

# **A Partial Summary of 2010 USGS Activities Related to the FHWA and State Highway Agencies**

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## ***Introduction***

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 jointly 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.

The following table and text provides 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 detailed 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](mailto:rrmason@usgs.gov)).

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

<b>Project Type</b>	<b>Sponsoring Agencies/States</b>
<b>Regional Flow Frequency/Statistics Investigations</b>	
- National Flood Frequency Program	USGS
- StreamStats Program/automated basin characteristics	CA, CT, CO, HI, IL, ID, IN, KS, MA, MD, MN, MS, MT, NC, ND, NH, NJ, NM, NY, OH, OK, PA, SD, TN, VT, WI
- Investigation of rural flow-frequency	AL, CA, FL, GA, HI, IA, KS, MO, MA, MT, MS, NC, NH, NM, NY, OK, PA, SC, SD, TN, VA, WI, WV, FEMA
- Investigation of urban flow-frequency	AL, KS
- Investigation of small watershed flow-frequency	IA, KS, ME, MT, TX, VA
- Investigation of hydrograph timing, rainfall hyetographs, and rainfall-duration-frequency maps	TX
<b>Bridge Scour and Sediment Transport</b>	
- National Bridge Scour Project	
- Scour at Contracted Bridge Sites	NCHRP
- Near real time scour monitoring	AK, GA, MO, MT, NJ
- Data collection and analysis	AK, AL, ME, MO, MS, MT, NJ, SC, SD, FHWA
- Investigation of Scour in cohesive soils using the EFA	IL, SC
- Channel stability and scour assessment	AK, MO, MT, NJ, NE, SD
- Investigation/modeling of sediment transport	MT, TN, TX
- Investigation of bio-engineered bank protection and A-jacks scour countermeasures	
<b>Hydrologic and Hydraulic River Investigations</b>	
- Investigation of bridge site hydrology and hydraulics	AL, GA, MN, MO, MT, MS,
- Investigation and modeling of multi-dimensional flows	AK, ND, PA
- Flood documentation	IA, ID, NM, NV, NY, PA, TN
<b>Stream Characteristic Investigations</b>	
- Regional channel characteristics/bankfull discharge	PA, WV
- Investigation of Manning's roughness coefficients	
<b>Gages</b>	
- Tidal gages	
- Crest stage gages to estimate annual peak flows	AK, GA, HI, IA, KS, LA, ME, MI, MN, MS, MO, MT, NV, NJ, NM, NY, OH, PA, SC, SD, TN, VT, VA, WI, WV
- Continuous-record discharge and stage gages	AK, FL, HI, IN, IA, IN, LA, ME, MD, MI, MN, MS, MO, MT, NH, NJ, PA, SC, TN, VT, WV
<b>Water Quality/Environmental Investigations</b>	
- Evaluation of Stormwater Runoff Models	FHWA, MA
- Monitor water quality/quantity at selected sites	HI, MA, ME, MN, MT, NC, NV, SC, TN, VT, WI
- Investigation of wetland impact/remediation	MT
- Investigation of stream restoration	CO, MT, PA
- Investigation of the impact of deicing chemicals	VT
- Investigation of habit impact by bridge pier	
- Investigation of BMP	SC, WI
- Investigation of potential impacts of highway construction to the GW aquifer	AR

## ***Partial Summary of USGS National Activities***

### ***USGS WaterAlert***

The USGS has developed a new water-threshold exceedance notification program. The system sends email or text messages when water or water-quality conditions meet user-specified criteria. Criteria can include greater-than, less-than, within, out-of-range thresholds. Reporting frequencies can include once-per-event, once-a-day, or once-per-hour messaging while the condition lasts. The system can be accessed at <http://water.usgs.gov/wateralert/>.

