

A Partial Summary of 2017 USGS Activities of Interest to the FHWA and State Highway Agencies

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For questions, please contact either:

Todd Koenig (tkoenig@usgs.gov)

Julie Kiang (jkiang@usgs.gov)

Introduction and summary of current projects

Part of the mission of the U.S. Geological Survey (USGS) is to assess the quantity, quality, and trends of the Nation's water resources, to advance the understanding of natural processes related to these resources, and to provide information that will assist resource managers and policymakers in making sound decisions.

The USGS has a long history of funded investigations with the Federal Highway Administration (FHWA) and State highway agencies to provide data and information to address various issues related to water resources and the Nation's transportation infrastructure. These issues cover a wide spectrum and include items such as regional flow statistics, flood documentation, regional stream characteristics, bridge scour, and water-quality assessments. For example, on a national scale, the USGS is supporting efforts to update the Federal Guidelines for Flood Frequency Determinations (Bulletin 17B) and maintain the USGS PeakFQ Program. In addition, the USGS enhances and maintains the National Streamflow Statistics Program, the StreamStats flow statistics application and delivery tool, and WaterAlert, a tool for automatic notification of threshold exceedance for stream stage, streamflow, and other water-related data collected by USGS.

On a regional scale, the USGS is conducting investigations to update Bulletin 17B skew maps, to define channel characteristics at bankfull discharge, and to document major coastal storm tides. Current locally focused investigations include the examination of rural, urban, and small watershed flow frequency; the documentation of extreme inland floods along with flood-frequency updates; and the development of flood inundation maps to assist with the protection of public infrastructure, such as roads and bridges, and to improve public safety.

The following table and text provide a partial summary of current or recently completed USGS activities related to highway issues. Table 1 organizes the current and recent activities into categories and

subcategories and gives a quick overview of the USGS programs and the State and (or) Federal agencies that are helping sponsor the programs. The text following Table 1 provides more information on the various activities. The text initially describes activities that have been or are being conducted on a national level and is followed by state activities listed alphabetically by State. If you should have questions regarding this information, please contact Robert Mason (rrmason@usgs.gov).

Table 1. Partial summary of USGS activities of interest to the FHWA and State Highway Agencies

State	Project Title	In cooperation with...
National	Federal Geographic Data Committee	US Dept of Transportation
	FHWY SELDM Model	US Federal Highway Administration
	Performance and Effectiveness of Scour Countermeasures	
Alabama	Mapping Contracts	Alabama Dept of Transportation
	LMG WSC Ecohydrology/Aquatic Biology (formerly Landforms and Ecology)	
	LMG WSC Hydrohazards (Floods & Droughts)	
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Alaska	ASC WILD: Streambed Scour Monitoring	Alaska Dept of Transportation and Public Facilities
	ASC WILD: Surface Water Data	
	ASC WILD: Railroad Streambed Scour	Alaska Railroad
Arizona	Surface Water Stations	Arizona Dept of Transportation
	Data collection around key bridge structures and roadways	
	Maricopa County n-verification study	Flood Control Department of Maricopa County, Salt River Project, and Arizona Dept of Transportation
Arkansas	LMG WSC Hydrologic Data Programs	Arkansas State Highway and Transportation Dept
	LMG WSC Watershed Hydrology (formerly Watershed Assessments) (WLU)	

State	Project Title	In cooperation with...
California	FHWY SELDM Model	California Dept of Transportation
	WERC Wildlife and Terrestrial Resources	
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	Evaluation of Groundwater Conditions and Land Subsidence Along the High-Speed Rail Alignments	California High Speed Rail Authority
Colorado	Colorado Surface-Water Data Collection Networks	Colorado Dept of Transportation
	Eastern Colorado Crest-Stage Gage Network	
	Real-time monitoring and evaluation of bridge scour, Colorado	
	CDOT - DEFEnS DEbris and Flood Early warNing System	
	Post-flood discharge, stage, and frequency documentation, 2016	
	CDOT Additional Basin Characteristics in StreamStats	
	Implementation of the Curve Number and Rational Hydrologic Methods in StreamStats	
	Updates to the Regional Regression Equations in Western Colorado in StreamStats	
CDOT - Precipitation and Streamgage Flood Warning System		
Connecticut	CT Flood Frequency Study	Connecticut Dept of Transportation
Georgia	Hydrologic Surveillance and Analysis	Georgia Dept of Transportation
	Flood Characteristics for Georgia	
Hawaii	Hydrologic Data Networks, Hawaii and Guam	Hawaii Dept of Transportation
Idaho	Idaho Peak Flow Statistics	Idaho Transportation Dept
	Bridge Scour Countermeasures	FHWA

State	Project Title	In cooperation with...
Illinois	Hydrologic Data Program	Winnebago County - Highway Dept
	Updated Rural and Urban Flood Frequency Estimation and StreamStats Update	Illinois Dept of Transportation
Indiana	Surface Water stations	Indiana Dept of Transportation
	Inundation Mapping-IN WSC	
	Wabash River Modeling	
Iowa	Flood Assessments	Iowa Dept of Transportation
	80 Crest Stage Stations including 21 real-time crest-stage gages.	
	26 continuous-record real-time surface water Stations	
	Stream-Channel and Watershed Delineations and Basin-Characteristic Measurements using Lidar Elevation Data for Small Drainage Basins within the Des Moines Lobe Landform Region in Iowa	
Kansas	FSC Rural Regression Equations	Kansas Dept of Transportation
Louisiana	LMG WSC Hydrologic Data Programs	Louisiana Dept of Transportation and Development - Intelligent Transportation Systems
	LMG WSC Hydrohazards (Floods & Droughts)	
	LMG WSC Water Use And Availability(WATAV)	
	LMG WSC Limnology	
Maryland	MD-DE-DC Data Collection Program	Maryland Dept of Transportation
	Sediment, Nitrogen and Phosphorus for TMDLs	
	Update peak flow regression equations, basin characteristic data sets, and coverages in StreamStats for Delaware	
Maine	Surface Water Stations	Maine Dept of Transportation
	Lag to peak equations for small watersheds in Maine	
	Peak flow equations for Maine	

State	Project Title	In cooperation with...
Massachusetts	Effectiveness of Open Graded Friction Course Pavement in reducing loads of suspended sediment discharged from Massachusetts Highways	Massachusetts Dept of Transportation
	Characterization of Stormwater Runoff from Bridge Decks in Eastern Massachusetts	
Michigan	Michigan Groundwater & Streamflow Information	Michigan Dept of Transportation
Minnesota	Data Program	Minnesota Dept of Transportation
	Techniques to Estimate Peak-Flows on small Ungaged Streams in BiNational Rainy River Basin Peakflow Gage Gap Analysis	
Mississippi	LMG WSC Hydrologic Data Programs	Mississippi Highway Dept
	LMG WSC Hydrohazards (Floods & Droughts)	
Missouri	Surface Water Stations	Missouri Highways and Transportation Commission
	Meramec River	
	Multibeam surveys at Missouri and Mississippi River bridges	
Montana	Bridge Scour in Montana	Montana Dept of Transportation
	Hydrologic Characterization of Potential Sites for Restored and Constructed Wetlands, Montana	
	Data Collection in Wyoming and Montana	
	Regional Regression Equations Based on Channel-Width Characteristics to Estimate Peak-Flow Frequencies at Ungaged Sites in Montana Using Data through Water Year 2011	
	Montana Crest-Stage Gage Network	
Nevada	Nevada Surface-Water Networks	Nevada Dept of Transportation
	Clear Creek Monitoring Program	
New Hampshire	Predicting iron precipitation from rock fill drainage	New Hampshire Dept of Transportation

State	Project Title	In cooperation with...
New Jersey	National Bridge Scour Project	Federal Highway Administration
New Mexico	Flood Analysis	New Mexico Dept of Transportation
	Surface Water Data Collection	
New York	Surface Water - Troy	New York State Dept of Transportation
	Flood Investigations - Troy	
	Flood Investigations - Ithaca	
North Carolina	NC SELDM (for NCDOT via URS Corporation)	North Carolina Dept of Transportation
	Hydrologic Surveillance and Analysis	
	Characterization of Baseline Water Quality Conditions in Currituck Sound, North Carolina prior to the Mid-Currituck Bridge Construction	
Ohio	Techniques for estimating the magnitude and frequency of floods in Ohio, developed with unregulated rural peak-flow data through water year 2014	Ohio Dept of Transportation (through MS Consultants)
	Hydrologic Investigations and Assessment of Volume Reduction for Stormwater Management in Ohio	
Oklahoma	Web-based Flood Inform - Oklahoma	Oklahoma Dept of Transportation
Pennsylvania	PennDOT Peak-flow Regression Equations	Pennsylvania Dept of Transportation
South Carolina	Hydrologic Surveillance and Analysis	South Carolina Dept of Transportation
	South Atlantic Water Science Center Technical Assistance (HWM data collection and Development of HWM field flip book)	
	Changes in Water Quality, Streambed Sediment, and Benthic Macroinvertebrates as a Result of Stormwater from Bridges in South Carolina	
	Streamstats Application for South Carolina	
	Effects Of Culverts On The Ecological Conditions Of Streams	

State	Project Title	In cooperation with...
South Dakota	Data Program	South Dakota Department of Transportation
	SD DOT Flood frequency analyses	
Tennessee	LMG WSC Hydrologic Data Programs	Tennessee Dept of Transportation
	LMG WSC Ecohydrology/Aquatic Biology (formerly Landforms and Ecology)	
Texas	Urbanization Effects, Lake Houston	Texas Dept of Transportation
	TXDOT- Crest Stage Gages	
Vermont	NH/VT Water Resources Data Program	Vermont Agency of Transportation
Virginia	Data Program	Virginia Dept of Transportation
	SW Processes	
Washington	Cascades Volcano Observatory	Washington State Dept of Transportation
West Virginia	Data Program	West Virginia Dept of Transportation
	Time of Concentration	
Wisconsin	Surface Water & Sediment Team	Wisconsin Dept of Transportation
	Non Point Evaluation Team	

Partial Summary of USGS National Activities

USGS WaterAlert and WaterNow

The USGS continues to provide a very popular water-threshold exceedance notification program. The system sends email or text messages when water levels, water-quality conditions, or rainfall meet user-specified criteria at real-time USGS hydrologic data collection sites. Criteria can include greater-than, less-than, within, and out-of-range thresholds. Reporting frequencies can include once-per-day or once-per-hour alerting while the condition lasts. In 2012, the process was started to link subscribers with the USGS Flood Inundation Mapping Program Map Viewer (<http://wim.usgs.gov/FIMI/>) to help users select thresholds of interest. These maps, where available, along with National Weather Service E-19 flood stage information, provide locations and descriptions of local features such as roads or structures in the vicinity of streamgages and river stages that affect those features. The USGS WaterAlert system can be accessed at <http://water.usgs.gov/wateralert/>.

