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Groundwater and Streamflow Information Program

Prepared in cooperation with the Federal Highway Administration
Office of Project Development and Environmental Review

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Open-File Report 2017–1108

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

Cover. Example of riffle and pool. Photograph by Gregory E. Granato, USGS, taken on May 6, 2016.

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RYAN K. ZINKE, Secretary

U.S. Geological Survey
William H. Werkheiser, Acting Director

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Contents

Figures

Tables

Conversion Factors

U.S. customary units to International System of Units

Multiply	By	To obtain
	Length	
mile (mi)	1.609	kilometer (km)
	Area	
square mile (mi^2)	2.590	square kilometer (km^2)
	Flow rate	
cubic foot per second (ft^3/s)	0.02832	cubic meter per second (m^3/s)
cubic foot per second per square mile ($[ft^3/s]/mi^2$)	0.01093	cubic meter per second per square kilometer ($[m^3/s]/km^2$)

Datum

Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83).

Abbreviations

7Q2	7-day, 2-year low flow
GNWISQ	Get National Water Information System Streamflow (Q) files
NWISWeb	National Water Information System Web
Q	streamflow
QSTATS	Streamflow (Q) Statistics
SREF	Streamflow Record Extension Facilitator
USGS	U.S. Geological Survey

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Abstract

Streamflow statistics are needed by decision makers for many planning, management, and design activities. The U.S. Geological Survey (USGS) StreamStats Web application provides convenient access to streamflow statistics for many streamgages by accessing the underlying StreamStatsDB database. In 2016, non-interpretive streamflow statistics were compiled for streamgages located throughout the Nation and stored in StreamStatsDB for use with StreamStats and other applications. Two previously published USGS computer programs that were designed to help calculate streamflow statistics were updated to better support StreamStats as part of this effort. These programs are named "GNWISQ" (Get National Water Information System Streamflow (Q) files), updated to version 1.1.1, and "QSTATS" (Streamflow (Q) Statistics), updated to version 1.1.2.

Statistics for 20,438 streamgages that had 1 or more complete years of record during water years 1901 through 2015 were calculated from daily mean streamflow data; 19,415 of these streamgages were within the conterminous United States. About 89 percent of the 20,438 streamgages had 3 or more years of record, and about 65 percent had 10 or more years of record. Drainage areas of the 20,438 streamgages ranged from 0.01 to 1,144,500 square miles. The magnitude of annual average streamflow yields (streamflow per square mile) for these streamgages varied by almost six orders of magnitude, from 0.000029 to 34 cubic feet per second per square mile. About 64 percent of these streamgages did not have any zero-flow days during their available period of record. The 18,122 streamgages with 3 or more years of record were included in the StreamStatsDB compilation so they would be available via the StreamStats interface for user-selected streamgages. All the statistics are available in a USGS ScienceBase data release.

Introduction

Streamflow statistics are critical for many planning, management, and design activities, including water-supply analysis, habitat protection, bridge and culvert design, calibration of surface-water and groundwater models, water-quality assessments, and design and operation of government, commercial, and industrial facilities (Ries and others 2004, 2008; Granato, 2009, 2013). Streamflow statistics also provide information needed to protect people and property from floods as well as to help communities prepare for and minimize the effects of droughts. In addition, streamflow statistics are necessary to estimate the potential effects of point sources, such as wastewater-treatment plants, and nonpoint sources, such as highway and urban-runoff discharges, on receiving waters. Streamflow statistics at individual data-collection stations change with time as additional data are collected. Therefore, reliable, efficient, and repeatable methods are needed to periodically access and process streamflow data for the computation of streamflow statistics.

The U.S. Geological Survey (USGS) provides streamflow information in a variety of formats. Time-series data and some basic statistics are available from the USGS National Water Information System Web (NWISWeb, https://waterdata.usgs.gov/nwis). Also, the USGS periodically computes and publishes streamflow statistics and basin characteristics for its streamflow data-collection stations. This information typically is published in water year summaries (previously called annual water data reports) for active streamgages (defined here as data-collection stations at which streamflow data are collected continuously) through NWISWeb, or in reports that are products of statewide or regional studies done in cooperation with State and local agencies. Although the interpretive reports are available on the USGS Publications Warehouse (https://pubs.er.usgs.gov/), it can be difficult to obtain needed information because available streamflow statistics and basin characteristics for a given area commonly are scattered among many reports with publication dates that can span several decades. Therefore, the USGS StreamStats Web application (https://water.usgs.gov/osw/streamstats/) was designed to provide convenient access to previously published information for streamgages. This information is served from a database, named "StreamStatsDB."

In StreamStats, the different types of data-collection stations are shown on the map in the user interface by symbols of different colors. Clicking on the location of a station gives access to the available information for that station, which includes tables of descriptive information, previously published basin characteristics, and streamflow statistics. The available information varies by station type and by the needs of local cooperators, who may have shared in the cost of computing the basin characteristics and streamflow statistics.

Commonly, streamflow statistics have been updated in StreamStatsDB by report authors soon after publication of the reports that contain the statistics. However, such reports are published only infrequently, and the USGS has not mandated the updating of StreamStatsDB when new reports are published. As a result, the availability and currency of statistics in StreamStatsDB have varied widely among data-collection stations. A remedy was needed so that non-interpretive streamflow statistics—those for which hydrologic expertise is not required to finalize the computations—could be recomputed on a regular basis, updated in StreamStatsDB, and served by StreamStats.

Purpose and Scope

This report describes efforts to update existing USGS software, use that software to compile non-interpretive streamflow statistics, and provide those statistics for use in StreamStatsDB. These efforts occurred during the 2015–17 period. The report explains how two existing computer programs previously published by the USGS (Granato, 2009) were modified to facilitate regular updates to the data in StreamStatsDB. Program additions include options for filtering data from NWISWeb, streamflow statistics available for output, and types of output files. The report summarizes the selection of streamgages for which statistics were calculated and the results of the ensuing data-mining efforts. The statistics are available in a USGS data release (https://doi.org/10.5066/F71V5CFT). The report documents attributes of the available data for these streamgages, including record lengths, drainage areas, zero-flow days, and magnitudes of streamflow yields. Also described are the update to StreamStatsDB and the method for obtaining calculated statistics from StreamStatsDB via the online StreamStats application.

Computer-Program Updates

Two existing computer programs that were designed to facilitate calculation of streamflow statistics were updated to better support the StreamStats effort. These programs are named “Get National Water Information System Streamflow (Q) files” (GNWISQ) and “Streamflow (Q) Statistics” (QSTATS). These programs were initially developed by the USGS in cooperation with the Federal Highway Administration (Granato, 2009). Both programs have graphical user interfaces that follow standard Microsoft Windows interface conventions.

Get National Water Information System Streamflow (Q) Files (GNWISQ Version 1.1.1)

The GNWISQ program (fig. 1) was developed to facilitate the process for downloading files of streamgage information and daily mean streamflow data from NWISWeb and reformatting them to a standard format that can be used with other programs, such as QSTATS (Granato, 2009). GNWISQ has an individual-file mode to retrieve information and data for one streamgage and a batch-file mode to retrieve information and data for multiple streamgages. To facilitate its use for generating data needed to compute streamflow statistics for StreamStats, GNWISQ was updated to include a “Water Year Threshold” box to allow the specification of a threshold that defines an allowable number of missing days within a water year, and a “Water Years” button was added to filter the data to include only data from water years that meet the specified threshold. Water years begin on October 1 of the previous year and end on September 30 of the stated year. The GNWISQ default is zero missing days; the default value was used to compile the lists of streamgages and statistics described in this report. The program also was updated to provide tab-delimited error files with codes that can be used in the analysis of errors that may occur during the downloading or reformatting processes. The methods for using GNWISQ version 1.1.1 are almost identical to the methods described by Granato (2009). The primary differences are the textbox for specifying the water-year threshold and the button for filtering out incomplete water years that do not meet the specified water-year threshold (Granato, 2015).

The GNWISQ program can produce up to four output files containing streamgage characteristics and daily streamflow values (table 1) and, if necessary, an error file. If an input error occurs, the streamgage site-identification number and the type of error are recorded in the error file “GNWISQErrFile.txt.” The two primary files, which are created each time GNWISQ is run, are the “########H.txt” file (with the “########” symbolizing the 8–12 digit streamgage site-identification number), which has the streamgage information, and the “########Q.txt” file, which has the daily streamflow values.