### ***National Streamflow Information Program (NSIP)***

NSIP—This USGS program is an umbrella over all streamflow information activities of the USGS. The program has five major goals - (1) a stable streamgauge network to provide federally needed streamflow information, (2) to provide better understanding of floods and droughts, (3) to perform periodic regional and national assessments of streamflow information, (4) to enhance the delivery of streamflow information and products, and (5) to develop and evaluate new technologies and methods for obtaining streamflow information.

NSIP received a \$5M increase for 2009, which put the program at about 20% of full planned funding. (Congress has not finalized the 2010 budget as of January 2011). The 2009 increase was used to help stabilize the streamgauge network, speed implementation of WaterSmart, a new initiative to develop information about water availability and use.

The NSIP program description and list of proposed NSIP streamgages are on-line at <http://water.usgs.gov/nsip/>. A general information product on the mission and goals of NSIP is on-line at <http://pubs.usgs.gov/gip/70/>. It also includes internet links to streamflow data and information.

### ***The National Water-Quality Monitoring Network***

Another network effort is now taking form in response to recommendations of the Presidents Commission on Ocean Policy and the President's Ocean Action Plan. This is a coordinated effort led by the National Ocean and Atmospheric Administration (NOAA), the Environmental Protection Agency (EPA), and the USGS working through the National Water Quality Monitoring Council (NWQMC) to develop an integrated system of long-term streamgages, water-quality and ecological monitoring sites with standardized monitoring techniques, parameters, and data-dissemination portals. The network will link elements of Federal, State, and local monitoring networks to reduce duplication and strengthen coverage. The network design will focus on water and ecological issues affecting coastal waters and ocean environments. The NWQMC report describing the network is available at <http://acwi.gov/monitoring/network/index.html>.

### ***Flood-Frequency Analysis Using Bulletin 17B Guidelines***

Flood-frequency analysis provides information about the magnitude and frequency of selected flood discharges. Bulletin 17B of the Hydrology Subcommittee of the Interagency Advisory Committee on Water Data (1982) defines procedures recommended to provide a consistent approach for determining flood-flow frequency from peak-flow records. The procedures include methods for improving skew estimates using regional skew information, tests for high and low outliers, adjustments for low outliers and zero flows, and methods for incorporating historic peak-flow information. In 2011, the Advisory Committee on Water Information, Subcommittee on Hydrology, Hydrologic Frequency Analysis Workgroup will consider a number of changes to the Bulletin 17B including the Expected Moments Algorithm (EMA) and a new multiple low outlier test based on a generalization of the Grubbs-Beck test. EMA is a highly efficient approach for capturing the information contained in historical flood data and other censored (incomplete) datasets.

The Peak flow FreQuency analysis program (PeakFQ) implements the Bulletin 17B recommended procedures for flood-frequency analysis of streamflow records. The program has been updated and now provides an interactive Windows interface to PeakFQ. Also the program can be run from a batch-style processing on DOS, UNIX and Linux operating systems. PeakFQ has been modified to include the EMA and the new multiple low outlier test.

## **National Streamflow Statistics**

The National Streamflow Statistics (NSS) Program is a Microsoft Windows-based computer program<sup>1</sup> written in Visual Basic programming language that has been created by the USGS to provide an easily accessible graphical user interface (GUI) to estimate high and low streamflow statistics for ungaged sites across the United States. NSS is a replacement for the National Flood Frequency (NFF) Program. The name change from NFF to NSS is the direct result of enhancements to the program, which now provides estimates for low-flow duration/frequency in addition to flood-frequency estimates such as the 100-year flood.

The NSS program has four components—a GUI, an equation calculation routine, a database, and a help feature. The GUI allows users to control the operation of the software and present results. The equation calculation routine computes streamflow statistics using basin and climatic characteristics entered by the user and provides tabling and graphing capabilities that graph frequency and hydrographs. The database contains all the information needed, such as the regression coefficients and standard errors, to solve more than 5,500 regression equations. The help facility contains the NSS Program User's manual, a link to the NSS program Web page, and version information.