A complementary interactive USGS query and alert feature called WaterNow is also available for users to query any real-time USGS hydrologic data collection site and request reports of the most recent values for any data collected at the site of interest. The query and response can be sent and received using any device with email or text message capabilities. Information about the USGS WaterNow system is available at: <http://water.usgs.gov/waternow/>

Groundwater and Streamflow Information Program (GWSIP)

The U.S. Geological Survey (USGS) operates more than 8,200 near real-time streamgages in the National Streamflow Network (NSN) in cooperation with Federal, State, local, regional, tribal, non-governmental and industrial partners. The USGS provides a continuous source of streamflow information that is used in countless ways by governmental organizations, private industries, and the general public (<https://www.usgs.gov/gwsip>).

Historically, the collection and dissemination of hydrologic information have been managed through multiple USGS programs, which were combined in 2016 into GWSIP, including in large part, the Cooperative Matching Funds (CMF, formerly the Cooperative Water Program) and the Federal Priority Streamgages (FPS, formerly the National Streamflow Information Program). The goal of GWSIP is to enhance its comprehensiveness and interdisciplinary value and more effectively represent key components of the hydrologic cycle including surface water, groundwater, evapotranspiration, precipitation, and some water quality and sediment (Super Gages).

One of the highest goals of the USGS is to maintain long-term stability of a "federal needs backbone network of streamgages" (a total of 4,760 streamgages as defined in the original NSIP design, now managed as FPS) for long-term tracking and forecasting/modeling of streamflow conditions in the future in response to changes in land use, water use, and climate. Specifically, consistent and systematically-collected information is paramount to meet the full gamut of Federal water priorities and responsibilities over the long term (previously defined by the NSIP) related to:

- Forecasting extreme hydrologic events (floods and droughts);
- Monitoring water flows across international, interstate, and tribal borders needed to address inter-jurisdictional and court adjudicated water rights and other legal responsibilities;
- Tracking streamflow, water quality, and habitat in major river basins, such as those discharging into key estuaries or draining heavily populated areas; and
- Tracking long-term streamflow trends and causes, such as relating to population growth and changes in land use, water use, and climate.

In 2016, approximately 3,460 streamgages of the more than 8,200 streamgage network met these strategic long-term Federal priorities and responsibilities. These Federal high-priority streamgages were funded by the GWSIP (approximately 1/3 of the funding) and USGS partners (the remaining 2/3 of the funding). In 2017, a total of approximately 1,178 of these streamgages were fully funded by the USGS

(through FPS). Support for a full "federal needs backbone network of streamgages" requires about \$150M, requiring an additional \$96 million dollars annually.

Beginning in 2016, the USGS has aligned its budget structure to the Water Science Strategy by consolidating the previous seven programs into four major program areas. The first, which has been discussed previously, GWSIP, focuses on observing and delivering water data. The other three programs, National Water Quality Program; Water Availability and Use Science Program; and Water Resources Research Act; all focus on understanding, predicting and delivering. The USGS Water Science Strategy (URL: <http://pubs.usgs.gov/of/2012/1066/of2012-1066.pdf>) identifies water science goals and objectives that serve the Nation and address the water challenges for the future. The Strategy outlines areas where hydrologic science can make substantial contributions to the Nation and identifies opportunities for the USGS to better use its hydrologic science capabilities to advance healthy watersheds and sustainable, secure water supplies and to minimize impacts of water-related hazards.

GWSIP will encompass the USGS objectives to provide long-term, national networks for observation of the vital components of the hydrologic cycle and include activities such as the USGS streamgaging network, flood monitoring and inundation science, including response to other Hazards. GWSIP also includes the National Groundwater Monitoring Network and USGS Climate Response Network. The USGS is working through the Advisory Committee for water Information (ACWI) Subcommittee on Hydrology (SOH) on the Streamflow Information Collaborative" to discuss the USGS streamgaging network, including suggestions for improvement in the network, its operations and funding, as well as, other information and data needed to improve streamflow information for the nation. Interested state and local agencies, other Federal agencies, and other interested parties can participate as a member of the collaborative. Please contact Doug Yeskis (djyeskis@usgs.gov) for more information.

Flood Response Activities

The USGS, as the nation's premier earth science agency, is expected by cooperators, emergency management agencies, news media, and the public to provide hydrologic information prior to, during, and after flooding, with a particular expectation that USGS will disseminate near real-time flood data and flood summaries on the World Wide Web. The role of the USGS related to flood response activities has greatly expanded over the years as commitments at all levels of government have increased. In addition, USGS has a responsibility to advance scientific understanding of floods and public risk awareness both internally in its own scientific studies as well as collaboratively with outside agencies, academics, and non-profits. Accordingly, USGS must prepare for and respond decisively and consistently to flood events, including post-flood scientific study when appropriate.

During major floods, the USGS deploys field crews to measure flood flows at streamgages and other locations of interest (such as breached levees, chemical spills, etc.). Flood-related data are available at the following locations:

- <https://waterdata.usgs.gov>: time series stage, streamflow, and water quality data and at-site measurements

- <https://stn.wim.usgs.gov/FEV/>: a national event-based tool for viewing and downloading storm tides sensor data and high-water mark data
- <https://water.usgs.gov/wateralert/>: user-customized alerts
- <https://waterwatch.usgs.gov/>: situational awareness maps and tools
- <https://water.usgs.gov/floods/>: a national website on major flooding events

While the USGS streamgage network is large, during an emergency, a streamgage may not exist where it is most needed. The needs include flood control reservoir operation, flood forecasting, flood fight operations, road closure, and emergency management, including evacuations. To meet this need, USGS develops, builds, and maintains a cache of rapid deployment streamgages (RDG) that can be installed to collect and transmit near real-time data within hours to days of a recognized need. They can be installed quickly and with minimal impacts to bridges and structures, and data will begin appearing on the web within minutes of installation.

If additional data is needed for calibration of models or documenting flood peaks, USGS technicians can install small water-level sensors in opportunistic networks. These have been used to document storm-tide flooding where the local coastal conditions prohibit a network of larger sensors. Over 900 USGS storm tide sensors and RDG's were installed in the 2017 water year to monitor and measure the effects of major storms including Matthew, Harvey, Irma, Jose, Maria, Nate, and a number of other significant events.

High water marks (HWMs) are also instrumental in post-flood analyses. After an event, USGS technicians survey HWMs according to the standards in the recently published USGS Techniques and Methods manual: Identifying and Preserving High-Water Mark Data (<https://pubs.er.usgs.gov/publication/tm3A24>). In the 2017 water year, the USGS collected and documented nearly 4000 high-water marks, which are now stored with marks from many past events and accessible at the USGS Flood Event Viewer at <http://stn.wim.usgs.gov/FEV/>.

Many federal, state, and local partners use the data that USGS collects for modelling, peak verification, flood inundation mapping, flood frequency computation (discussed further below), emergency management, and public education. USGS scientists and technicians are also involved in documenting extreme floods (see <http://water.usgs.gov/floods/reports/>) and flood inundation studies (see <https://wim.usgs.gov/FIMI>).

Contact Bob Holmes (bholmes@USGS.gov), the USGS National Flood Hazard Coordinator, for more information.

Updated Flood-Frequency Analysis Guidelines

Flood-frequency analysis provides information about the magnitude and frequency of flood discharges. Bulletin 17B, which was written by the Hydrology Subcommittee of the Interagency Advisory Committee

on Water Data (1982), defines procedures that provide a uniform and consistent approach for determining flood-flow frequency from peak-flow records. An update to the guidelines, written under the auspices of the Advisory Committee on Water Information and its subgroups, is nearing publication. Improvements include more detailed representations of flood data, an improved computational algorithm, better screening for statistical outliers, improved methods for incorporation of regional information, and improved accuracy of confidence limits. The enhancements combine to provide more robust estimation of flood frequency. The updated methods are particularly valuable when new regional information is available or when historical flood records or paleoflood information are available. Note that while the estimation methods have been improved, the framework for flood frequency analysis has not been changed. As a result, Bulletin 17C methods allow continuity with previous studies. A draft of the proposed new guidelines is posted at <https://acwi.gov/hydrology/Frequency/b17c/>.

The Peak flow FreQuency analysis program (PeakFQ) implements the Bulletin 17B and (draft) Bulletin 17C recommended procedures for flood-frequency analysis of streamflow records. A Windows version is available at <http://water.usgs.gov/software/PeakFQ/>.

Contact Julie Kiang (jk Chiang@USGS.gov) for more information about the USGS contributions to the effort.

