

New Jersey StreamStats: A Web Application for Streamflow Statistics and Basin Characteristics

StreamStats is an interactive, map-based web application from the U.S. Geological Survey (USGS) that allows users to easily obtain streamflow statistics and watershed characteristics for both gaged and ungaged sites on streams throughout New Jersey. Users can determine flood magnitude and frequency, monthly flow-duration, monthly low-flow frequency statistics, and watershed characteristics for ungaged sites by selecting a point along a stream, or they can obtain this information for streamgages by selecting a streamgage location on the map. StreamStats provides several additional tools useful for water-resources planning and management, as well as for engineering purposes. StreamStats is available for most states and some river basins through a single web portal.

Streamflow statistics for water resources professionals include the 1-percent annual chance flood flow (100-year peak flow) used to define flood plain areas and the monthly 7-day, 10-year low flow (M7D10Y) used in water supply management and studies of recreation, wildlife conservation, and wastewater dilution. Additionally, watershed or basin characteristics, including drainage area, percent area forested, and average percent of impervious areas, are commonly used in land-use planning and environmental assessments. These characteristics are easily derived through StreamStats.

Benefits of StreamStats

- Delineate basins automatically
- Derive basin characteristics
- Generate peak-flow statistics
- Generate low-flow statistics
- Create reports with tables and maps
- Download geographic information system (GIS) and spreadsheet files
- Link to published USGS reports and data

StreamStats Application

The StreamStats home page can be accessed at <https://streamstats.usgs.gov>. This page provides a brief description of the application, a link to the Version 4 application, and links to user documentation. Documentation includes Version 4 User Instructions, a fact sheet, and Frequently Asked Questions. Additional pages describe the batch processing tool, available web services, and contact information for the StreamStats team.

This is the gateway to all StreamStats applications for the nation. Navigate to New Jersey by using the search box or zoom in function. The map display will highlight the state border in cyan (fig. 1).

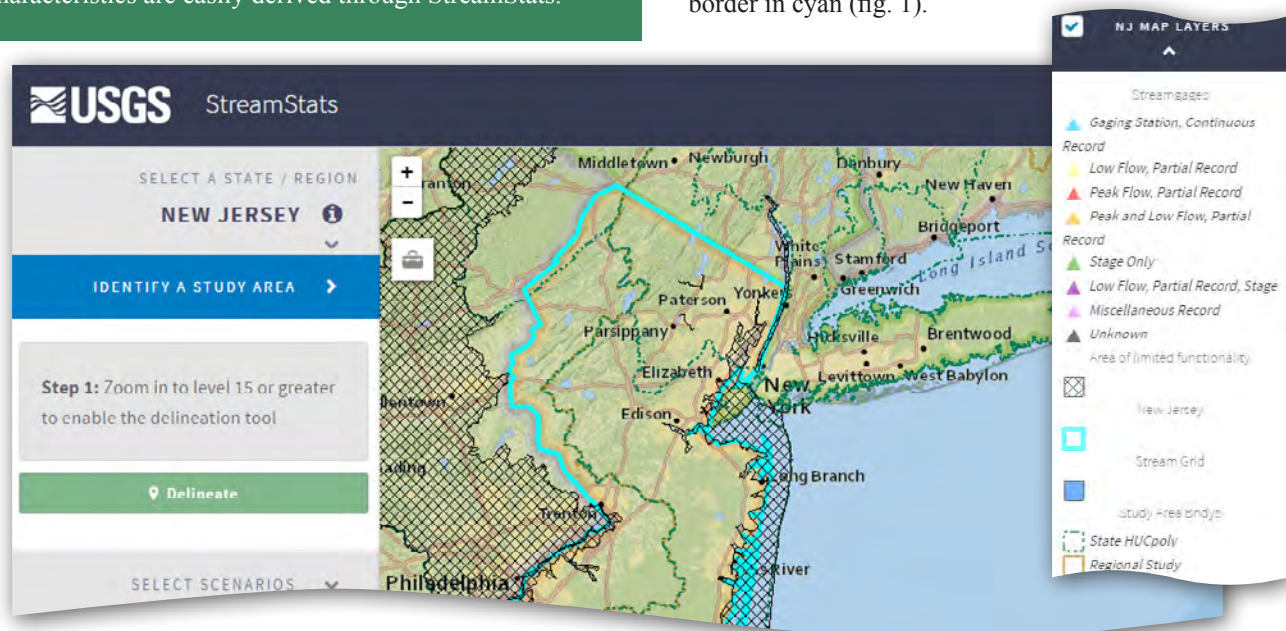


Figure 1. Screen capture of the StreamStats user interface for New Jersey with New Jersey map layers displayed.

The sidebar area to the left of the map in the User Interface (UI) provides buttons to obtain information for ungaged sites. Users can obtain drainage-basin delineations, basin characteristics, and estimates of flow statistics for any ungaged site in New Jersey using four steps.