Regression equations for estimating flood-frequency statistics of peak flows for rural and naturally flowing rivers are available for all 50 U.S. States including the Commonwealth of Puerto Rico and the island of Tutuila, American Samoa. Regression equations for estimating flood-frequency statistics of peak flows for urban streams are available in NSS for 20 U.S. States. Regression equations for estimating low-flow duration and (or) frequency are also currently available in NSS for 23 U.S. States. All equations contained in NSS were reviewed by USGS and were generally prepared in cooperation with state and local transportation, environmental, and/or water resource management agencies in each state.

The NSS program and documentation can be downloaded from the Internet at <http://water.usgs.gov/software/nss.html>. A fact sheet that describes the NSS program was published in 2007 and can be downloaded at <http://pubs.usgs.gov/fs/2007/3010/>. If you should have questions regarding this information, please contact Todd Koenig ([tkoing@usgs.gov](mailto:tkoing@usgs.gov)).

## **StreamStats Program**

StreamStats (<http://streamstats.usgs.gov>) 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 needed for use 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 that location. The estimates for ungaged sites are determined from USGS regional-regression equations and usually can be obtained in only a few minutes.

As of October 2010, StreamStats was available to the public for 23 states - Hawaii, Washington, Oregon, Idaho, Utah, Colorado, Oklahoma, Minnesota, Tennessee, North Carolina (partial), Kentucky, Indiana, Illinois, Ohio, Pennsylvania, Maryland (partial), Delaware, New Jersey, New York, Connecticut, Massachusetts, New Hampshire, and Vermont. The application also was undergoing quality assurance in preparation for public release in California and New Mexico (partial). In addition, all states except Tennessee were converted to StreamStats Version 2 during the fiscal year. This new version adds the abilities to (1) navigate the stream network to locate upstream or downstream streamgaging stations, dams, point discharges and other water-related features and get information about those features, (2) estimate flows at ungaged sites based on the flows at nearby streamgaging stations, (3) change the basin characteristics for an ungaged site and obtain new estimates of flow statistics that reflect the changed basin characteristics, (4) obtain graphs of land-surface and stream-channel elevation profiles, (5) trace the path of a drop of water or a hazardous-waste spill from a point on the land surface to where it reaches a stream, and then downstream through the stream network, and (6) access StreamStats functionality from other Web or desktop GIS applications remotely by use of Web services. This functionality has been fully implemented only for Massachusetts, New York, New Jersey, Pennsylvania, and Maryland. In addition, functionality was

added to Maryland StreamStats to allow it to summarize water use activities within the drainage basins for user-selected sites.

Plans for fiscal year 2011 include implementing five states - Alabama, Arkansas, Rhode Island, Mississippi, and North Dakota. In addition, network-navigation capabilities are planned to be added to all states, and updates to regression equations and/or supporting GIS datasets will be made to the applications for Oregon, Tennessee, Maryland, and North Carolina.

### ***Evaluation and Update of the Federal Highway Administration (FHWA) Pollutant Loadings Model for Highway Stormwater Runoff***

The purpose of the project is to develop and implement a new version of the FHWA water quality model. The U.S. Geological Survey (USGS) in cooperation with the FHWA has developed a new model the Stochastic Empirical, Loading and Dilution Model (SELDM). SELDM is a water-quality model that uses available data and stochastic Monte Carlo methods to generate planning-level estimates of event mean concentrations (EMCs), discharges, and loads from the highway and in the receiving waters upstream of the highway-runoff outfall. These values are then used to calculate the EMCs, discharges, and loads downstream of the highway-runoff outfall using mass balance methods.