Streamflow (Q) Statistics (QSTATS Version 1.1.2)

The QSTATS program (fig. 2) was developed to calculate non-interpretive streamflow statistics from files containing the time series of daily mean streamflow that were downloaded from NWISWeb and reformatted by using GNWISQ. Version 1.0 of the QSTATS program calculated the proportion of zero-flow days, the median, the average, the standard deviation, the skew, the probability-weighted moments and the

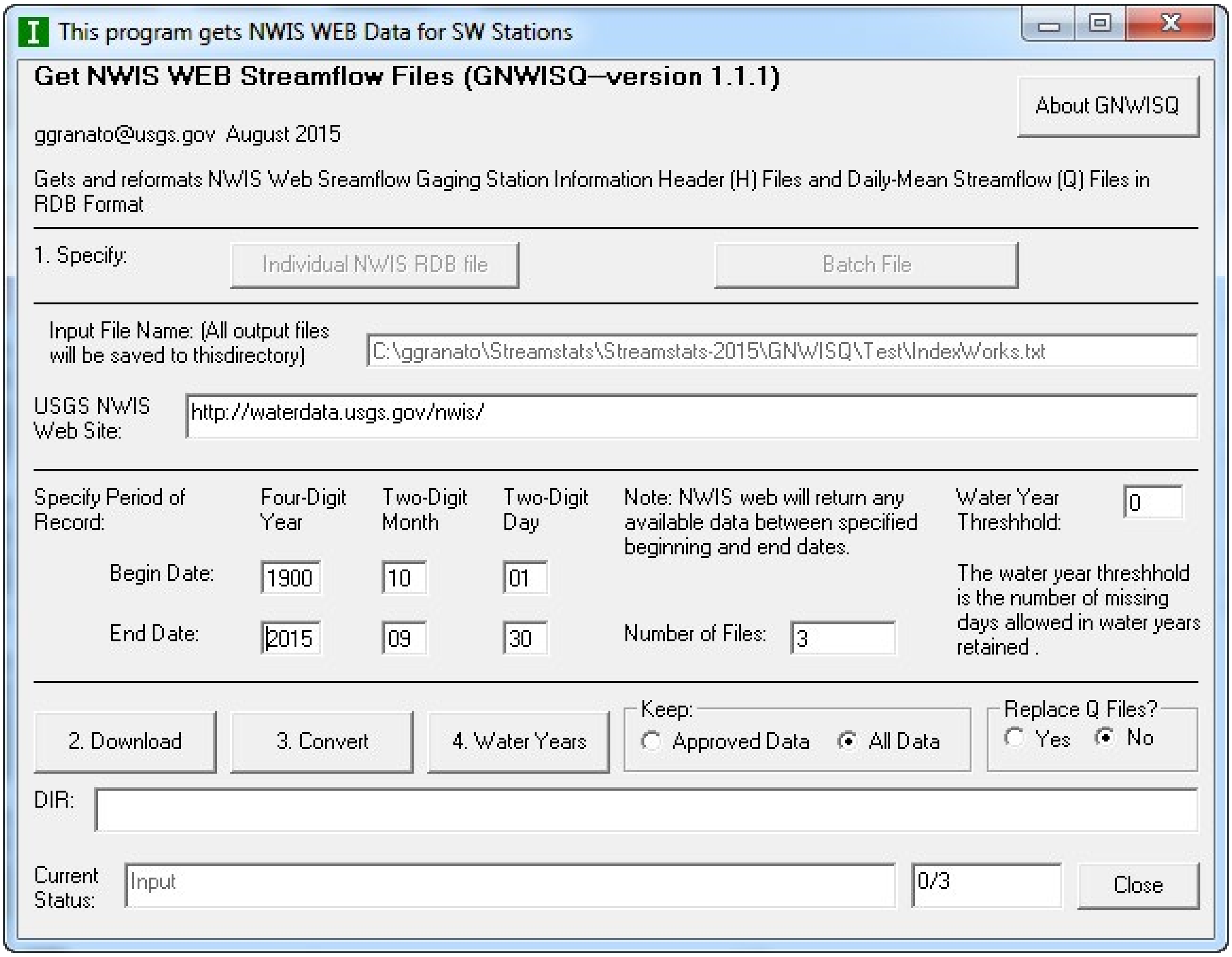


Figure 1. The Get National Water Information System Streamflow (Q) files (GNWISQ) program input form as it would appear after downloading and processing data in batch mode from three streamgages. DIR, directory; RDB, relational database; USGS NWIS, U.S. Geological Survey National Water Information System.

Table 1. Streamflow data files created by the Get National Water Information Streamflow (Q) files program (GNWISQ version 1.1.1).

[########, the 8–16-digit U.S. Geological Survey identification number for each streamgage retrieved]

File name root	Contents
########H.txt	Streamgage station information including identification number, name, location, State, altitude information, hydrologic unit code, drainage area, contributing drainage area, period of record, and daily mean value count.
########Q.txt	The daily-value file for the selected streamgage. The format of this file depends on the user's selection for converting the file format. The content of this file depends on the user's selection for accepting only complete water years.
########Q.txt.orig	The daily-value file for the selected streamgage in the format that is downloaded. This file is created if the user converts the format with the replace Q files option set to No (the default).
########Q.txt.Alldv	The file containing all daily values for the selected streamgage in the format that is downloaded. This file is created if the user filters out data from incomplete water years with the replace Q files option set to No (the default).

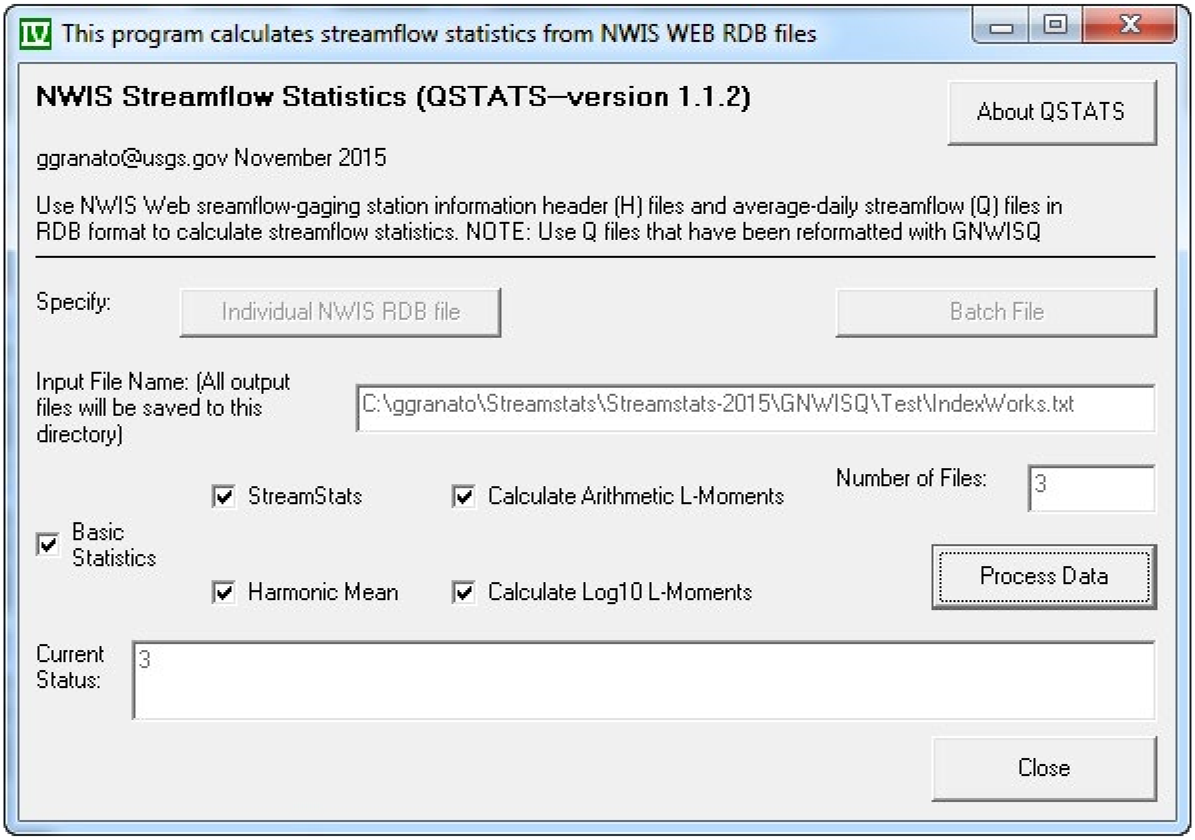


Figure 2. The Streamflow (Q) Statistics (QSTATS) input form as it would appear after batch processing data from three streamgages. GNWISQ, Get National Water Information System Streamflow (Q) files; NWIS, National Water Information System; RDB, relational database.