Updated Flood-Frequency Regional Skew Map

The regional skew is the third moment of the log Pearson Type III distribution and is a measure of the asymmetry of the distribution. The skew is very sensitive to extreme events, such as large floods. Thus, in flood frequency analysis, the skew becomes significant because interest is focused on the right hand tail of the distribution. However, the span of available years of recorded flood data at a given gage site is usually too short to provide a highly reliable estimate of the skew. In order to improve the precision, Bulletin 17B (and the draft Bulletin 17C) recommends weighting the at-site skew with a regional skew. The USGS is working with FEMA and various state and local agencies to update the National flood-frequency skew map provided with Bulletin 17B. Since the first map was published in 1976, over 35 years of additional streamflow information has accumulated, and better spatial estimation procedures have been developed (Stedinger and Griffis, 2008). A new statistical technique, Bayesian Generalized Least Squares (B-GLS) regression, is being used to estimate new regional skewness values. USGS is applying the new methods to update skew estimates on a multi-state, hydrologic basis with the eventual goal of updating skew estimates for the entire Nation. The current status of regional skew updates is available at <https://acwi.gov/hydrology/Frequency/b17c/supplementary-materials/reports.html>.

Contact Andrea Veilleux (aveilleux@usgs.gov) if you have questions related to efforts related to updating the National flood-frequency skew estimates.

Non-Stationarity in Flood Frequency Analyses

Flood frequency estimates are a major consideration in hydrologic design of culverts, bridges, and other infrastructure. In using historically observed peak flows to determine the peak design flow, the standard methods assume that the peak design flow will occur in the future with the same probability and magnitude as determined from the historical analysis. With changes to climate, land cover, snowpack, and agricultural and land drainage practices occurring across the United States and potential future changes, the assumption of stationarity in the observed peak flow record may not be valid.

Potential changes to floods may be the result of a number of factors, some of which operate at the watershed scale (such as changes to land-drainage or urbanization), some of which operate at the regional scale (such as changes to snowpack) and some of which operate at the global scale (such as changes to climate and large-scale weather patterns). USGS is using its extensive database of streamflow information and its site-specific knowledge about individual gages in cooperation with FHWA to advance the state of knowledge in three gap areas:

- **Characterize changes in peak flows:** In this study, we will extend on previous analyses by using data from long-record stream gages, to study observed trends - whatever the cause. We will also extend previous work which has shown that the observed changes depend on the magnitude of the flood event being studied.
- **Diagnose and attribute changes in flood frequency:** This study will attempt to relate the observed flood trends to changes in both climate-based metrics as well as land-cover characteristics such as artificial land drainage and urbanization and other land cover change.
- **Adjusting flood-frequency analysis for observed and projected change:** The study will include an assessment of different methods for incorporating trends into flood frequency analysis.

Contact Julie Kiang (jk Chiang@usgs.gov) for more information.

National Streamflow Statistics

The National Streamflow Statistics (NSS) Program is a Microsoft Windows-based computer program created by the USGS to present high and low streamflow estimation equations for ungaged sites across the United States. Equations and their solutions in NSS provide low-flow duration and frequency estimates in addition to flood-frequency estimates such as the 100-year flood.

The NSS program has an equation database, a graphical user interface (GUI), and an equation calculation routine. The equation calculation routine computes streamflow statistics using basin and climatic characteristics entered by the user. The GUI allows users to control the operation of the software and presents results. It also provides tabling and graphing capabilities that graph frequency and hydrographs. The database contains all the information needed, including the regression equations and standard errors, to solve more than 7,000 regression equations.

Regression equations for estimating flood-frequency statistics of peak flows for rural and naturally flowing rivers are available for all 50 United States as well as the Commonwealth of Puerto Rico and the island of Tutuila, American Samoa. State-specific regression equations for estimating flood-frequency statistics of peak flows for urban streams are available in NSS for 17 U.S. States. In addition, nationwide urban regression equations are available. Regression equations for estimating low-flow duration and (or) frequency are also currently available in NSS for 37 States. All equations contained in NSS were reviewed by USGS and were typically prepared in cooperation with state and local transportation, environmental, and/or water resource management agencies in each state.

Efforts are currently underway to convert the stand-alone program into a web-based service that can be accessed without downloading or installing any files. Contact Todd Koenig at the email address below for more information or if you would like to volunteer to test the new system.

The NSS program and documentation can be downloaded from the Internet at:

<http://water.usgs.gov/software/NSS/>.

If you have questions regarding this information, please contact Todd Koenig (tkoenig@usgs.gov).

StreamStats Program

StreamStats (<https://water.usgs.gov/osw/streamstats/>) is a Geographic Information Systems-based Web application, developed by the U.S. Geological Survey (USGS) Office of Surface Water (OSW), which greatly reduces the time needed for users to obtain streamflow statistics, basin characteristics, and other information for USGS data-collection stations and for ungaged sites. This information is used by engineers, land and water-resource managers, biologists, and many others to help guide decisions in their everyday work. Users can select data-collection station locations shown on a map interface in a Web browser window to obtain previously published information for the stations. Users also can select any location along a stream to obtain the drainage-basin boundary, basin and climatic characteristics, and estimated streamflow statistics for the location. The estimates for ungaged sites are determined from USGS regional-regression equations and usually can be obtained in only a few minutes.

StreamStats version 4 was officially released to the public on December 11, 2017. This new version has a completely new user interface that guides users through the process of delineating basin boundaries and computing basin characteristics and estimated streamflow statistics for user-selected sites. In addition, version 4 restores some of the tools that were lost when version 2 was forced into retirement in July 2015, but several tools that use stream-network navigation are still in development. Outputs for user-selected sites now include a map of the delineated basin, improved formatting of information, and additional options for printing the output and saving it in a variety of formats.

As of December 2017, StreamStats is available to the public for 39 states with full functionality.

Applications also are available for three states and three river basins that allow only basin delineations and computation of basin characteristics. The three river basins are the Connecticut River Basin, which encompasses area in Connecticut, Massachusetts, New Hampshire, and Vermont; the Delaware River

However, lack of field verification of the performance and effectiveness of these countermeasures leaves uncertainty in the reliability of scour countermeasures for protecting foundations, especially for use at new bridges. FHWA, therefore, has teamed with the U.S. Geological Survey (USGS) to conduct a comprehensive, national investigation of scour countermeasures. Through this investigation, FHWA hopes to evaluate and improve its published guidance and technical procedures for the selection, design, construction and maintenance of scour countermeasures and possibly reevaluate its policy of not using scour countermeasures at new bridge piers.

For this project, the USGS has performed various levels of site evaluations at approximately 34 bridges with scour countermeasures across the Nation; USGS and FHWA teams have assessed bridges in Florida, Missouri, Idaho, Iowa, Missouri/Illinois (border bridge), Indiana/Illinois (border bridge), Missouri/Tennessee (border bridge), South Carolina, Iowa, Montana, New Jersey, Pennsylvania, and Connecticut. Some of the techniques used include stream-side investigations and underwater reconnaissance using state-of-the-art survey techniques such as terrestrial LiDAR, multi-beam bathymetry and side-scan sonar. At a small subset of these sites, USGS and FHWA are returning to completed sites and actively pushing the limits of technology to collect additional very-high resolution sonar data that has not been readily available until this time. FHWA has worked with USGS to identify bridge locations and provide technical assistance at all levels; USGS has conducted the evaluations, documented each evaluation in templates, made all data and approved metadata available to FHWA via the web, and summarized data and findings in a series of official USGS reports (2 open-file reports and a final scientific-investigations report). The project is scheduled for completion in December of 2018.

The first report was published in 2017 and the final reports are currently in preparation – the citation for the published report is:

Dudunake, T.J., Huizinga, R.J., and Fosness, R.L., 2017, Bridge scour countermeasure assessments at select bridges in the United States, 2014–16 (ver. 1.1, October 2017): U.S. Geological Survey Open-File Report 2017-1048, 10 p., <https://doi.org/10.3133/ofr20171048>.

As a complement to the USGS site evaluations, the J. Sterling Jones Hydraulics Research Laboratory (HRL) is running hydraulic physical models and computational fluid dynamics (CFD) on several bridge sites. The goal of these lab tests is to test and model at high flows the stability and performance of the as-built countermeasures observed in the field. These results will also be used to evaluate FHWA guidance on scour countermeasure design.

Please contact Peter Cinotto (pcinotto@usgs.gov) to learn more.

Training and technical support for the FHWA-USGS Stochastic Empirical Loading and Dilution Model (SELDM)

The purpose of the project is to help State DOTs and decision makers adopt and use SELDM by providing training and technical support for the model. The USGS, in cooperation with the FHWA, has developed and delivered a 3-day classroom training course, an abbreviated half-day training class, and a series of

webinars. In 2017 the 3-day training course was delivered in Santa Ana California, Sacramento California, and Carson City Nevada. To date, 148 people from across the Nation who work for State DOTs, USEPA, USGS, and other agencies have attended the 3-day classes in person and 32 attended the three-day class remotely by webinar. This project also supported two Water Environment & Reuse Foundation webinars with about 120 participants.

Work in 2018 will include more updates to the highway-runoff database, another SELDM class for State and Federal DOT people, presentation of case studies at conferences, outreach to Universities to share SELDM training materials, and coordination/cooperation with research projects being done by the NCHRP and International BMP database teams.

A graphical post-processor for SELDM output also will be developed as part of this project. The post-processor will extract model results from the SELDM output and generate graphs that can be used to communicate the results of modeling efforts. We will be looking for software beta testers and reviewers for the documentation in the second half of FY 2018.