These estimates can be used to evaluate highway-runoff discharges as a potential source of water-quality constituents, the potential effects of runoff loads on receiving-water quality, and the potential effectiveness of Best Management Practices (BMPs) for reducing the effects of highway runoff on receiving waters. Statistics for streamflow, precipitation, runoff coefficients, highway water quality and upstream water quality are needed to develop planning level estimates for use with SELDM. The USGS developed a series of reports (and associated) computer programs to provide planning level estimates of stormflow and water quality and to refine such estimates with local or site-specific data. Currently, the model is in the beta test stage, the final user manual is in draft stage, and the other supporting documents have been published or are in press. Information is available on the website <http://ma.water.usgs.gov/FHWA/SELDM.htm>

#### **Recent Publications**

Granato, G.E., 2006, Kendall-Theil Robust Line (KTRLine--version 1.0)—A visual basic program for calculating and graphing robust nonparametric estimates of linear-regression coefficients between two continuous variables: Techniques and Methods of the U.S. Geological Survey, book 4, chap. A7, 31 p. with CD-ROM <http://pubs.usgs.gov/tm/2006/tm4a7/>

Granato, G.E., 2009, Computer programs for obtaining and analyzing daily mean streamflow data from the U.S. Geological Survey National Water Information System Web Site: U.S. Geological Survey Open-File Report 2008–1362, 123 p. with CD-ROM <http://pubs.usgs.gov/of/2008/1362/>

Granato, G.E., and Cazenias, P.A., 2009, Highway-Runoff Database (HRDB Version 1.0)--A data warehouse and preprocessor for the stochastic empirical loading and dilution model: Washington, D.C., U.S. Department of Transportation, Federal Highway Administration, FHWA-HEP-09-004, 57 p. with CD-ROM <http://ma.water.usgs.gov/fhwa/FHWA-HEP-09-004/FHWA-HEP-09-004.pdf>

Granato, G.E., Carlson, C.S., and Sniderman, B.S., 2009, Methods for development of planning-level stream-water-quality estimates at unmonitored sites in the conterminous United States: Washington, D.C., U.S. Department of Transportation, Federal Highway Administration, FHWA-HEP-09-003, 53 p. with CD-ROM <http://ma.water.usgs.gov/fhwa/FHWA-HEP-09-003/FHWA-HEP-09-003.pdf>

#### **Report in press**

Granato, G.E., 2010, Methods for development of planning-level estimates of stormflow at unmonitored stream sites in the conterminous United States: FHWA-HEP-09-005, 90 p. with CD-ROM

### **National Synthesis on Potential Sources, Fate and Transport, and Potential Effects of Chloride in Surface- and Ground-Water Resources of the Conterminous United States (<http://ma.water.usgs.gov/fhwa/Cl.htm>)**

The Chloride (Cl) ion is receiving increasing attention as population growth makes increasing demands on available water resources and anthropogenic activities increase solute loads in natural waters. Cl is a growing concern because anthropogenic inputs may increase Cl concentrations to the USEPA taste criterion for potable waters (250 mg/L) and to the USEPA suggested limits of 230 mg/L for chronic aquatic life

exposure and 860 mg/L for acute aquatic life exposure in surface waters. The Cl ion is ubiquitous in natural waters, has a wide variety of sources, readily moves through surface and ground waters, and is difficult to remove from runoff and water supplies. This national synthesis is a cooperative effort between the USGS and Federal Highway Administration designed to provide the information necessary for watershed managers to assess all potential sources of Cl in a given watershed as part of a total water and solute budget. This will include information necessary to develop a localized water budget; to develop water-quality transport curves; to estimate natural, agricultural, and anthropogenic sources of Cl; to examine interrelationships among water-quality constituents and to use the National Water Information System Web to identify and interpret available groundwater, surface-water and water-quality data. This effort also will provide a summary of field methods including geophysical techniques and automated monitoring of runoff, streamflow, and ground water. Of 275 reports that have been compiled, about 165 reports have been cataloged and reviewed. Water-quality transport curves for dissolved chloride have been developed for 84 USEPA Nutrient Ecoregions.