L-moments of the daily values, and the logarithms of nonzero daily values (Granato, 2009). Additional non-interpretive streamflow statistics were added to version 1.1.2 of QSTATS for the StreamStats project (Granato, 2015). The averages, standard deviations, and skews of annual and monthly flows, and the minimums, maximums, and selected percentiles of the annual, monthly, and daily flows were added. The unadjusted and adjusted harmonic-mean values also were added. The unadjusted harmonic mean is defined as the average of reciprocals of nonzero daily mean streamflow values. The adjusted harmonic mean is the unadjusted harmonic mean multiplied by the proportion of nonzero streamflow values (Martin and Ruhl, 1993). QSTATS version 1.1.2 also is designed to produce output files in a format for use with the USGS StreamStatsDB (Ries and others, 2004). The methods for using QSTATS version 1.1.2 are almost identical to the methods described by Granato (2009). The primary difference is that the new version has check boxes to calculate and output statistics for StreamStats and to calculate comparative harmonic-mean statistics.

The QSTATS program can produce up to 12 output files containing various statistics (table 2) and, if necessary, an error file. If an input error occurs, the streamgage site-identification number and the type of error are recorded in the error file “QStatsErrFile.” The two primary files, which are created each time QSTATs is run, are the “QStatsDatFile” and “QStatsGISFile” files. If the “Calculate Arithmetic L-Moments” or “Calculate Log 10 L-Moments” option is selected, then the probability-weighted moments and L-moments (Hosking and Wallis, 1997) are calculated and the results are written to the associated “QStatsLMomFile” or “QStatsLMomLogFile” files. The output files have an index number that is increased each time QSTATS is run in a particular directory. If the StreamStats option is selected before data are processed, then seven StreamStats files with the “SSDB” prefix are created (table 2). If the “Harmonic Mean” option is selected, then comparative harmonic-mean statistics are written to the “HarmonicMeanComp” file. These files are indexed by date and version number each time QSTATS is run in a particular directory. All these files are tab-delimited text files to facilitate their use with other programs, such as spreadsheets, databases, or graphing software. The files begin with comment fields, marked by pound symbols (#), that describe the file contents.

Table 2. Names, input options, and descriptions of streamflow statistics files created by the Streamflow (Q) Statistics program (QSTATS version 1.1.2).

File name root	Option	Contents
QStatsDatFile	Basic Statistics	Station number, name, location, drainage area, period of record, data counts, proportion of zero flow, and statistics for daily mean flows and the common logarithms of nonzero flows
QStatsGISFile	Basic Statistics	Station location, number, name, drainage area, data counts, proportion of zero flow, and statistics for daily mean flows and the common logarithms of nonzero flows normalized by drainage area
QStatsLMomFile	Calculate Arithmetic L-Moments	Station number, name, probability-weighted moments, and L-moments for daily mean flows
QStatsLMomLogFile	Calculate Log 10 L-Moments	Station number, name, probability-weighted moments, and L-moments for the common logarithms of daily mean flows
HarmonicMeanComp	Harmonic Mean	Station number and the harmonic means of daily mean flows in cubic feet per second calculated by three commonly used methods
SSDB_Annual_Input	StreamStats	Minimum, median, maximum, average, and standard deviation of annual flows and daily mean flows
SSDB_Duration_Input	StreamStats	Selected flow durations from the 1st to 99th percentile of daily mean flows
SSDB_SELDM_Input	StreamStats	The average, standard deviation, and skew of the logarithms of nonzero flows and the proportion of zero flows
SSDB_HarmonicMean-QAH	StreamStats	Harmonic mean, defined as average of reciprocals of nonzero daily mean streamflow values (multiplied by the proportion of nonzero flow values)
SSDB_HarmonicMean-QAHNA	StreamStats	Harmonic mean, defined as average of reciprocals of nonzero daily mean streamflow values (not adjusted for the proportion of zero-flow values)
SSDB_Jan_To_June_Input	StreamStats	The average, minimum, maximum, median, and standard deviation of the monthly mean flows for the months January through June
SSDB_July_To_Dec_Input	StreamStats	The average, minimum, maximum, median, and standard deviation of the monthly mean flows for the months July through December

Station Selection and Attributes

A search of data in NWISWeb identified 37,737 data-collection stations (including continuous-record and partial-record streamgages) with one or more streamflow measurements. Among these streamgages, 20,438 were streamgages that had 1 or more complete water years of record (no missing days within the selected water years) during water years 1901 through 2015. Statistics for these streamgages were calculated and documented for use in a USGS data release (Granato, 2017; https://doi.org/10.5066/F71V5CFT). At the end of water year 2015, 7,152 streamgages had complete records for that water year; 3,076 were Federal priority streamgages monitored as part of the USGS Groundwater and Streamflow Information Program, and 4,076 were monitored in cooperation with other Federal, State and local agencies. The remaining 13,286 streamgages were not actively collecting continuous records at the end of water year 2015. The geographic distribution of the 19,415 streamgages in the conterminous United States with 1 or more years of record is displayed in four ways in figure 3, including by record length (fig. 3*A*), drainage area (fig. 3*B*), percentage of zero-flow days (fig. 3*C*), and geometric mean of nonzero daily mean streamflow per square mile (fig. 3*D*). All the statistics are available in a USGS ScienceBase data release (Granato, 2017).

Record lengths varied substantially. About 89 percent of the 20,438 streamgages had 3 or more years of record; about 65 percent had 10 or more years of record; about 40 percent had 25 or more years of record; about 21 percent had 50 or more years of record; 1.3 percent had 100 or more years of record; and 35 streamgages (about 0.2 percent) had the maximum 114 years of record (fig. 4). Although some of the oldest streamgages were installed in the West, streamgages with various record lengths are well distributed (fig. 3*A*). Long-term statistics and estimated flow records can be generated for short-record streamgages by using tools such as the Streamflow Record Extension Facilitator (SREF, Granato, 2009) with data from nearby, hydrologically similar streamgages with longer periods of record.

Drainage areas ranged from 0.01 to 1,144,500 square miles (mi^2). About 3 percent of streamgage drainage areas were less than 1 mi^2. About 14 percent were between 1 and 10 mi^2, about 34 percent were between 10 and 100 mi^2, about 33 percent were between 100 and 1,000 mi^2, and about 16 percent of these drainage areas were greater than 1,000 mi^2. In the Midwest, most of the streamgages represented drainage areas greater than 100 mi^2, but streamgages with a variety of drainage areas were well distributed over the rest of the conterminous United States (figs. 3*B* and 5).

The percentage of time that a stream has zero flow is important for a variety of water-resource, ecological, and agricultural planning, management, and regulatory purposes (fig. 3*C*). A zero-flow day is defined herein as a day with a daily mean streamflow that is less than the detection limit—commonly about 0.01 cubic foot per second (ft^3/s) (Rantz, 1982). About 64 percent of the streamgages in the USGS dataset did not have any zero-flow days during their available periods of record. By definition, perennial streams never go dry (Chow and others, 1988; Mosley and McKerchar, 1993). By practice and statute, however, perennial streams are defined differently among the States. For example, Massachusetts defines perennial streams as having an observable or measurable flow except during drought conditions (Bent and Steeves, 2006), whereas Idaho defines them as having an unregulated 7-day, 2-year low flow (7Q2) greater than or equal to 0.1 ft^3/s (Idaho Department of Environmental Quality, 2006). Likewise, intermittent and ephemeral streams are statutorily defined differently among the States. However, ephemeral streams commonly are defined as streams that flow only during runoff events; they do not have prestorm base flows. Intermittent streams are those that are classified neither as perennial nor ephemeral. They typically flow more often than only during and after storms, but they usually are dry for multiple days each year.

The percentages of time that streamgages had 1 or more zero-flow days are shown in figure 6 for the 36 percent of streamgages that had at least 1 day of zero flow during their period of record. The minimum percentage of days with zero streamflow shown on the graph represents a streamgage with 1 zero-flow day in a 114 year record. A criterion for identifying intermittent streams as having 1 zero-flow day per year on average would be a threshold of about 0.274 percent zero-flow days. About 31 percent of the streamgages in the USGS dataset would be classified as intermittent by applying this criterion for the available period of record.