Publications:

Granato, G.E., and Jones, S.C., 2017, Estimating Total Maximum Daily Loads with the Stochastic Empirical Loading and Dilution Model: Transportation Research Record, Journal of the Transportation Research Board, No. 2638, p. 104-112. <https://doi.org/10.3141/2638-12>

Granato, G.E., and Jones, S.C., 2017, Estimating risks for water-quality exceedances of total-copper from highway and urban runoff under predevelopment and current conditions with the Stochastic Empirical Loading and Dilution Model (SELDM): in Proceedings of the 2017 World Environmental & Water Resources Congress, Sacramento, CA, May 21-25, 2017, Reston, VA, American Society of Civil Engineers, 15 p. <http://ascelibrary.org/doi/abs/10.1061/9780784480601.028>

Granato G.E., Ries, K.G., III, and Steeves, P.A., 2017, Compilation of streamflow statistics calculated from daily mean streamflow data collected during water years 1901–2015 for selected U.S. Geological Survey streamgages: U.S. Geological Survey Open-File Report 2017–1108, 17 p. <https://doi.org/10.3133/ofr20171108>

Granato, G.E., 2017, Streamflow statistics calculated from daily mean streamflow data collected during water years 1901–2015 for selected U.S. Geological Survey streamgages: U.S. Geological Survey data release, accessed October 2017 at <https://doi.org/10.5066/F71V5CFT>.

Web page (with links to the published reports):

<https://doi.org/10.5066/F7TT4P3G>

USGS Surface Velocity Workgroup

Objectives: The purpose of the Surface Velocity Work Group (“Surf Board”) is to assist the USGS Water Mission Area (WMA) in its overall mission to identify and develop new, advanced streamflow and

velocity measurement and monitoring methods, provide guidance and training to most effectively deploy and use them, and to evaluate the trade-offs in the quality of the resulting data. The Surf Board membership includes USGS scientists from each region as well as representation from international partners including Environment and Climate Change Canada; the Centro de Estudios y Tecnología del Agua (CETA) in Córdoba, Argentina; and Électricité de France (EDF).

The objectives of this work group include evaluating and testing the Large Scale Particle Image Velocimetry (LSPIV) and Surface Velocity Radar (SVR) techniques as well as developing training materials and guidance for their proper application. The work should result in less-costly techniques suitable for flood measurement and, potentially, an expanded flood-monitoring network for both operation decision making and long-term flood characterization.

Interested persons should contact Frank Engel (fengel@usgs.gov) to learn more.

Selected References

Le Coz, J., Patalano, A., Collins, D., Guillén, N. F., García, C. M., Smart, G. M., Braud, I. (2016). Crowd-sourced data for flood hydrology: feedback from recent citizen science projects in Argentina, France and New Zealand. *Journal of Hydrology*, In Press. <http://doi.org/10.1016/j.jhydrol.2016.07.036>

Lewis, Q. W., & Rhoads, B. L. (2015). Resolving two-dimensional flow structure in rivers using large-scale particle image velocimetry: An example from a stream confluence. *Water Resources Research*, 51(10), 7977–7994. <http://doi.org/10.1002/2015WR017783>

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Dobson, D. W., Todd Holland, K., & Calantoni, J. (2014). Fast, large-scale, particle image velocimetry-based estimations of river surface velocity. *Computers and Geosciences*, 70, 35–43. <http://doi.org/10.1016/j.cageo.2014.05.007>

Costa, J. E., Cheng, R. T., Haeni, F. P., Melcher, N., Spicer, K. R., Hayes, E., Barrick, D. (2006). Use of radars to monitor stream discharge by noncontact methods. *Water Resources Research*, 42(7), 1–14. <http://doi.org/10.1029/2005WR004430>

Le Boursicaud, R., Pénard, L., Hauet, A., Thollet, F., & Le Coz, J. (2015). Gauging extreme floods on YouTube: application of LSPIV to home movies for the post-event determination of stream discharges. *Hydrological Processes*, 105(July 2015). <http://doi.org/10.1002/hyp.10532>

Recent publications by State

To obtain more detailed information about state-based activities from a USGS Water Science Center, visit <http://water.usgs.gov/> and select a state from the “Water Science Centers” drop-down link.

National

The U.S. Geological Survey Peak-Flow File Data Verification Project, 2008–16 (2017, Scientific Investigations Report 2017-5119)

Karen R. Ryberg, Burl B. Goree, Tara Williams-Sether, Robert R. Mason Jr.

Annual peak streamflow (peak flow) at a streamgage is defined as the maximum instantaneous flow in a water year. A water year begins on October 1 and continues through September 30 of the following year; for example, water year 2015 extends from October 1, 2014, through September 30, 2015. The... (<https://pubs.er.usgs.gov/publication/sir20175119>)

Informing watershed connectivity barrier prioritization decisions: A synthesis (2017, River Research and Applications (33) 847-862)

S. K. McKay, A. R. Cooper, M.W. Diebel, D. Elkins, G. Oldford, C. Roghair, Daniel J. Wieferich

Water resources and transportation infrastructure such as dams and culverts provide countless socio-economic benefits; however, this infrastructure can also disconnect the movement of organisms, sediment, and water through river ecosystems. Trade-offs associated with these competing costs and benefits occur globally, with applications in barrier addition (e.g. dam and road construction),... (<https://pubs.er.usgs.gov/publication/70178638>)

The 3D Elevation Program and America's infrastructure (2016, Fact Sheet 2016-3093)

Vicki Lukas, William J. Carswell, Jr.

Infrastructure—the physical framework of transportation, energy, communications, water supply, and other systems—and construction management—the overall planning, coordination, and control of a project from beginning to end—are critical to the Nation’s prosperity. The American Society of Civil Engineers has warned that, despite the importance of the Nation’s infrastructure, it is in... (<https://pubs.er.usgs.gov/publication/fs20163093>)

U.S. Geological Survey Volcano Hazards Program—Assess, forecast, prepare, engage (2016, Fact Sheet 2016-3040)

Wendy K. Stovall, Aleeza M. Wilkins, Charles W. Mandeville, Carolyn L. Driedger

At least 170 volcanoes in 12 States and 2 territories have erupted in the past 12,000 years and have the potential to erupt again. Consequences of eruptions from U.S. volcanoes can extend far beyond the volcano’s immediate area. Many aspects of our daily life are vulnerable to volcano hazards, including air travel, regional power generation and transmission infrastructure, interstate transportation, port facilities, communications...

(<https://pubs.er.usgs.gov/publication/fs20163040>)

Natural graphite demand and supply - Implications for electric vehicle battery requirements (2016, GSA Special Papers (520) 67-77)

Donald W. Olson, Robert L. Virta, Mahbood Mahdavi, Elizabeth S. Sangine, Steven M. Fortier

Electric vehicles have been promoted to reduce greenhouse gas emissions and lessen U.S. dependence on petroleum for transportation. Growth in U.S. sales of electric vehicles has been hindered by technical difficulties and the high cost of the lithium-ion batteries used to power many electric vehicles (more than 50% of the... (<https://pubs.er.usgs.gov/publication/70146891>))

Post-disaster supply chain interdependent critical infrastructure system restoration: A review of data necessary and available for modeling (2016, Data Science Journal (15))

Varun Ramachandran, Suzanna K. Long, Thomas G. Shoberg, Steven Corns, Hector J. Carlo

The majority of restoration strategies in the wake of large-scale disasters have focused on short-term emergency response solutions. Few consider medium- to long-term restoration strategies to reconnect urban areas to national supply chain interdependent critical infrastructure systems (SCICI). These SCICI promote the effective flow of goods, services, and information vital... (<https://pubs.er.usgs.gov/publication/70161860>)

Use of raw materials in the United States from 1900 through 2014 (2017, Fact Sheet 2017-3062)

Grecia R. Matos

The economic growth of an industrialized nation such as the United States requires raw materials for construction (buildings, bridges, highways, and so forth), defense, and processing and manufacture of goods and services. Since the beginning of the 20th century, the types and quantities of raw materials used have increased and... (<https://pubs.er.usgs.gov/publication/fs20173062>)

Estimating risks for water-quality exceedances of total-copper from highway and urban runoff under predevelopment and current conditions with the Stochastic Empirical Loading and Dilution Model (SELDM) (2017, Conference Paper, World environmental and water resources congress 2017: Watershed management, irrigation and drainage, and water resources planning and management)

Gregory E. Granato, Susan C. Jones

The stochastic empirical loading and dilution model (SELDM) was used to demonstrate methods for estimating risks for water-quality exceedances of event-mean concentrations (EMCs) of total-copper. Monte Carlo methods were used to simulate stormflow, total-hardness, suspended-sediment, and total-copper EMCs as stochastic variables. These simulations were done for the Charles River Basin... (<https://pubs.er.usgs.gov/publication/70190087>)

Alabama

St. Louis area earthquake hazards mapping project; seismic and liquefaction hazard maps (2016, Seismological Research Letters (88) 206-223)

Chris H. Cramer, Robert A. Bauer, Jae-won Chung, David Rogers, Larry Pierce, Vicki Voigt, Brad Mitchell, David Gaunt, Robert Williams, David Hoffman, Gregory L. Hempen, Phyllis Steckel, Oliver Boyd, Connor M. Watkins, Kathleen Tucker, Natasha McCallister

We present probabilistic and deterministic seismic and liquefaction hazard maps for the densely populated St. Louis metropolitan area that account for the expected effects of surficial geology on earthquake ground shaking. Hazard calculations were based on a map grid of 0.005°, or about every 500 m, and are thus higher... (<https://pubs.er.usgs.gov/publication/70189628>)

Alaska

Integrating subsistence practice and species distribution modeling: assessing invasive elodea's potential impact on Native Alaskan subsistence of Chinook salmon and whitefish (2016, Environmental Management (58) 144-163)

Matthew Luizza, Paul Evangelista, Catherine S. Jarnevech, Amanda West, Heather Stewart

