statistics and basin characteristics do not exist. Although the USGS publishes manual methods for the estimation of streamflow statistics at ungaged locations, the calculations can be complex, often requiring specialized computer software and interpretation that can lead to inconsistent results.

Missouri StreamStats is a web-based geographic information system (GIS) that was created by the USGS in cooperation with the Missouri Department of Natural Resources to provide users with access to an assortment of tools that are useful for water-resources planning and management. StreamStats allows users to easily obtain the most recent published streamflow statistics and basin characteristics for streamgauge locations

and to automatically calculate selected basin characteristics and estimate streamflow statistics at ungaged locations. Missouri StreamStats is constructed based on the integration of the National Hydrography Dataset (1:24,000 scale), the Watershed Boundary Dataset (1:24,000 scale), and the 10-meter resolution digital elevation data from the National Elevation Dataset (NED) (fig. 1).

The current (2018) application supports the following features:

- View and navigate a base-map interface that features roads, streams, political boundaries, and hydrologic boundaries (fig. 2);
- Zoom in or out to different map scales using (1) a drawn rectangle around an area of interest, (2) latitude and longitude coordinates, or (3) a specified scale;
- Access previously published streamflow statistics, basin characteristics, and descriptive information for each current and discontinued streamgauge (fig. 3);
- Link streamgauge locations (fig. 4) to the National Water Information System where users can access historical and real-time data;
- Delineate a basin from a user-selected location and edit the basin boundary, if necessary (fig. 5);
- Download delineated basins as a GIS feature class with basin characteristics and streamflow statistics saved as attributes;
- Determine selected basin characteristics including drainage area, longest flow path, main-channel slope, basin shape, impervious area, and composite curve number for any delineated basin;
- Modify the basin characteristics that are used as explanatory variables in regression equations for estimating streamflow at ungaged locations;
- Estimate values of selected streamflow statistics including low flows, rural flood frequency, and urban flood frequency;
- Obtain plots of land surface and stream elevation profiles between two user-selected points;
- Measure distance between two user-defined points on the land surface or on the stream network; and
- Print the results in the map frame.

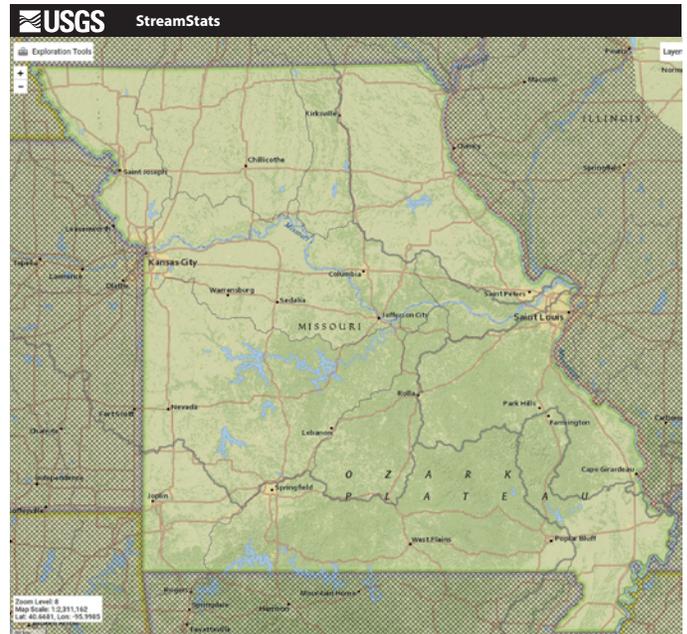


Figure 2. StreamStats user interface.



StreamStats Data-Collection Station Report

USGS Station Number 06928000
Station Name Gasconade River near Hazelgreen, MO

[Click here to link to available data on NWIS Web for this site.](#)

Descriptive Information

Station Type	Streamgauge, continuous record
Location	
Gage	
Regulation and Diversions	
Regulated?	Unknown
Period of Record	
Remarks	
Latitude (degrees NAD83)	37.75920725
Longitude (degrees NAD83)	-92.45183833
Hydrologic unit code	10290201
County	105 Laclede
HCDN2009	No

Figure 3. StreamStats data collection station report.



Figure 4. An example of a streamgage data collection location (Photograph of Fall Hollow tributary, Ft. Leonard Wood, Missouri, Larry Buschmann, U.S. Geological Survey, 2013).