1. **Identify A Study Area**—Zoom into the location of interest and select New Jersey as the study area in the sidebar.
2. **Delineate Basin**—When the process is complete, the delineated basin will appear in yellow on the map (fig. 2).
3. **Select Scenarios and Basin Characteristics**
4. **Build A Report**—After StreamStats computes the flow statistics and basin characteristics, the selected basin characteristics appear (fig. 3).

Basin characteristics are used as explanatory variables in the statistical analyses to develop the regression equations for estimating peak-flow and low-flow statistics in New Jersey (table 1).

Streamflow Statistics

The USGS collects streamflow data at many sites across New Jersey, including continuous-record streamgage stations and partial-record stations. Data such as gage height, also known as the water surface elevation or stage, are collected continuously at streamgages. Discharge, or streamflow, is

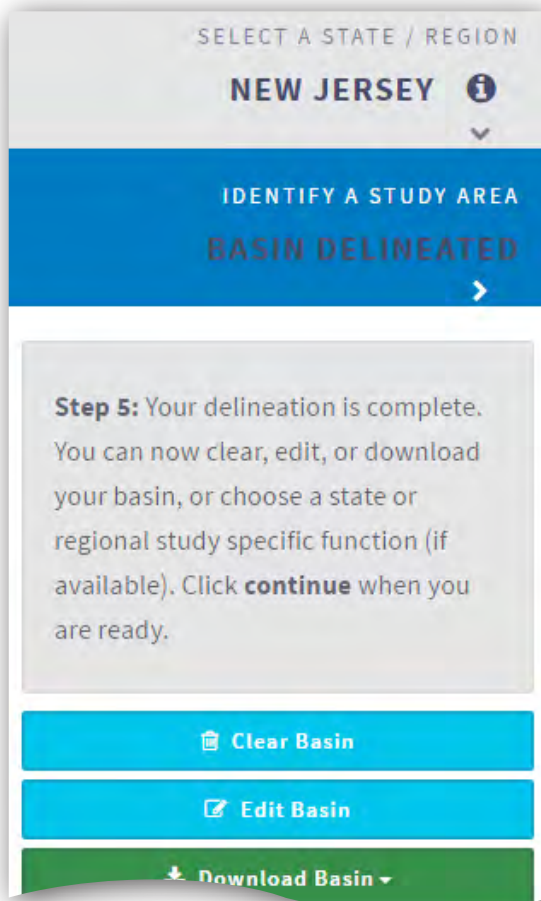


Figure 2. Screen capture of StreamStats sidebar as it appears after delineating a drainage basin.