Alaska has one of the most rapidly changing climates on earth and is experiencing an accelerated rate of human disturbance, including resource extraction and transportation infrastructure development. Combined, these factors increase the state's vulnerability to biological invasion, which can have acute negative impacts on ecological integrity and subsistence practices. Of... (<https://pubs.er.usgs.gov/publication/70175025>)

Estimating flood magnitude and frequency at gaged and ungaged sites on streams in Alaska and conterminous basins in Canada, based on data through water year 2012 (2016, Scientific Investigations Report 2016-5024)

Janet H. Curran, Nancy A. Barth, Andrea G. Veilleux, Robert T. Ourso

Estimates of the magnitude and frequency of floods are needed across Alaska for engineering design of transportation and water-conveyance structures, flood-insurance studies, flood-plain management, and other water-resource purposes. This report updates methods for estimating flood magnitude and frequency in Alaska and conterminous basins in Canada. Annual peak-flow data through water... (<https://pubs.er.usgs.gov/publication/sir20165024>)

Arkansas

St. Louis area earthquake hazards mapping project; seismic and liquefaction hazard maps (2016, Seismological Research Letters (88) 206-223)

Chris H. Cramer, Robert A. Bauer, Jae-won Chung, David Rogers, Larry Pierce, Vicki Voigt, Brad Mitchell, David Gaunt, Robert Williams, David Hoffman, Gregory L. Hempen, Phyllis Steckel, Oliver Boyd, Connor M. Watkins, Kathleen Tucker, Natasha McCallister

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California

The HayWired earthquake scenario (2017, Scientific Investigations Report 2017-5013)

Shane T. Detweiler, Anne M. Wein, editor(s)

The 1906 Great San Francisco earthquake (magnitude 7.8) and the 1989 Loma Prieta earthquake (magnitude 6.9) each motivated residents of the San Francisco Bay region to build countermeasures to earthquakes into the fabric of the region. Since Loma Prieta, bay-region communities, governments, and utilities have invested tens of billions of...

(<https://pubs.er.usgs.gov/publication/sir20175013>)

Development and utilization of USGS ShakeCast for rapid post-earthquake assessment of critical facilities and infrastructure (2017, Conference Paper, Proceedings of the 16th World Conference on Earthquake Engineering)

David J. Wald, Kuo-wan Lin, C.A. Kircher, Kishor Jaiswal, Nicolas Luco, L. Turner, Daniel Slosky

The ShakeCast system is an openly available, near real-time post-earthquake information management system. ShakeCast is widely used by public and private emergency planners and responders, lifeline utility operators and transportation engineers to automatically receive and process ShakeMap products for situational awareness, inspection priority, or damage assessment of their own infrastructure... (<https://pubs.er.usgs.gov/publication/70189714>)

Application of an extreme winter storm scenario to identify vulnerabilities, mitigation options, and science needs in the Sierra Nevada mountains, USA (2016, Natural Hazards (80) 879-900)

Christine M. Albano, Michael Dettinger, Maureen McCarthy, Kevin D. Schaller, Toby Wellborn, Dale A. Cox

In the Sierra Nevada mountains (USA), and geographically similar areas across the globe where human development is expanding, extreme winter storm and flood risks are expected to increase with changing climate, heightening the need for communities to assess risks and better prepare for such events. In this case study, we...

(<https://pubs.er.usgs.gov/publication/70175033>)

Geologic map of the Providence Mountains in parts of the Fountain Peak and adjacent 7.5' quadrangles, San Bernardino County, California (2017, Scientific Investigations Map 3376)

Paul Stone, David M. Miller, Calvin H. Stevens, Jose J. Rosario, Jorge A. Vazquez, Elmira Wan, Susan S. Priest, Zenon C. Valin

The Providence Mountains are in the eastern Mojave Desert about 60 km southeast of Baker, San Bernardino County, California. This range, which is noted for its prominent cliffs of Paleozoic limestone, is part of a northeast-trending belt of mountainous terrain more than 100 km long that also includes the Granite... (<https://pubs.er.usgs.gov/publication/sim3376>)

Colorado

Paleoflood investigations to improve peak-streamflow regional-regression equations for natural streamflow in eastern Colorado, 2015 (2016, Scientific Investigations Report 2016-5099)

Michael S. Kohn, Michael R. Stevens, Tessa M. Harden, Jeanne E. Godaire, Ralph E. Klinger, Amanullah Mommandi

The U.S. Geological Survey (USGS), in cooperation with the Colorado Department of Transportation, developed regional-regression equations for estimating the 50-, 20-, 10-, 4-, 2-, 1-, 0.5-, 0.2-percent annual exceedance-probability discharge (AEPD) for natural streamflow in eastern Colorado. A total of 188 streamgages, consisting of 6,536 years of record and a... (<https://pubs.er.usgs.gov/publication/sir20165099>)

Connecticut

Transportation and Hydrology Studies of the U.S. Geological Survey in New England (2016, Fact Sheet 2016-3009)

Pamela J. Lombard

The U.S. Geological Survey (USGS) has a long history of working with the Federal Highway Administration (FHWA) and State transportation agencies to provide data and information to address various issues related to water resources and the Nation's transportation infrastructure. These issues include the following: • Streamgaging data networks • Flow... (<https://pubs.er.usgs.gov/publication/fs20163009>)

Florida

Bridge scour countermeasure assessments at select bridges in the United States, 2014–16 (2017, Open-File Report 2017-1048)

Taylor J. Dudunake, Richard J. Huizinga, Ryan L. Fosness

In 2009, the Federal Highway Administration published Hydraulic Engineering Circular No. 23 (HEC-23) to provide specific design and implementation guidelines for bridge scour and stream instability countermeasures. However, the effectiveness of countermeasures implemented over the past decade following those guidelines has not been evaluated. Therefore, in 2013, the U.S.... (<https://pubs.er.usgs.gov/publication/ofr20171048>)

Idaho

Bridge scour countermeasure assessments at select bridges in the United States, 2014–16 (2017, Open-File Report 2017-1048)

Taylor J. Dudunake, Richard J. Huizinga, Ryan L. Fosness

In 2009, the Federal Highway Administration published Hydraulic Engineering Circular No. 23 (HEC-23) to provide specific design and implementation guidelines for bridge scour and stream instability countermeasures. However, the effectiveness of countermeasures implemented over

the past decade following those guidelines has not been evaluated. Therefore, in 2013, the U.S.... (<https://pubs.er.usgs.gov/publication/ofr20171048>)

Estimating peak-flow frequency statistics for selected gaged and ungaged sites in naturally flowing streams and rivers in Idaho (2016, Scientific Investigations Report 2016-5083)

Molly S. Wood, Ryan L. Fosness, Kenneth D. Skinner, Andrea G. Veilleux

The U.S. Geological Survey, in cooperation with the Idaho Transportation Department, updated regional regression equations to estimate peak-flow statistics at ungaged sites on Idaho streams using recent streamflow (flow) data and new statistical techniques. Peak-flow statistics with 80-, 67-, 50-, 43-, 20-, 10-, 4-, 2-, 1-, 0.5-, and 0.2-percent annual...

(<https://pubs.er.usgs.gov/publication/sir20165083>)

Illinois

Adjusting annual maximum peak discharges at selected stations in northeastern Illinois for changes in land-use conditions (2016, Scientific Investigations Report 2016-5049)

Thomas M. Over, Riki J. Saito, David T. Soong

The effects of urbanization on annual maximum peak discharges in northeastern Illinois and nearby areas from 1945 to 2009 were analyzed with a two-step longitudinal-quantile linear regression approach. The peak discharges were then adjusted to 2010 land-use conditions. The explanatory variables used were daily precipitation at the time of the peak discharge event...

(<https://pubs.er.usgs.gov/publication/sir20165049>)

Estimation of peak discharge quantiles for selected annual exceedance probabilities in northeastern Illinois (2016, Scientific Investigations Report 2016-5050)

Thomas M. Over, Riki J. Saito, Andrea G. Veilleux, Jennifer B. Sharpe, David T. Soong, Audrey L. Ishii

This report provides two sets of equations for estimating peak discharge quantiles at annual exceedance probabilities (AEPs) of 0.50, 0.20, 0.10, 0.04, 0.02, 0.01, 0.005, and 0.002 (recurrence intervals of 2, 5, 10, 25, 50, 100, 200, and 500 years, respectively) for watersheds in Illinois based on annual maximum peak discharge data from 117 watersheds in and near...

(<https://pubs.er.usgs.gov/publication/sir20165050>)

Flood-hazard analysis of four headwater streams draining the Argonne National Laboratory property, DuPage County, Illinois (2016, Scientific Investigations Report 2016-5132)

David T. Soong, Elizabeth A. Murphy, Timothy D. Straub, Hannah L. Zeeb

Results of a flood-hazard analysis conducted by the U.S. Geological Survey, in cooperation with the Argonne National Laboratory, for four headwater streams within the Argonne National Laboratory property indicate that the 1-percent and 0.2-percent annual exceedance probability floods would cause multiple roads to be overtopped. Results indicate that most of the effects...