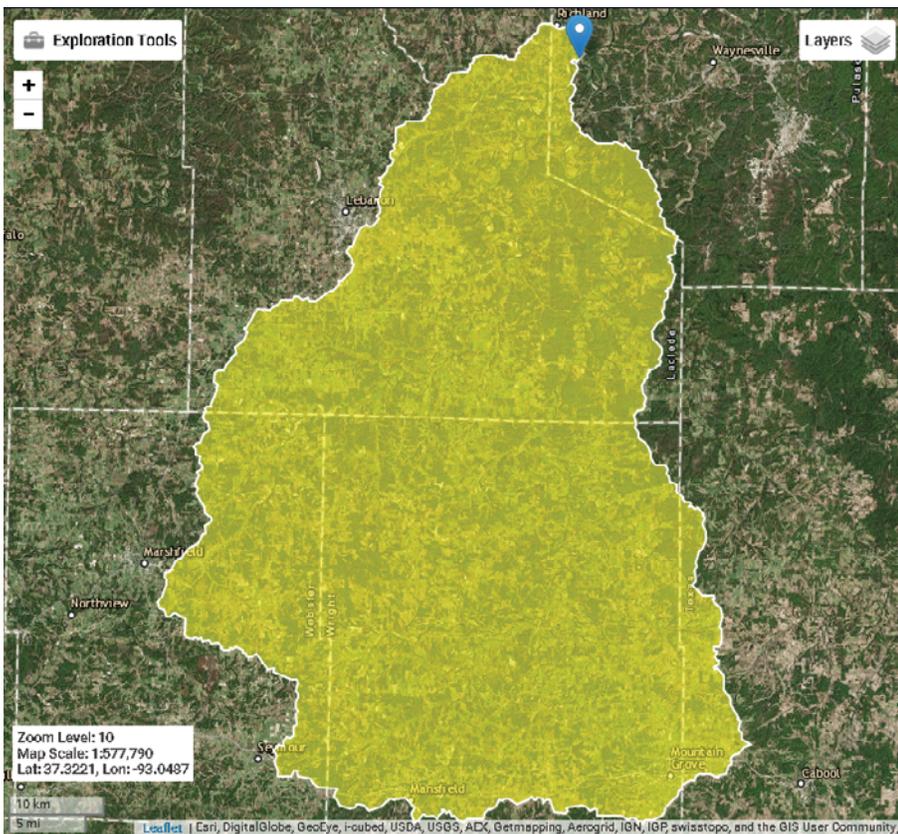


Figure 5. A basin delineated at an ungaged location.

User Interface

StreamStats consists of

- a user interface that displays base maps and the 24K NHD network on which users can select a point of interest;
- a database (StreamStatsDB) that contains previously published streamflow statistics, basin characteristics, and descriptive information for USGS streamgages;
- a GIS process that automatically delineates basin boundaries and determines basin characteristics for user-selected ungaged locations on the stream network (fig. 6);
- a geographic database (geodatabase) that stores base-map data; and
- an automated process that uses determined basin characteristics to estimate selected streamflow statistics at ungaged locations using regression equations.

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
BSHAPE	Basin Shape Factor for Area	9.36	dimensionless
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	3.64	feet per mi
DRNAREA	Area that drains to a point on a stream	1320	square miles
IMPNLCD01	Percentage of impervious area determined from NLCD 2001 impervious dataset	0.57	percent
LFPLENGTH	Length of longest flow path	111	miles
STREAM_VARG	Streamflow variability index as defined in WRIR 02-4068, computed from regional grid	0.47	dimensionless

Figure 6. Example of basin characteristics determined at an ungaged location.

The StreamStats interface allows users to select a location of interest on the stream network. If a streamgage location is selected, StreamStats will provide published streamflow statistics and basin characteristics for that site from the StreamStatsDB and give the user a link to the National Water Information System website to view real-time and historical data at active streamgage locations. If an ungaged location is selected, StreamStats automatically delineates the basin upstream from the selected location and prompts the user for confirmation that the delineation is correct. StreamStats then provides a selection of streamflow statistics to estimate and determine the basin characteristics required to compute the desired streamflow statistics and provides an option to download a GIS feature class of the drainage basin boundary that can be imported into a local GIS. A summary report of the determined basin characteristics and estimates of streamflow statistics is provided to the user.

Streamflow Statistics at Ungaged Locations

Missouri StreamStats can be used to quickly and reproducibly estimate streamflow statistics at ungaged locations (fig. 7). The USGS has developed regional regression equations to estimate selected streamflow statistics at ungaged locations based on statistically significant basin characteristics at gaged locations. StreamStats uses GIS processes to determine the significant basin characteristics at ungaged locations, which are then used as explanatory variables in regional regression equations that estimate streamflow statistics at those locations.

Users of Missouri StreamStats should be familiar with the application and limitations of regional regression equations before calculating streamflow statistics. Links to the supporting USGS reports that describe these regional regression equations are provided in the references at the end of this document. The

following statistics can be determined using the regional regression equations for Missouri:

- Low flows (1-day, 10-year; 2-day, 10-year; 3-day, 10-year; 7-day, 10-year; 10-day, 10-year; and 60-day, 10-year recurrence intervals);
- Rural flood frequency (the 50-, 20-, 10-, 4-, 2-, 1-, 0.5-, and 0.2-percent annual exceedance probability, which can be defined as the 2-, 5-, 10-, 25-, 50-, 100-, 200-, and 500-year recurrence intervals); and
- Urban flood frequency (the 50-, 20-, 10-, 4-, 2-, 1-, and 0.2-percent annual exceedance probability), which can be defined as the 2-, 5-, 10-, 25-, 50-, 100-, and 500-year recurrence intervals.