In water-quality studies, a recurrence of one event in 3 years, on average, is considered an acute event for stream biota (Rossman, 1990a,b). Using this probability for the available period of record for each streamgage would result in a criterion of 0.091 percent zero-flow days, and 33 percent of streamgages would be classified as intermittent or ephemeral. Analysis of synoptic precipitation records by ecoregion indicates that the average number of runoff-producing events per year ranges from 68 in parts of the Northwest to 10 in parts of the Southwest (Granato, 2010). Therefore, the breakpoints between intermittent and ephemeral streams, as percentages of zero-flow days, range from greater than 81 percent zero-flow days in very humid areas to greater than 99 percent zero-flow days in arid areas. Nationwide, about 2.82 percent of streamgages had 81 percent or more zero-flow days during the available period of record; about 0.37 percent had 99 percent or more zero-flow days during the available period of record. Although some intermittent and ephemeral streams are monitored in the humid areas of the country (largely in the East, the mountainous West, and the Northwest), most streamgages in these areas are on perennial streams (fig. 3*C*). The proportion of intermittent to perennial streams at streamgages is higher in the Midwest and Southwest than in the East and Northwest. Most of the streamgages on ephemeral streams are in the Southwest.

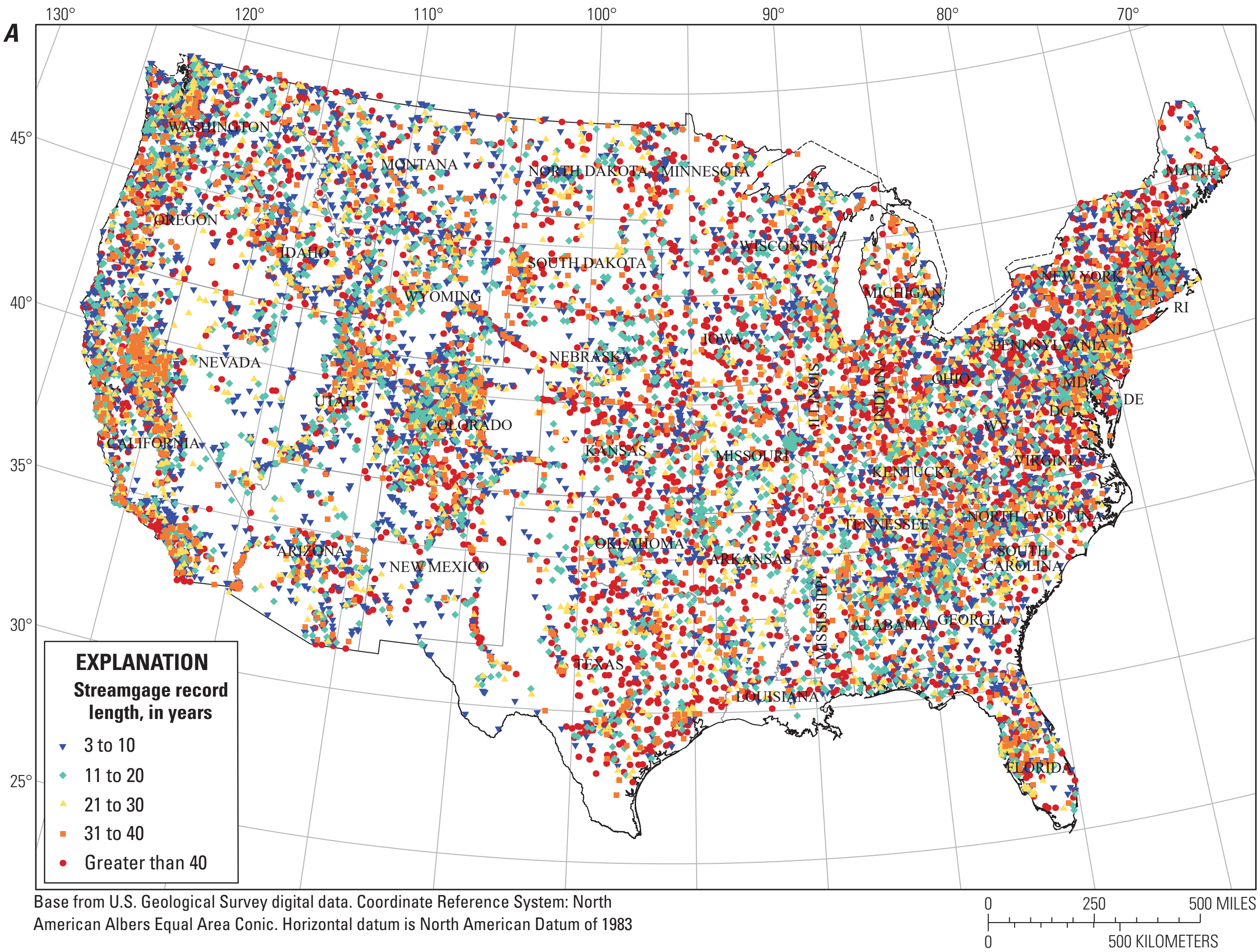
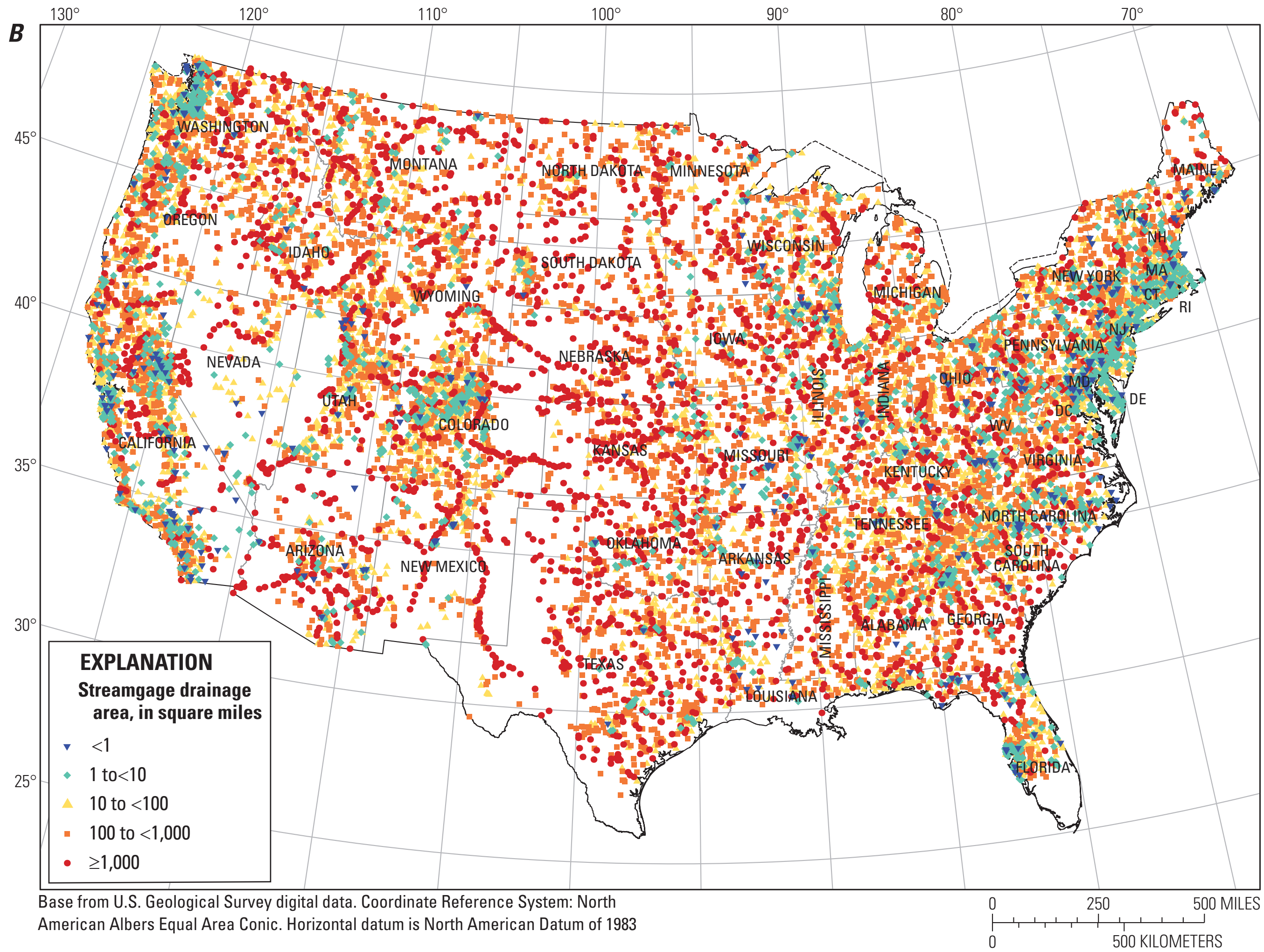


Figure 3. Geographic distribution of 19,415 streamgages within the conterminous United States with 1 or more years of record during water years 1901 through 2015 by *A*, record length, *B*, drainage area, *C*, percentage of zero-flow days in the record, and *D*, geometric mean of nonzero daily mean streamflow values. Interactive versions of figures 3*A*–*D* can be downloaded at https://doi.org/10.3133/ofr20171108.