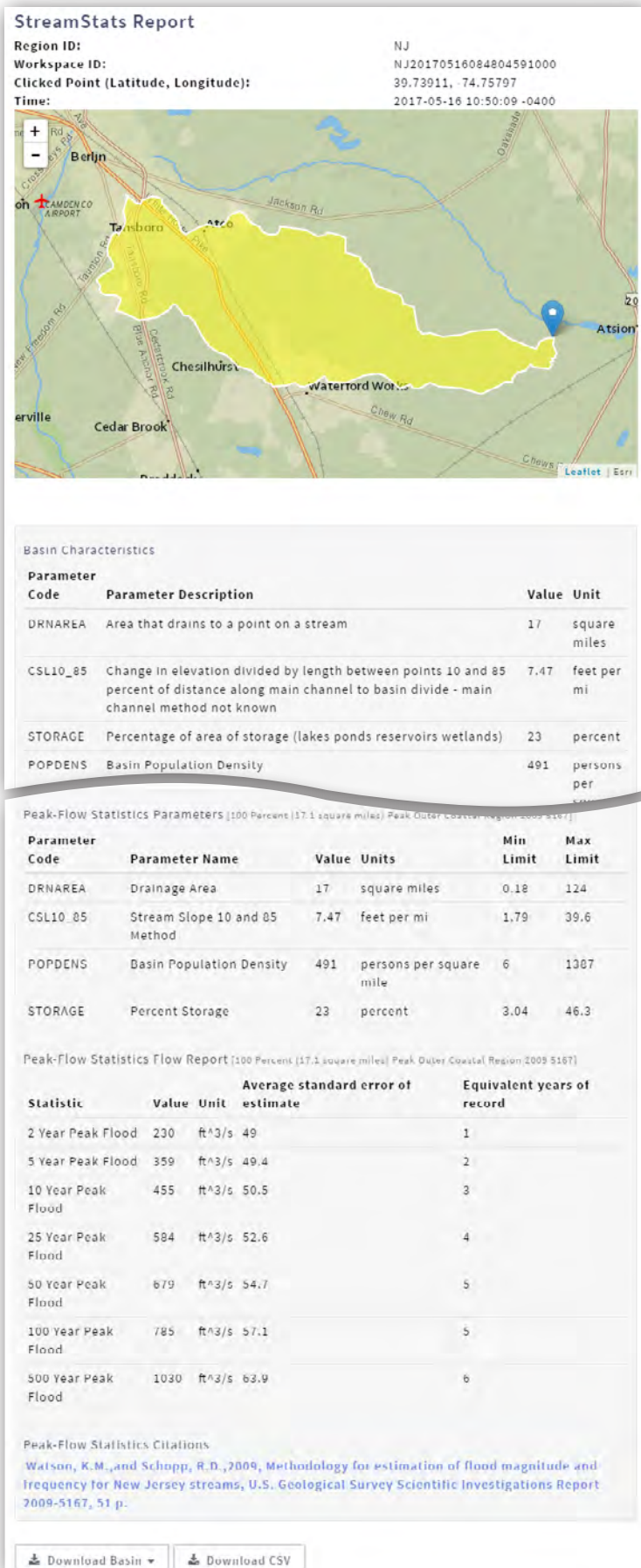


Figure 3. Screen capture of the StreamStats Report with map frame showing a basin delineation and table of results for peak-flow statistics in New Jersey.

Table 1. Definitions of basin characteristics available for New Jersey in StreamStats.

[% , percent; NRCS, Natural Resources Conservation Service; SSURGO, Soil Survey Geographic database; NLCD, National Land Cover Database]

Parameter code	Characteristic name	Parameter description	Unit
DRNAREA	Drainage area	Area that drains to a point on a stream	Square miles
CSL10_85	Channel slope	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	Feet per mile
FOREST	Percent forested	Percentage of area covered by forest	% of basin area
STORAGE	Percent water storage	Percentage of area of storage (lakes, ponds, reservoirs, wetlands)	% of basin area
POPDENS	Population density	Basin population density	People per square mile
PERMSSUR	Soil permeability	Area-weighted average soil permeability from NRCS SSURGO database	Inches per hour
APRAVPRE	April precipitation	Mean April precipitation	Inches
JUNAVPRE	June precipitation	Mean June precipitation	Inches
LC11IMP	Percent impervious surfaces	Average percentage of impervious area determined from NLCD 2011 impervious dataset	% of basin area
LC11DEV	Percent urban land use	Percentage of developed (urban) land from NLCD 2011 classes 21–24	% of basin area

the volume of water passing a location in a stream over a unit of time. It is determined by its relation to stage. Periodic measurements of high flow or low flow are collected at partial-record stations specifically to support the calculation of flow statistics. These data, collected over years, are the foundation for the statistics available for New Jersey data-collection stations through StreamStats. The locations of the stations are shown in the UI as triangles of various colors, depending on the type of data that are collected. Information on streamgages can be accessed by clicking on the *Exploration Tools* button (looks like a toolbox) near the top left on the map, then on the *Query Streamgages* button on the tool list that will appear, and finally on a station of interest on the map.

The *About* button in the black banner above the StreamStats map frame provides access to the *State/Regional Info* page for New Jersey, which identifies the statistics that StreamStats can compute for ungaged sites and provides (1) citations for the reports that contain the equations, with hyperlinks to the online versions; (2) a link to a page that describes how the basin characteristics are computed; (3) notes of particular interest about using StreamStats for New Jersey; and (4) acknowledgement of the agencies that cooperated with the USGS to implement StreamStats.

Flood Magnitude and Frequency Statistics

StreamStats for New Jersey can be used to estimate peak flood discharges for seven annual exceedance probabilities (AEP; 0.5, 0.2, 0.1, 0.04, 0.02, 0.01, and 0.002) for ungaged, unregulated or slightly regulated, non-tidal streams in New Jersey. These AEPs correspond to recurrence intervals of 2, 5, 10, 25, 50, 100, and 500 years, respectively. An AEP of 0.01 means there is a 1-percent chance that a specific streamflow will be equaled or exceeded at a given location in a given year. The recurrence interval for a given AEP is determined by dividing 1 by the AEP; therefore, an AEP of 0.01 is equivalent to a 100-year recurrence interval.

Low-Flow Statistics

StreamStats for New Jersey can be used to estimate monthly flow-duration and monthly low-flow frequency statistics for ungaged streams in Coastal Plain and non-coastal regions of New Jersey for baseline and current land- and water-use conditions. The equations were developed to estimate 87 different streamflow statistics, which include the monthly 99-, 90-, 85-, 75-, 50-, and 25-percentile flow-durations of the minimum 1-day daily flow; the August–September 99-, 90-, and 75-percentile minimum 1-day daily flow; and the monthly 7-day, 10-year low-flow frequency (Watson and McHugh, 2014).