(<https://pubs.er.usgs.gov/publication/sir20165050>)

St. Louis area earthquake hazards mapping project; seismic and liquefaction hazard maps (2016, Seismological Research Letters (88) 206-223)

Chris H. Cramer, Robert A. Bauer, Jae-won Chung, David Rogers, Larry Pierce, Vicki Voigt, Brad Mitchell, David Gaunt, Robert Williams, David Hoffman, Gregory L. Hempen, Phyllis Steckel, Oliver Boyd, Connor M. Watkins, Kathleen Tucker, Natasha McCallister

We present probabilistic and deterministic seismic and liquefaction hazard maps for the densely populated St. Louis metropolitan area that account for the expected effects of surficial geology on earthquake ground shaking. Hazard calculations were based on a map grid of 0.005°, or about every 500 m, and are thus higher... (<https://pubs.er.usgs.gov/publication/70189628>)

Infrastructure system restoration planning using evolutionary algorithms (2016, INCOSE International Symposium (26) 1947-1956)

Steven Corns, Suzanna K. Long, Thomas G. Shoberg

This paper presents an evolutionary algorithm to address restoration issues for supply chain interdependent critical infrastructure. Rapid restoration of infrastructure after a large-scale disaster is necessary to sustaining a nation's economy and security, but such long-term restoration has not been investigated as thoroughly as initial rescue and recovery efforts. A... (<https://pubs.er.usgs.gov/publication/70176482>)

Hydrologic monitoring for Chicago's Sustainable Streetscapes Program (2016, Fact Sheet 2016-3014)

James J. Duncker, William S. Morrow

The Chicago Department of Transportation's Sustainable Streetscapes Program is an innovative program that strives to convert Chicago's neighborhood commercial areas, riverwalks, and bicycle facilities into active, attractive places for Chicagoans to live, work, and play. The objective of each project is to create flourishing public places while improving the ability... (<https://pubs.er.usgs.gov/publication/fs20163014>)

Bridge scour countermeasure assessments at select bridges in the United States, 2014–16 (2017, Open-File Report 2017-1048)

Taylor J. Dudunake, Richard J. Huizinga, Ryan L. Fosness

In 2009, the Federal Highway Administration published Hydraulic Engineering Circular No. 23 (HEC-23) to provide specific design and implementation guidelines for bridge scour and stream instability countermeasures. However, the effectiveness of countermeasures implemented over the past decade following those guidelines has not been evaluated. Therefore, in 2013, the U.S.... (<https://pubs.er.usgs.gov/publication/ofr20171048>)

Indiana

Flood-inundation maps for North Fork Salt Creek at Nashville, Indiana (2017, Scientific Investigations Report 2017-5127)

Zachary W. Martin

Digital flood-inundation maps for a 3.2-mile reach of North Fork Salt Creek at Nashville, Indiana, were created by the U.S. Geological Survey (USGS) in cooperation with the Indiana Department of Transportation. The flood-inundation maps, which can be accessed through the USGS Flood Inundation Mapping Science website at http://water.usgs.gov/osw/flood_inundation/,... (<https://pubs.er.usgs.gov/publication/sir20175127>)

Vulnerable transportation and utility assets near actively migrating streams in Indiana (2017, Data Series 1068)

Benjamin J. Sperl

An investigation was completed by the U.S. Geological Survey in cooperation with the Indiana Office of Community and Rural Affairs that found 1,132 transportation and utility assets in Indiana are vulnerable to fluvial erosion hazards due to close proximity to actively migrating streams. Locations of transportation assets (bridges, roadways, and... (<https://pubs.er.usgs.gov/publication/ds1068>)

Flood-inundation maps for the White River at Noblesville, Indiana (2017, Scientific Investigations Report 2017-5123)

Zachary W. Martin

Digital flood-inundation maps for a 7.5-mile reach of the White River at Noblesville, Indiana, were created by the U.S. Geological Survey (USGS) in cooperation with the Indiana Department of Transportation. The flood-inundation maps, which can be accessed through the USGS Flood Inundation Mapping Science website at https://water.usgs.gov/osw/flood_inundation/, depict... (<https://pubs.er.usgs.gov/publication/sir20175123>)

St. Louis area earthquake hazards mapping project; seismic and liquefaction hazard maps (2016, Seismological Research Letters (88) 206-223)

Chris H. Cramer, Robert A. Bauer, Jae-won Chung, David Rogers, Larry Pierce, Vicki Voigt, Brad Mitchell, David Gaunt, Robert Williams, David Hoffman, Gregory L. Hempen, Phyllis Steckel, Oliver Boyd, Connor M. Watkins, Kathleen Tucker, Natasha McCallister

We present probabilistic and deterministic seismic and liquefaction hazard maps for the densely populated St. Louis metropolitan area that account for the expected effects of surficial geology on earthquake ground shaking. Hazard calculations were based on a map grid of 0.005°, or about every 500 m, and are thus higher... (<https://pubs.er.usgs.gov/publication/70189628>)

Iowa

St. Louis area earthquake hazards mapping project; seismic and liquefaction hazard maps (2016, Seismological Research Letters (88) 206-223)

Chris H. Cramer, Robert A. Bauer, Jae-won Chung, David Rogers, Larry Pierce, Vicki Voigt, Brad Mitchell, David Gaunt, Robert Williams, David Hoffman, Gregory L. Hempen, Phyllis Steckel, Oliver Boyd, Connor M. Watkins, Kathleen Tucker, Natasha McCallister

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Stream-channel and watershed delineations and basin-characteristic measurements using lidar elevation data for small drainage basins within the Des Moines Lobe landform region in Iowa (2017, Scientific Investigations Report 2017-5108)

David A. Eash, Kimberlee K. Barnes, Padraic S. O'Shea, and Brian K. Gelder

This study investigated five different methods to define stream initiation using 3-meter light detection and ranging (lidar) digital elevation models (DEMs) data for 17 streamgages with drainage areas less than 50 square miles within the Des Moines Lobe landform region in north central Iowa. Each DEM was hydrologically enforced and the....(in press)

Kansas

Methods for estimating annual exceedance-probability streamflows for streams in Kansas based on data through water year 2015 (2017, Scientific Investigations Report 2017-5063)

Colin C. Painter, David C. Heimann, Jennifer L. Lanning-Rush

A study was done by the U.S. Geological Survey in cooperation with the Kansas Department of Transportation and the Federal Emergency Management Agency to develop regression models to estimate peak streamflows of annual exceedance probabilities of 50, 20, 10, 4, 2, 1, 0.5, and 0.2 percent at ungaged locations in... (<https://pubs.er.usgs.gov/publication/sir20175063>)

Kentucky

St. Louis area earthquake hazards mapping project; seismic and liquefaction hazard maps (2016, Seismological Research Letters (88) 206-223)

Chris H. Cramer, Robert A. Bauer, Jae-won Chung, David Rogers, Larry Pierce, Vicki Voigt, Brad Mitchell, David Gaunt, Robert Williams, David Hoffman, Gregory L. Hempen, Phyllis Steckel, Oliver Boyd, Connor M. Watkins, Kathleen Tucker, Natasha McCallister

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Maine

Transportation and Hydrology Studies of the U.S. Geological Survey in New England (2016, Fact Sheet 2016-3009)

Pamela J. Lombard

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(<https://pubs.er.usgs.gov/publication/fs20163009>)

Massachusetts

Loads and yields of deicing compounds and total phosphorus in the Cambridge drinking-water source area, Massachusetts, water years 2009–15 (2017, Scientific Investigations Report 2017-5047)

Kirk P. Smith

The source water area for the drinking-water supply of the city of Cambridge, Massachusetts, encompasses major transportation corridors, as well as large areas of light industrial, commercial, and residential land use. Because of the large amount of roadway in the drinking-water source area, the Cambridge water supply is affected by...

(<https://pubs.er.usgs.gov/publication/sir20175047>)

Estimating total maximum daily loads with the Stochastic Empirical Loading and Dilution Model (2017, Transportation Research Record (2638) 104-112)

Gregory Granato, Susan Cheung Jones

The Massachusetts Department of Transportation (DOT) and the Rhode Island DOT are assessing and addressing roadway contributions to total maximum daily loads (TMDLs). Example analyses for total nitrogen, total phosphorus, suspended sediment, and total zinc in highway runoff were done by the U.S. Geological Survey in cooperation with FHWA to...

(<https://pubs.er.usgs.gov/publication/70192097>)

Magnitude of flood flows for selected annual exceedance probabilities for streams in Massachusetts (2017, Scientific Investigations Report 2016-5156)

Phillip J. Zarriello

The U.S. Geological Survey, in cooperation with the Massachusetts Department of Transportation, determined the magnitude of flood flows at selected annual exceedance probabilities (AEPs) at streamgages in Massachusetts and from these data developed equations for estimating flood flows at ungaged locations in the State. Flood magnitudes were determined for the... (<https://pubs.er.usgs.gov/publication/sir20165156>)

Transportation and Hydrology Studies of the U.S. Geological Survey in New England (2016, Fact Sheet 2016-3009)

Pamela J. Lombard

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(<https://pubs.er.usgs.gov/publication/fs20163009>)

Mississippi

St. Louis area earthquake hazards mapping project; seismic and liquefaction hazard maps (2016, Seismological Research Letters (88) 206-223)

Chris H. Cramer, Robert A. Bauer, Jae-won Chung, David Rogers, Larry Pierce, Vicki Voigt, Brad Mitchell, David Gaunt, Robert Williams, David Hoffman, Gregory L. Hempen, Phyllis Steckel, Oliver Boyd, Connor M. Watkins, Kathleen Tucker, Natasha McCallister

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Missouri

Flood-inundation maps for the Meramec River at Valley Park and at Fenton, Missouri, 2017 (2017, Scientific Investigations Report 2017-5116)

Benjamin J. Dietsch, Jacob N. Sappington

Two sets of digital flood-inundation map libraries that spanned a combined 16.7-mile reach of the Meramec River that extends upstream from Valley Park, Missouri, to downstream from Fenton, Mo., were created by the U.S. Geological Survey (USGS) in cooperation with the U.S. Army Corps of Engineers, St. Louis Metropolitan Sewer District, Missouri... (<https://pubs.er.usgs.gov/publication/sir20175116>)