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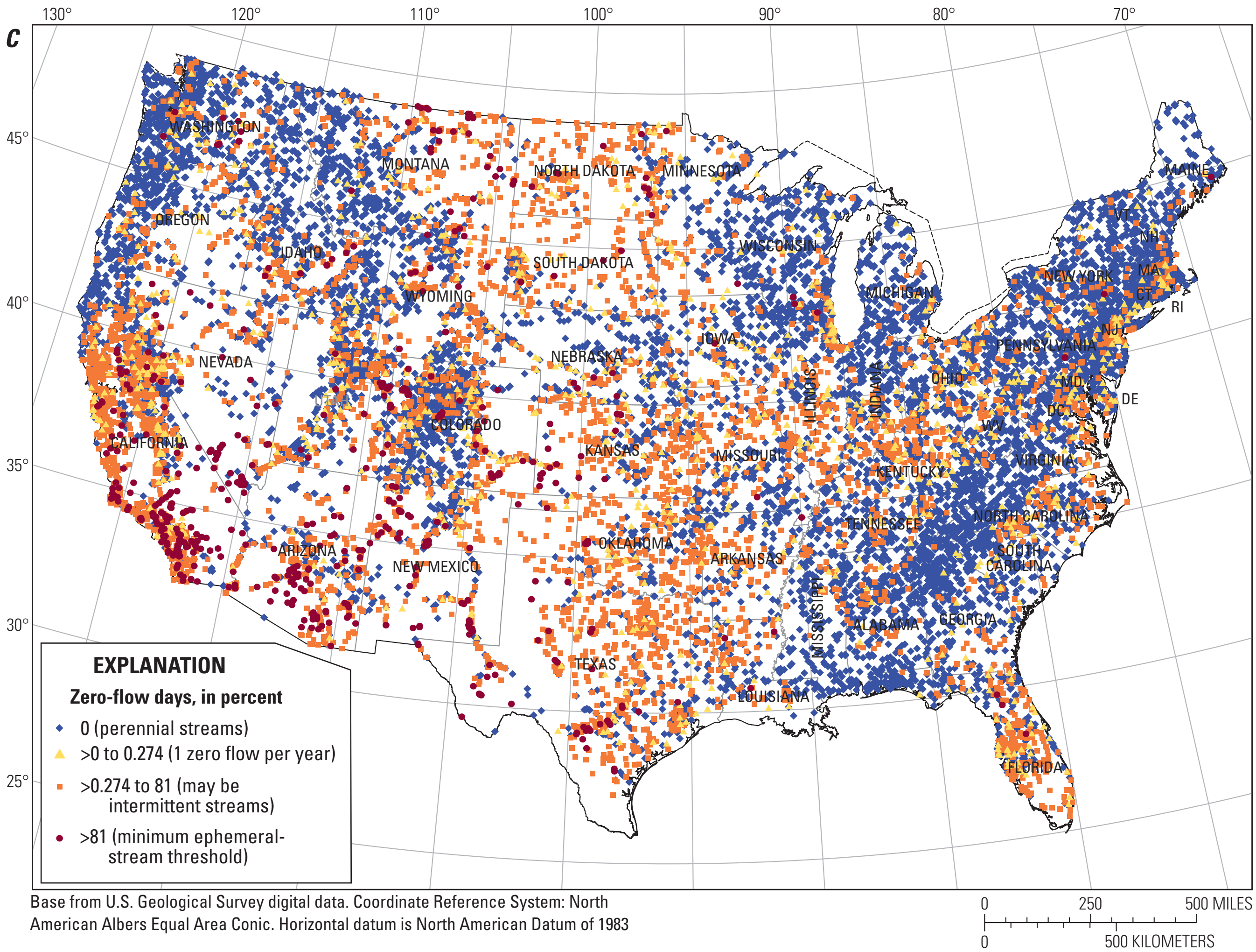

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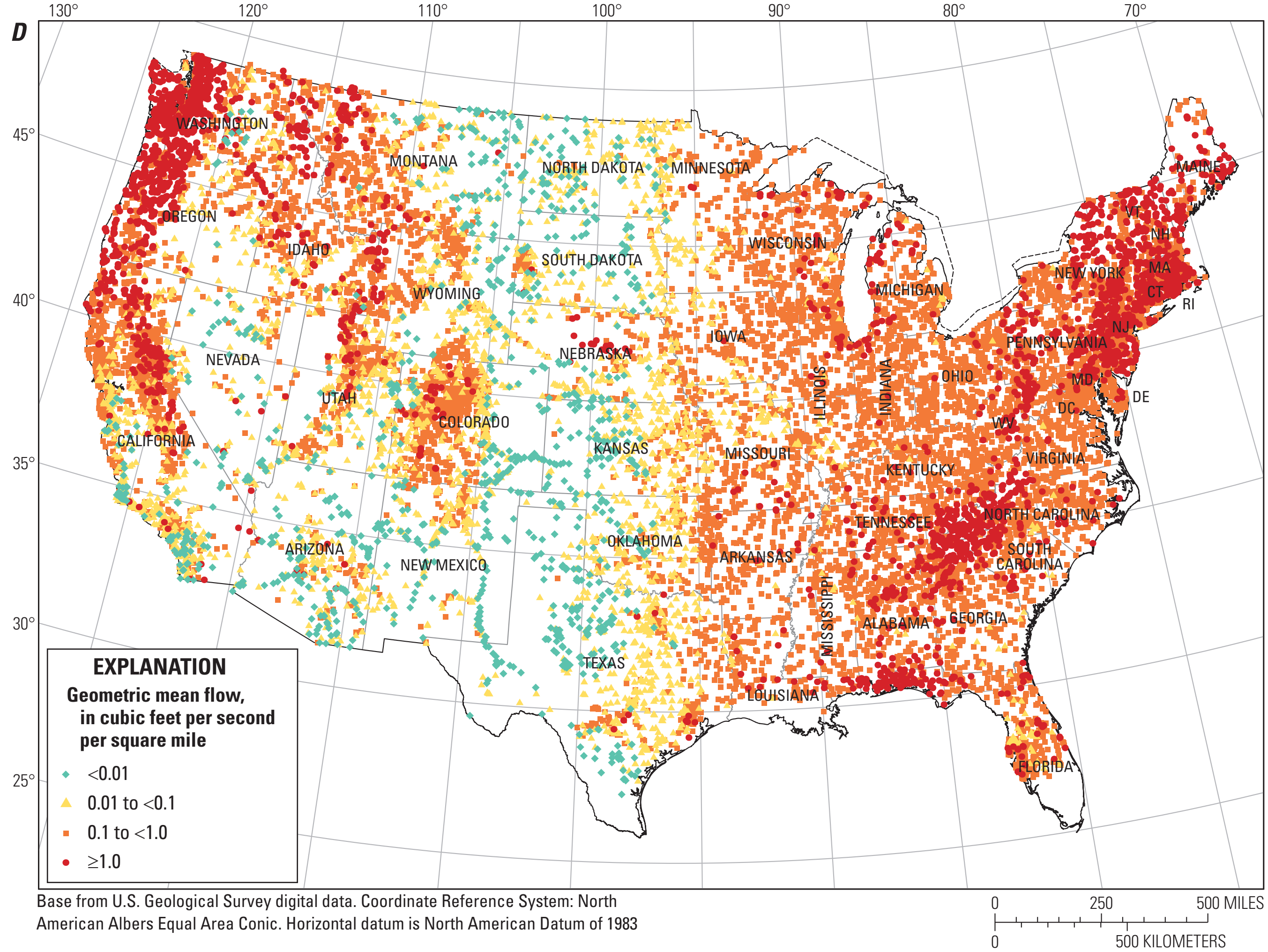