Exploratory Tools

In addition to the Query Streamgages tool for obtaining streamgage information, the Exploration Tools menu (found by clicking on the toolbox icon in the top left corner of the map) includes several useful tools (fig. 4).

Recent Improvements

A new and improved digital topographic dataset, called a digital elevation model (DEM), was prepared by the State of New Jersey and has been integrated into StreamStats. The horizontal resolution of the DEM is 10 feet. The vertical accuracy for each cell is 1.1 feet. The previous version of StreamStats was produced using a 32.8-foot grid with a relative vertical accuracy of 5.4 feet. The higher resolution allows for improved calculations of basin characteristics and refined estimates of streamflow.

The national web application has recently been upgraded from Version 3 to Version 4. Version 4 offers a seamless user interface for all states and selected river basins. Users can easily step through the interface work flow to obtain results from identifying a study area to building a report of results with maps.

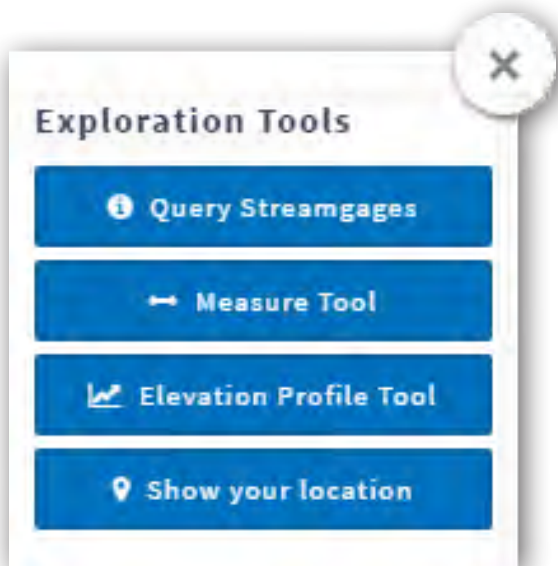


Figure 4. Screen capture of the menu that appears after clicking on the Exploration Tools button on the map.

Use of the New Jersey StreamStats Application

Users are highly encouraged to read the StreamStats documentation before attempting to use the application. Users who plan to use StreamStats to estimate streamflow statistics for ungaged sites are also encouraged to review the reports listed on the State/Regional Info page to understand how the regression equations were developed and how they should be applied, and to view any special instructions for estimating streamflow statistics for ungaged sites in the State.

The application of New Jersey regression equations is appropriate for

- Sites on ungaged streams,
- Streams that are unregulated or slightly regulated and also non-tidal, and
- Sites where the basin characteristics are within the published range limits.

For more information, contact:

New Jersey Water Science Center
 U.S. Geological Survey
 3450 Princeton Pike, Suite 110
 Lawrenceville, NJ 08648

Or visit:

<http://nj.usgs.gov> || <https://streamstats.usgs.gov>

StreamStats users are encouraged to always

1. Check the accuracy of the basin delineation from StreamStats,
2. Evaluate and understand the errors associated with each estimate, and
3. Consider alternate methods of estimation, if the uncertainty from StreamStats results is too great for the intended use.

Methods for Obtaining Peak Flows in New Jersey

At Streamgage Sites—Peak flow is computed as a weighted average of the discharge from the regression equation and the discharge from station data using the procedures outlined in Bulletin 17B (U.S. Water Resources Council, 1981). These values are reported in Watson and Schopp (2009).

At Sites Upstream or Downstream from a Streamgage—The site must be on the same stream as the streamgage, and the drainage area of the site should be approximately between $\frac{1}{3}$ and 3 times the basin area for the streamgage. Peak flow is estimated using a ratio of the drainage area for the site to the drainage area for the upstream or downstream streamgage multiplied by the weighted average of the discharge for the streamgage, which is found using the Query Streamgage tool.

At Sites on Ungaged Streams—Peak flow is estimated by the regression-based equations offered within New Jersey StreamStats (Watson and Schopp, 2009). Users select a point along a stream, then StreamStats calculates basin characteristics and estimates peak flow. Care is needed in evaluating the basin characteristics for the ungaged site and determining whether they are within or beyond published range limits.

—Kara M. Watson and Jon A. Janowicz

References Cited

- Watson, K.M., and Schopp, R.D., 2009, Methodology for estimation of flood magnitude and frequency for New Jersey streams: U.S. Geological Survey Scientific Investigations Report 2009–5167, 51 p.
- Watson, K.M., and McHugh, A.R., 2014, Regional regression equations for the estimation of selected monthly low-flow duration and frequency statistics at ungaged sites on streams in New Jersey: U.S. Geological Survey Scientific Investigations Report 2014–5004, 59 p.
- U.S. Water Resources Council, 1981, Guidelines for determining flood flow frequency: U.S. Water Resources Council, Hydrology Committee, Bulletin 17B [variously paged].