Bathymetric and velocimetric surveys at highway bridges crossing the Missouri and Mississippi Rivers near St. Louis, Missouri, May 23–27, 2016 (2017, Scientific Investigations Report 2017-5076)

Richard J. Huizinga

Bathymetric and velocimetric data were collected by the U.S. Geological Survey, in cooperation with the Missouri Department of Transportation, near 13 bridges at 8 highway crossings of the Missouri and Mississippi Rivers in the greater St. Louis, Missouri, area from May 23 to 27, 2016. A multibeam echosounder mapping system... (<https://pubs.er.usgs.gov/publication/sir20175076>)

Methods for estimating annual exceedance-probability streamflows for streams in Kansas based on data through water year 2015 (2017, Scientific Investigations Report 2017-5063)

Colin C. Painter, David C. Heimann, Jennifer L. Lanning-Rush

A study was done by the U.S. Geological Survey in cooperation with the Kansas Department of Transportation and the Federal Emergency Management Agency to develop regression models to estimate peak streamflows of annual exceedance probabilities of 50, 20, 10, 4, 2, 1, 0.5, and 0.2 percent at ungaged locations in... (<https://pubs.er.usgs.gov/publication/sir20175063>)

St. Louis area earthquake hazards mapping project; seismic and liquefaction hazard maps (2016, Seismological Research Letters (88) 206-223)

Chris H. Cramer, Robert A. Bauer, Jae-won Chung, David Rogers, Larry Pierce, Vicki Voigt, Brad Mitchell, David Gaunt, Robert Williams, David Hoffman, Gregory L. Hempen, Phyllis Steckel, Oliver Boyd, Connor M. Watkins, Kathleen Tucker, Natasha McCallister

We present probabilistic and deterministic seismic and liquefaction hazard maps for the densely populated St. Louis metropolitan area that account for the expected effects of surficial geology on earthquake ground shaking. Hazard calculations were based on a map grid of 0.005°, or about every 500 m, and are thus higher... (<https://pubs.er.usgs.gov/publication/70189628>)

Infrastructure system restoration planning using evolutionary algorithms (2016, INCOSE International Symposium (26) 1947-1956)

Steven Corns, Suzanna K. Long, Thomas G. Shoberg

This paper presents an evolutionary algorithm to address restoration issues for supply chain interdependent critical infrastructure. Rapid restoration of infrastructure after a large-scale disaster is necessary to sustaining a nation's economy and security, but such long-term restoration has not been investigated as thoroughly as initial rescue and recovery efforts. A... (<https://pubs.er.usgs.gov/publication/70176482>)

Bathymetric and velocimetric surveys at highway bridges crossing the Missouri River near Kansas City, Missouri, June 2–4, 2015 (2016, Scientific Investigations Report 2016-5061)

Richard J. Huizinga

Bathymetric and velocimetric data were collected by the U.S. Geological Survey, in cooperation with the Missouri Department of Transportation, near 8 bridges at 7 highway crossings of the Missouri River in Kansas City, Missouri, from June 2 to 4, 2015. A multibeam echosounder mapping system was used to obtain channel-bed... (<https://pubs.er.usgs.gov/publication/sir20165061>)

Bridge scour countermeasure assessments at select bridges in the United States, 2014–16 (2017, Open-File Report 2017-1048)

Taylor J. Dudunake, Richard J. Huizinga, Ryan L. Fosness

In 2009, the Federal Highway Administration published Hydraulic Engineering Circular No. 23 (HEC-23) to provide specific design and implementation guidelines for bridge scour and stream instability countermeasures. However, the effectiveness of countermeasures implemented over the past decade following those guidelines has not been evaluated. Therefore, in 2013, the U.S.... (<https://pubs.er.usgs.gov/publication/ofr20171048>)

Montana

Case study: 2016 Natural glide and wet slab avalanche cycle, Going-to-the-Sun Road, Glacier National Park, Montana, USA (2016, Conference Paper, Proceedings of the International Snow Science Workshop)

Jacob Hutchinson, Erich H. Peitzsch, Adam Clark

The Going-to-the-Sun Road (GTSR) is the premier tourist attraction in Glacier National Park, Montana. The GTSR also traverses through and under 40 avalanche paths which pose a

hazard to National Park Service (NPS) road crews during the annual spring snow plowing operation. Through a joint collaboration between the NPS and the U.S. Geological... (<https://pubs.er.usgs.gov/publication/70179123>)

Peak-flow frequency analyses and results based on data through water year 2011 for selected streamflow-gaging stations in or near Montana: Chapter C in Montana StreamStats (2016, Scientific Investigations Report 2015-5019-C)

Steven K. Sando, Peter M. McCarthy, DeAnn M. Dutton

Chapter C of this Scientific Investigations Report documents results from a study by the U.S. Geological Survey, in cooperation with the Montana Department of Transportation and the Montana Department of Natural Resources, to provide an update of statewide peak-flow frequency analyses and results for Montana. The purpose of this report... (<https://pubs.er.usgs.gov/publication/sir20155019C>)

Montana StreamStats—A method for retrieving basin and streamflow characteristics in Montana: Chapter A in Montana StreamStats (2016, Scientific Investigations Report 2015-5019-A)

Peter M. McCarthy, DeAnn M. Dutton, Steven K. Sando, Roy Sando

The U.S. Geological Survey (USGS) provides streamflow characteristics and other related information needed by water-resource managers to protect people and property from floods, plan and manage water-resource activities, and protect water quality. Streamflow characteristics provided by the USGS, such as peak-flow and low-flow frequencies for streamflow-gaging stations, are frequently used... (<https://pubs.er.usgs.gov/publication/sir20155019A>)

Temporal trends and stationarity in annual peak flow and peak-flow timing for selected long-term streamflow-gaging stations in or near Montana through water year 2011: Chapter B in Montana StreamStats (2016, Scientific Investigations Report 2015-5019-B)

Steven K. Sando, Peter M. McCarthy, Roy Sando, DeAnn M. Dutton

A large-scale study by the U.S. Geological Survey, in cooperation with the Montana Department of Transportation and the Montana Department of Natural Resources and Conservation, was done to investigate general patterns in peak-flow temporal trends and stationarity through water year 2011 for 24 long-term streamflow-gaging stations (hereinafter referred to as... (<https://pubs.er.usgs.gov/publication/sir20155019B>)

Bridge scour countermeasure assessments at select bridges in the United States, 2014–16 (2017, Open-File Report 2017-1048)

Taylor J. Dudunake, Richard J. Huizinga, Ryan L. Fosness

In 2009, the Federal Highway Administration published Hydraulic Engineering Circular No. 23 (HEC-23) to provide specific design and implementation guidelines for bridge scour and stream instability countermeasures. However, the effectiveness of countermeasures implemented over the past decade following those guidelines has not been evaluated. Therefore, in 2013, the U.S.... (<https://pubs.er.usgs.gov/publication/ofr20171048>)

Using structure from motion photogrammetry to examine glide snow avalanches (2016, Conference Paper, Proceedings of the International Snow Science Workshop)

Erich H. Peitzsch, Jordy Hendrikx, Daniel B. Fagre

Structure from Motion (SfM), a photogrammetric technique, has been used extensively and successfully in many fields including geosciences over the past few years to create 3D models and high resolution digital elevation models (DEMs) from aerial or oblique photographs. SfM has recently been used in a limited capacity in snow avalanche research and...

(<https://pubs.er.usgs.gov/publication/70179121>)

Nebraska

Methods for estimating annual exceedance-probability streamflows for streams in Kansas based on data through water year 2015 (2017, Scientific Investigations Report 2017-5063)

Colin C. Painter, David C. Heimann, Jennifer L. Lanning-Rush

A study was done by the U.S. Geological Survey in cooperation with the Kansas Department of Transportation and the Federal Emergency Management Agency to develop regression models to estimate peak streamflows of annual exceedance probabilities of 50, 20, 10, 4, 2, 1, 0.5, and 0.2 percent at ungaged locations in... (<https://pubs.er.usgs.gov/publication/sir20175063>)

Nevada

Application of an extreme winter storm scenario to identify vulnerabilities, mitigation options, and science needs in the Sierra Nevada mountains, USA (2016, Natural Hazards (80) 879-900)

Christine M. Albano, Michael Dettinger, Maureen McCarthy, Kevin D. Schaller, Toby Wellborn, Dale A. Cox

In the Sierra Nevada mountains (USA), and geographically similar areas across the globe where human development is expanding, extreme winter storm and flood risks are expected to increase with changing climate, heightening the need for communities to assess risks and better prepare for such events. In this case study, we...

(<https://pubs.er.usgs.gov/publication/70175033>)

New Hampshire

Transportation and Hydrology Studies of the U.S. Geological Survey in New England (2016, Fact Sheet 2016-3009)

Pamela J. Lombard

The U.S. Geological Survey (USGS) has a long history of working with the Federal Highway Administration (FHWA) and State transportation agencies to provide data and information to address various issues related to water resources and the Nation's transportation infrastructure. These issues include the following: • Streamgaging data networks • Flow...

(<https://pubs.er.usgs.gov/publication/fs20163009>)

North Carolina

Characterization of water-quality and bed-sediment conditions in Currituck Sound, North Carolina, prior to the Mid-Currituck Bridge construction, 2011–15 (2016, Open-File Report 2015-1208)

Chad R. Wagner, Sharon Fitzgerald, Dominick J. Antolino

The North Carolina Turnpike Authority, a division of the North Carolina Department of Transportation, is planning to make transportation improvements in the Currituck Sound area by constructing a two-lane bridge from U.S. Highway 158 just south of Coinjock, North Carolina, to State Highway 12 on the Outer Banks just south...