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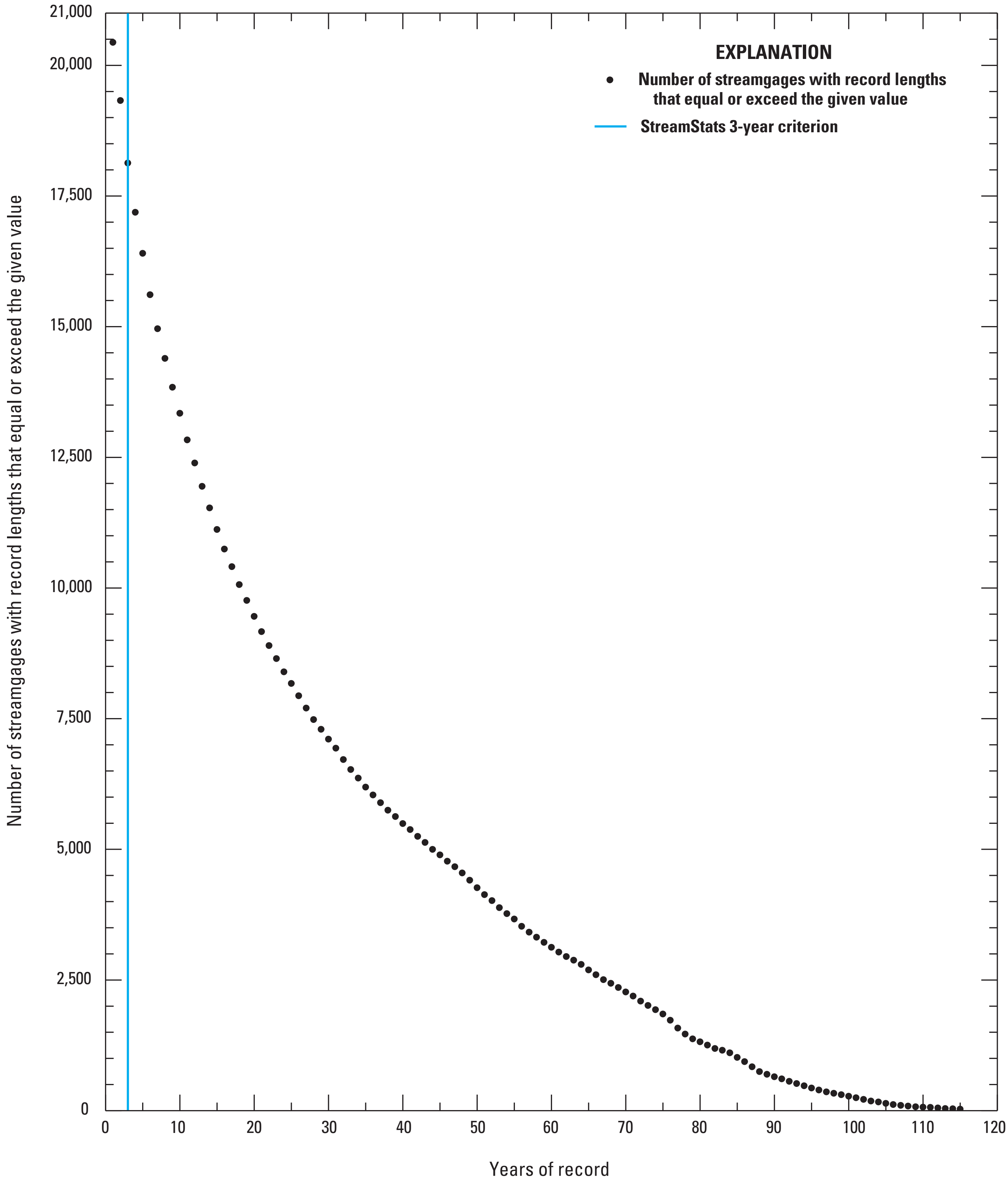

Figure 4. The number of U.S. Geological Survey streamgages with at least 1 year of record during water years 1901 through 2015 that have record lengths that equal or exceed a given value.

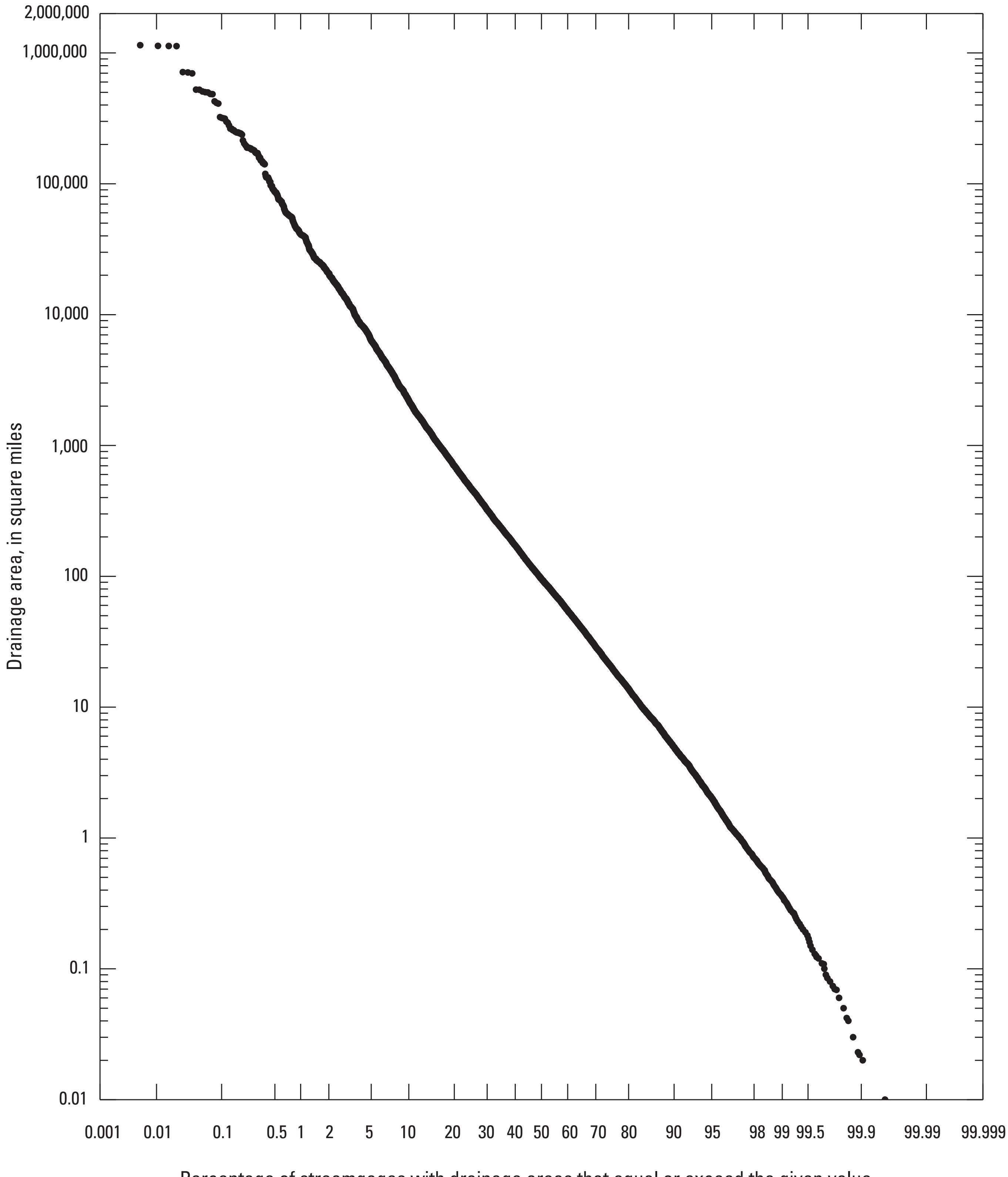

Figure 5. Percentages of U.S. Geological Survey streamgages with at least 1 year of record during water years 1901 through 2015 that have drainage areas that equal or exceed a given value.