Limitations

StreamStats provides estimates of streamflow values based on published reports that detail the assumptions and conditions for which the estimates are accurate. Although users should be familiar with the specific assumptions that are unique to each streamflow statistic, there are common limitations that apply to all statistics estimated by StreamStats.

Estimates of streamflow statistics at ungaged locations in StreamStats assume that natural flow conditions exist. If anthropogenic activities upstream of a selected site modify flow conditions in timing, quantity, or duration, the user should adjust streamflow statistics to account for those activities.

During the development of each regional regression equation, specific ranges of basin characteristics for which estimates of the streamflow statistic were valid were identified. When StreamStats is used to obtain streamflow statistics for

Low-Flow Statistics Parameters [LowFlow Region 2 SIR 2013 5090]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	1320	square miles	0.21	7380
STREAM_VARG	Streamflow Variability Index from Grid	0.47	dimensionless	0.273	0.926

Low-Flow Statistics Flow Report [100 Percent LowFlow Region 2 SIR 2013 5090]

Statistic	Value	Unit
1 Day 10 Year Low Flow	94.6	ft ³ /s
2 Day 10 Year Low Flow	99.9	ft ³ /s
3 Day 10 Year Low Flow	100	ft ³ /s
7 Day 10 Year Low Flow	104	ft ³ /s
10 Day 10 Year Low Flow	107	ft ³ /s
30 Day 10 Year Low Flow	120	ft ³ /s
60 Day 10 Year Low Flow	142	ft ³ /s

Low-Flow Statistics Citation

Southard, R.E., 2013, Computed statistics at streamgages, and methods for estimating low-flow frequency statistics and development of regional regression equations for estimating low-flow frequency statistics at un-gaged locations in Missouri: U.S. Geological Survey Scientific Investigations Report 2013–5090, 28 p.

Figure 7. Example of flow statistics estimated at an un-gaged location.

locations that have basin characteristics outside the specified range, StreamStats will provide a warning that extrapolation has happened. Users should not assume that streamflow statistics are accurate when basin characteristics are estimated using extrapolation.

Missouri StreamStats only determines basin characteristics and estimates streamflow statistics inside the state of Missouri and excludes locations on the main stem of the Mississippi, Missouri, Chariton, Nodaway, and Osage Rivers because upstream parts of those rivers have geospatial data that are not included in Missouri StreamStats.

Future Functionality

The underlying GIS processes that run StreamStats use 10-meter resolution elevation data to determine the direction of flow in the basin. In urbanized areas, subsurface storm water networks can change the catchment areas of the urban flow system so that they do not match topographic flow areas. Higher resolution datasets are necessary to accurately delineate these urbanized basins.

An Urban StreamStats project, which uses higher 3-meter resolution elevation data that are currently (2018) available in most urban areas in conjunction with detailed infrastructure features to improve the estimation of streamflow statistics in St. Louis County, Missouri, is in development by the USGS in cooperation with the Metropolitan St. Louis Sewer District.

Stream network navigation is an upcoming feature that will allow users to navigate upstream or downstream on the stream network to identify structures that affect water quality or quantity downstream. Structures indexed to the NHD will be easily identified to alert users of activities that may affect streamflow estimates downstream. Users will also be able to trace the stream network downstream from any point to determine the flow path that water or contaminants may take.

Missouri StreamStats also can determine many more basin characteristics than are currently available. Users interested in including additional basin characteristics of streamflow statistics should contact the USGS to discuss their needs. The current (2018) list of possible basin characteristics is available at https://streamstatsags.cr.usgs.gov/ss_defs/basin_char_defs.aspx (U.S. Geological Survey, 2017).

Selected References

Huizinga, R.J., 2014, An initial abstraction and constant loss model, and methods for estimating unit hydrographs, peak stream flows, and flood volumes for urban basins in Missouri: U.S. Geological Survey Scientific Investigations Report 2014–5193, 59 p. [Also available at <https://pubs.usgs.gov/sir/2014/5193/pdf/sir2014-5193.pdf>.]

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Southard, R.E., and Veilleux, A.G., 2014, Methods for estimating annual exceedance-probability discharges and largest recorded floods for unregulated streams in rural Missouri: U.S. Geological Survey Scientific Investigations Report 2014–5165, 39 p. [Also available at <https://pubs.usgs.gov/sir/2014/5165/>.]

U.S. Geological Survey, 2017, Basin characteristic definitions: U.S. Geological Survey StreamStats web page: accessed October 2017 at https://streamstats.sgs.cr.usgs.gov/ss_defs/basin_char_defs.aspx.

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Visit the USGS Office of Surface Water StreamStats Program homepage at <https://water.usgs.gov/osw/streamstats/>.

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