(<https://pubs.er.usgs.gov/publication/ofr20151208>)

Oklahoma

Methods for estimating annual exceedance-probability streamflows for streams in Kansas based on data through water year 2015 (2017, Scientific Investigations Report 2017-5063)

Colin C. Painter, David C. Heimann, Jennifer L. Lanning-Rush

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Oregon

Field-trip guide to mafic volcanism of the Cascade Range in Central Oregon—A volcanic, tectonic, hydrologic, and geomorphic journey (2017, Scientific Investigations Report 2017-5022-H)

Natalia I. Deligne, Daniele McKay, Richard M. Conrey, Gordon E. Grant, Emily R. Johnson, Jim O'Connor, Kristin Sweeney

The Cascade Range in central Oregon has been shaped by tectonics, volcanism, and hydrology, as well as geomorphic forces that include glaciations. As a result of the rich interplay between these forces, mafic volcanism here can have surprising manifestations, which include relatively large tephra footprints and extensive lava flows, as...

(<https://pubs.er.usgs.gov/publication/sir20175022H>)

Flood-inundation maps for a 9.1-mile reach of the Coast Fork Willamette River near Creswell and Goshen, Lane County, Oregon (2016, Scientific Investigations Report 2016-5029)

Glen W. Hess, Tana L. Haluska

Digital flood-inundation maps for a 9.1-mile reach of the Coast Fork Willamette River near Creswell and Goshen, Oregon, were developed by the U.S. Geological Survey (USGS) in cooperation with the U.S. Army Corps of Engineers (USACE). The inundation maps, which can

be accessed through the USGS Flood Inundation Mapping Science...
(<https://pubs.er.usgs.gov/publication/sir20165029>)

Pennsylvania

Transport of hydraulic fracturing waste from Pennsylvania wells: A county-level analysis of road use and associated road repair costs (2016, Journal of Environmental Management (181) 353-362)

Lauren A. Patterson, Kelly O. Maloney

Pennsylvania's rapid unconventional oil and gas (UOG) development—from a single well in 2004 to more than 6700 wells in 2013—has dramatically increased UOG waste transport by heavy trucks. This study quantified the amount of UOG waste and the distance it traveled between wells and disposal facilities on each type of...
(<https://pubs.er.usgs.gov/publication/70178813>)

Water quality and quantity and simulated surface-water and groundwater flow in the Laurel Hill Creek Basin, southwestern Pennsylvania, 1991–2007 (2017, Scientific Investigations Report 2016-5082)

Daniel G. Galeone, Dennis W. Risser, Lee W. Eicholtz, Scott A. Hoffman

Laurel Hill Creek is considered one of the most pristine waterways in southwestern Pennsylvania and has high recreational value as a high-quality cold-water fishery; however, the upper parts of the basin have documented water-quality impairments. Groundwater and surface water are withdrawn for public water supply and the basin has been...
(<https://pubs.er.usgs.gov/publication/sir20165082>)

Rhode Island

Estimating total maximum daily loads with the Stochastic Empirical Loading and Dilution Model (2017, Transportation Research Record (2638) 104-112)

Gregory Granato, Susan Cheung Jones

The Massachusetts Department of Transportation (DOT) and the Rhode Island DOT are assessing and addressing roadway contributions to total maximum daily loads (TMDLs). Example analyses for total nitrogen, total phosphorus, suspended sediment, and total zinc in highway runoff were done by the U.S. Geological Survey in cooperation with FHWA to...
(<https://pubs.er.usgs.gov/publication/70192097>)

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These issues include the following: • Streamgaging data networks • Flow...
(<https://pubs.er.usgs.gov/publication/fs20163009>)

South Carolina

The South Carolina bridge-scour envelope curves (2016, Scientific Investigations Report 2016-5121)

Stephen T. Benedict, Toby D. Feaster, Andral W. Caldwell

The U.S. Geological Survey, in cooperation with the South Carolina Department of Transportation, conducted a series of three field investigations to evaluate historical, riverine bridge scour in the Piedmont and Coastal Plain regions of South Carolina. These investigations included data collected at 231 riverine bridges, which lead to the development...
(<https://pubs.er.usgs.gov/publication/sir20165121>)

Assessing potential scour using the South Carolina bridge-scour envelope curves (2016, Fact Sheet 2016-3065)

Stephen T. Benedict, Toby D. Feaster, Andral W. Caldwell

Bridge-scour equations presented in the Federal Highway Administration Hydraulic Engineering Circular No. 18 reflect the current state-of-the practice for predicting scour at bridges. Although these laboratory-derived equations provide an important resource for assessing scour potential, there is a measure of uncertainty when applying these equations to field conditions. The uncertainty... (<https://pubs.er.usgs.gov/publication/fs20163065>)

Flood-Inundation Maps of Selected Areas Affected by the Flood of October 2015 in Central and Coastal South Carolina (2016, Open-File Report 2016-1019)

Jonathan W. Musser, Kara M. Watson, Jaime A. Painter, Anthony J. Gotvald

Heavy rainfall occurred across South Carolina during October 1–5, 2015, as a result of an upper atmospheric low-pressure system that funneled tropical moisture from Hurricane Joaquin into the State. The storm caused major flooding in the central and coastal parts of South Carolina. Almost 27 inches of rain fell near... (<https://pubs.er.usgs.gov/publication/ofr20161019>)

Upper bound of abutment scour in laboratory and field data (2016, Transportation Research Record (2588) 154-162)

Stephen Benedict

The U.S. Geological Survey, in cooperation with the South Carolina Department of Transportation, conducted a field investigation of abutment scour in South Carolina and used those data to develop envelope curves that define the upper bound of abutment scour. To expand on this previous work, an additional cooperative investigation was...
(<https://pubs.er.usgs.gov/publication/70193061>)

Upper bound of pier scour in laboratory and field data (2016, Transportation Research Record (2588) 145-153)

Stephen Benedict, Andral W. Caldwell

The U.S. Geological Survey (USGS), in cooperation with the South Carolina Department of Transportation, conducted several field investigations of pier scour in South Carolina and used the data to develop envelope curves defining the upper bound of pier scour. To expand on this previous work, an additional cooperative investigation was...

(<https://pubs.er.usgs.gov/publication/70193060>)

Tennessee

St. Louis area earthquake hazards mapping project; seismic and liquefaction hazard maps (2016, Seismological Research Letters (88) 206-223)

Chris H. Cramer, Robert A. Bauer, Jae-won Chung, David Rogers, Larry Pierce, Vicki Voigt, Brad Mitchell, David Gaunt, Robert Williams, David Hoffman, Gregory L. Hempen, Phyllis Steckel, Oliver Boyd, Connor M. Watkins, Kathleen Tucker, Natasha McCallister

We present probabilistic and deterministic seismic and liquefaction hazard maps for the densely populated St. Louis metropolitan area that account for the expected effects of surficial geology on earthquake ground shaking. Hazard calculations were based on a map grid of 0.005°, or about every 500 m, and are thus higher... (<https://pubs.er.usgs.gov/publication/70189628>)

Vermont

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(<https://pubs.er.usgs.gov/publication/fs20163009>)

Washington

Geologic map of the Beacon Rock quadrangle, Skamania County, Washington (2017, Scientific Investigations Map 3367)

Russell C. Evarts, Robert J. Fleck

The Beacon Rock 7.5' quadrangle is located approximately 50 km east of Portland, Oregon, on the north side of the Columbia River Gorge, a scenic canyon carved through the axis of the Cascade Range by the Columbia River. Although approximately 75,000 people live within the gorge, much of the region... (<https://pubs.er.usgs.gov/publication/sim3367>)

Precipitation thresholds for landslide occurrence near Seattle, Mukilteo, and Everett, Washington (2017, Open-File Report 2017-1039)

Caroline R. Scheevel, Rex L. Baum, Benjamin B. Mirus, Joel B. Smith

Shallow landslides along coastal bluffs frequently occur in the railway corridor between Seattle and Everett, Washington. These slides disrupt passenger rail service, both because of required track maintenance and because the railroad owner, Burlington Northern Santa Fe Railway, does not allow passenger travel for 48 hours after a disruptive landslide....

(<https://pubs.er.usgs.gov/publication/ofr20171039>)

Landslides in the western Columbia Gorge, Skamania County, Washington (2016, Scientific Investigations Map 3358)

Thomas C. Pierson, Russell C. Everts, Joseph A. Bard

Recent light detection and ranging (lidar) imagery has allowed us to identify and map a large number of previously unrecognized landslides, or slides, in heavily forested terrain in the western Columbia Gorge, Skamania County, Washington, and it has revealed that the few previously recognized areas of instability are actually...

(<https://pubs.er.usgs.gov/publication/sim3358>)

Water temperature profiles for reaches of the Raging River during summer baseflow, King County, western Washington, July 2015 (2016, Data Series 983)

Andrew S. Gendaszek, Chad C. Opatz

Re-introducing wood into rivers where it was historically removed is one approach to improving habitat conditions in rivers of the Pacific Northwest. The Raging River drainage basin, which flows into the Snoqualmie River at Fall City, western Washington, was largely logged during the 20th century and wood was removed... (<https://pubs.er.usgs.gov/publication/ds983>)

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Russell C. Everts, Robert J. Fleck

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West Virginia

Assessment of hydrogeologic terrains, well-construction characteristics, groundwater hydraulics, and water-quality and microbial data for determination of surface-water-influenced groundwater supplies in West Virginia (2016, Scientific Investigations Report 2016-5048)

Mark D. Kozar, Katherine S. Paybins

In January 2014, a storage tank leaked, spilling a large quantity of 4-methylcyclohexane methanol into the Elk River in West Virginia and contaminating the water supply for more than 300,000 people. In response, the West Virginia Legislature passed Senate Bill 373, which requires the West Virginia Department of Health and...

(<https://pubs.er.usgs.gov/publication/sir20165048>)