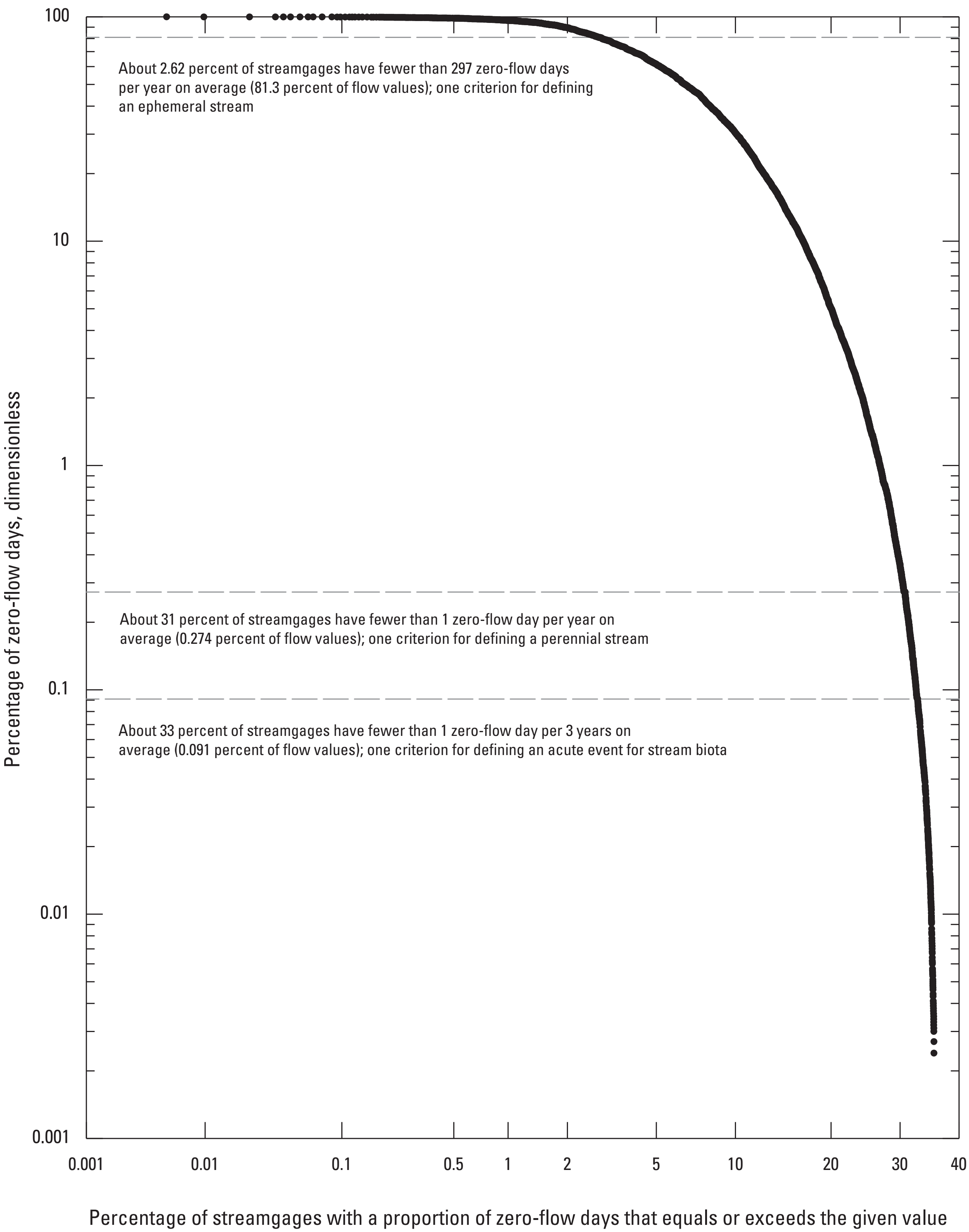

Figure 6. Percentages of U.S. Geological Survey streamgages with proportions of zero-flow days that equal or exceed a given value. Streamgages shown have 1 or more zero-flow days and at least 1 year of record during water years 1901 through 2015. Not shown are the 64 percent of streamgages that do not have any zero-flow days.

The magnitude of annual average streamflow yields (streamflow per square mile) varied substantially across the country (fig. 3*D*). For example, the geometric mean of nonzero daily mean streamflows varied by almost six orders of magnitude (fig. 7) from 0.000029 to 34 cubic feet per second per square mile ($ft^3/s/mi^2$). However, streamflow yields for the middle 50 percent of streamgages ranged by less than an order of magnitude from about 0.12 to 0.84 $ft^3/s/mi^2$. The middle 80 percent ranged by less than 2 orders of magnitude from about 0.025 to 1.4 $ft^3/s/mi^2$. The pattern of streamflow yields is similar to the pattern for the percentage of zero-flow days, with higher yields in the humid eastern and northwestern areas of the country, as well as in some high elevation areas in the western mountainous regions, and lower yields in the more arid areas (largely in the Midwest and Southwest) (fig. 3*D*).

Updating StreamStatsDB and Display of Statistics in StreamStats

Data were retrieved for the selected stations from NWISWeb by using the revised GNWISQ program, and statistics were computed by using the revised QSTATS program. Output files obtained from the revised QSTATS program were used to import the data into StreamStatsDB. Although statistics were calculated for all 20,438 streamgages with 1 or more complete years of record, statistics for use in StreamStatsDB were limited to the 18,122 streamgages that had 3 or more years of verified record when the data were extracted from NWISWeb.

Information from StreamStatsDB can be displayed by StreamStats for user-selected streamgages. Users can locate streamgages in the map-based user interface and then use the “Query Streamgages” tool to select the streamgage and get information for it (fig. 8). After the user selects a streamgage, StreamStats provides an output that includes descriptive information about the streamgage and previously computed basin characteristics and streamflow statistics. The information and statistics that are available for individual streamgages vary widely, reflecting the purpose for which the streamgage was established and the interest of local agencies that cooperate with the USGS to maintain the streamgage or to compute streamflow statistics. The information that is available for different streamgages can vary from only a few basic properties to several pages of detailed basin properties and streamflow statistics. An example output can be found at https://streamstatsags.cr.usgs.gov/gagepages/html/13308500.htm.

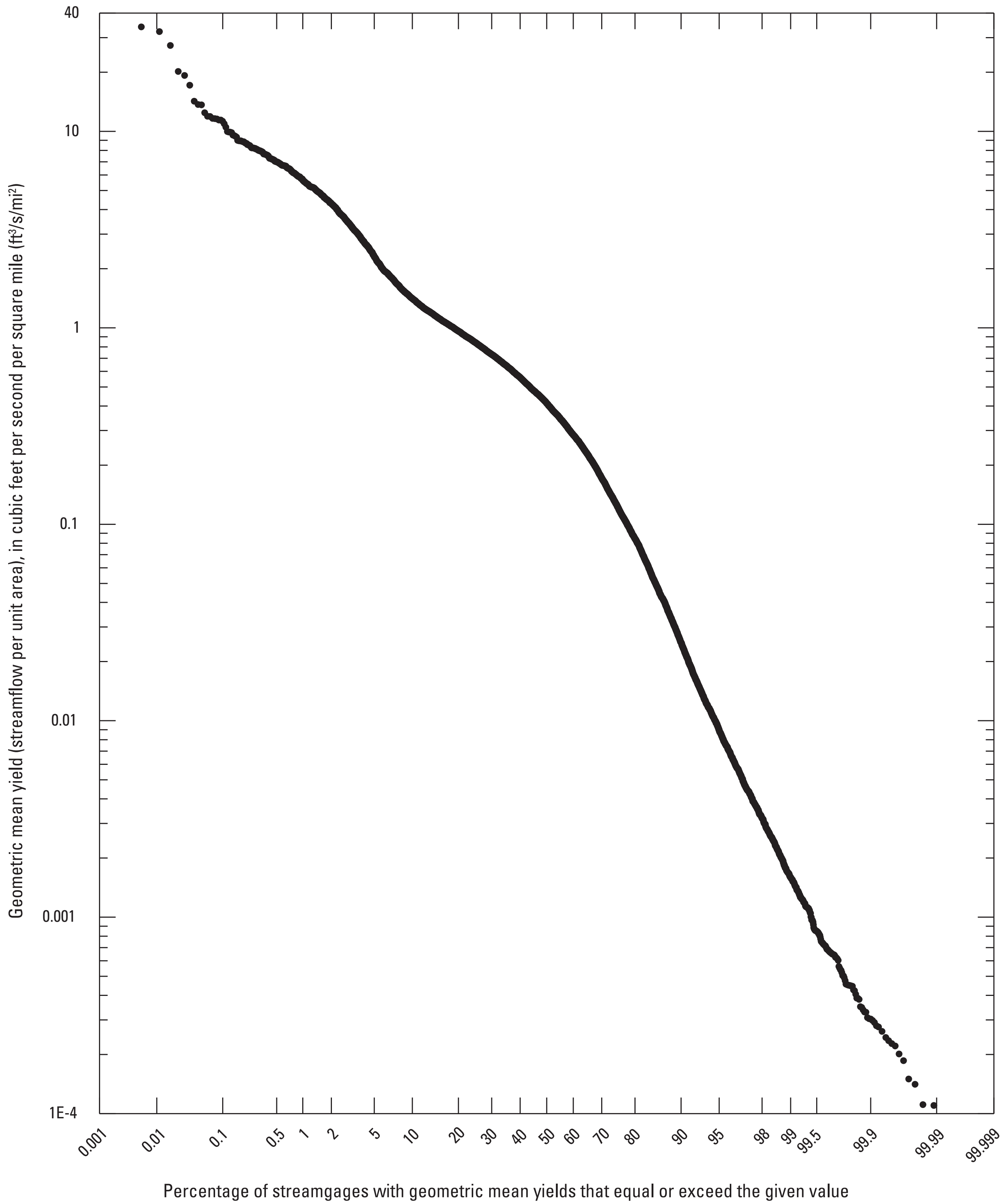

Figure 7. Percentages of U.S. Geological Survey streamgages with at least 1 year of record during water years 1901 through 2015 that have geometric mean yields (streamflow per unit area) that equal or exceed a given value. Yields below 0.0001 cubic foot per second per square mile are not shown.

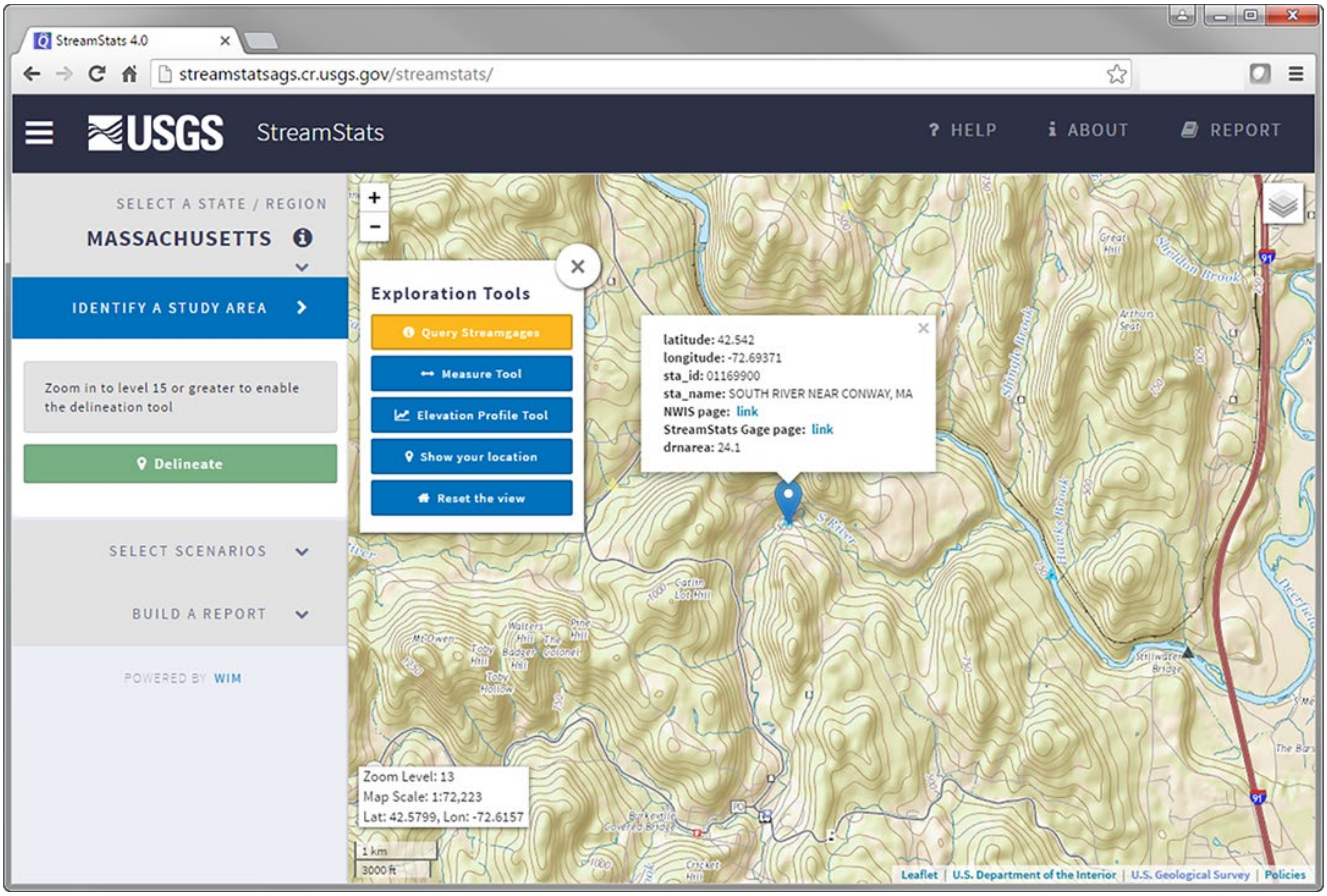

Figure 8. The selection of a streamgage using the "Query Streamgages" tool in the StreamStats version 4.0 user interface. Clicking on the "StreamStats Gage page" link in the pop-up text frame will cause the information that is available within the StreamstatsDB database for the selected streamgage to appear in a new tab. drnarea, drainage area in square miles; ft, foot; km, kilometer; NWIS, National Water Information System; sta_id, streamgage site-identification number; sta_name, streamgage name.

Summary

In 2015–17, two existing computer programs were modified and data were mined from the U.S. Geological Survey National Water Information System Web (NWISWeb) so that non-interpretive streamflow statistics could be recomputed on a regular basis, updated in the StreamStatsDB database, and served by StreamStats. These programs are named "Get National Water Information System Streamflow (Q) files" (GNWISQ) and "Streamflow (Q) Statistics" (QSTATS). The programs were initially developed by the U.S. Geological Survey in cooperation with the Federal Highway Administration. The GNWISQ program was developed to facilitate the process for downloading files of streamgage information and daily mean streamflow data from NWISWeb and reformatting them to a standard format that can be used with other programs. GNWISQ was updated to version 1.1.1 to include a "Water Year Threshold" box to allow the specification of a threshold that defines an allowable number of missing days within a water year, and a "Water Years" button was added to filter the data to include only data from water years that meet the specified threshold. The QSTATS program was developed to calculate non-interpretive streamflow statistics from files of time series of daily mean streamflow that were downloaded from NWISWeb and reformatted by using GNWISQ. Version 1.0 of the QSTATS program calculated the proportion of zero-flow days, the median, the average, the standard deviation, the skew, the probability-weighted moments and the L-moments of the daily values, and the logarithms of nonzero daily values. Additional non-interpretive streamflow statistics were added to version 1.1.2 of QSTATS for the StreamStats application. These statistics are the averages, standard deviations, and skews of annual and monthly flows, and the minimums, maximums, and selected percentiles of the annual, monthly, and daily flows. The unadjusted and adjusted harmonic-mean values also were added.

A search of data in NWISWeb identified 37,737 data-collection stations with one or more streamflow measurements. Among these stations, 20,438 were streamgages that had 1 or more complete years of record during water years 1901 through 2015. Of these, 19,415 were located within the conterminous United States. About 89 percent of the 20,438 streamgages had 3 or more years of record, and 65 percent had 10 or more years of record. The 18,122 streamgages with 3 or more years of record were included in the USGS StreamStats compilation. Drainage areas of the 20,438 streamgages ranged from 0.01 not have any zero-flow days during their available period of record. A zero-flow day is defined herein as a day with a daily mean streamflow that is less than the detection limit—commonly about 0.01 cubic foot per second. One criterion for identifying intermittent streams as having 1 zero-flow day per year on average would be a threshold of about 0.274 percent zero-flow days. About 31 percent of the streamgages in the U.S. Geological Survey dataset would be classified as intermittent by using this criterion for the available period of record. The magnitude of annual average streamflow yields (streamflow per square mile) for these streamgages varied by almost six orders of magnitude, from 0.000029 to 34 cubic feet per second per square mile. All the calculated streamflow statistics are available in a USGS ScienceBase data release.

Information from StreamStatsDB can be displayed by StreamStats for user-selected streamgages. Users can locate streamgages in the map-based user interface and then use the “Query Streamgages” tool to select the streamgage and get descriptive information about the streamgage and previously computed basin characteristics and streamflow statistics, which include the statistics described in this report and previously published interpretive and non-interpretive statistics. The information that is available for different streamgages can vary from only a few basic properties to several pages of detailed basin properties and streamflow statistics. This update of the statistics in StreamStatsDB ensures that a consistent set of non-interpretive statistics will be available for the 20,438 streamgages with at least 1 complete year and that StreamStats users will have access to these statistics for the 18,122 streamgages with at least 3 years of continuous record.

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