## ***Partial Summary of USGS Water Science Center Activities Supported by State Highway Agencies***

### ***Alabama***

The two current projects that we have with DOT are 1) Hydrologic and Hydraulic investigations at various bridge sites in Ala, and 2) Culvert Impacts Study. The culvert impacts study looks at the impacts that culvert construction has on geomorphology, sediment concentrations in streams during storm events, turbidity, and benthic invertebrate populations. The study is set up to look at three phases - before, during, and 2-year post construction.

#### **Recent Publications**

Hedgecock, T.S., and Lee, K.G., 2010, Magnitude and frequency of floods for urban streams in Alabama, 2007: U.S. Geological Survey Scientific Investigations Report 2010–5012, 17 p.

Lee, K.G., and Hedgecock, T.S., 2010, Flood-depth frequency relations for rural streams in Alabama, 2003: U.S. Geological Survey Scientific Investigations Report 2010–5066, 25 p. (Also available online at <http://pubs.usgs.gov/sir/2010/5066/>.)

### ***Alaska***

- One project with Alaska Department of Transportation and Public Facilities (ADOT&PF) is related to channel migration in the Copper River Delta used a multi-dimensional flow model to:
  - Evaluate water-surface elevation along Mile 40 - 45 of the Copper River Highway for a 2 percent recurrence flood. The ADOT&PF is considering raising the grade and removing culverts along this stretch of the highway in order to restore a clear water stream to its original condition.
  - Evaluate diversion channels away from Bridge 339 of the Copper River Highway in order to protect the structural integrity of the bridge.
- A second program with ADOT&PF focuses on streambed scour monitoring and modeling had these accomplishments in 2010:
  - Initiated emergency scour monitoring in response to increased scour at Bridge 339 on the Copper River Highway. Deployed two satellite modem cameras to monitor water level and damage from scour and had field personnel on site for over 4 weeks to keep the highway open.
  - Monitored pier scour at 19 sites around Alaska in near real time.
  - Surveyed channel cross-sections at 50 scour-critical bridges.
  - Continued to collect field data and evaluate scour at 37 bridges within in the tidal zone.
  - Redesigned streambed scour website: [http://ak.water.usgs.gov/usgs\\_scour/](http://ak.water.usgs.gov/usgs_scour/)

#### **Recent Publications**

Brabets, T. P. and Conaway, J.S., 2010, Application of the Multi-Dimensional Surface Water Modeling System at Bridge 339, Copper River Highway, Alaska: American Society of Civil Engineers, Geotechnical Special Publication No. 210, Proceedings of the Fifth International Conference on Scour and Erosion, November 8-10, 2010, San Francisco, California, pp. 570-579.

Conaway, J.S, 2010, Modeling and Monitoring Scour during Bridge Replacement with Multi-dimensional Modeling and Repeated Multi-beam Surveys at the Tanana River near Tok, Alaska: American Society of Civil Engineers, Geotechnical Special Publication No. 210, Proceedings of the 2010 International Conference on Scour and Erosion, November 8-10, 2010, San Francisco, California, pp. 978-986.

Conaway, J.S. and Knapp, M.W., 2010, Summary of ongoing streambed scour evaluations at tidally affected bridges in Alaska: *in* Proceedings of the 2010 National Hydraulic Engineering Conference, August 25-29, 2010, Park City, Utah, 1 p.

## **Arizona**

- No highway related projects at this time.

## **Arkansas**

- A 3-year study that began in 2006 in cooperation with Arkansas State Highway and Transportation Department (AHTD) has been completed and the report published. The study was located at Springs National Park in central Arkansas. AHTD and the National Park Service had concerns that the blasting of the hills to make a road in the park might cause cracks deep within the earth that will affect the flow system of the Hot Springs. More information about the study can be found in the publication SIR 2009-5263.
- A cooperative effort between seven agencies in Arkansas to implement StreamStats is underway. The Arkansas State Highway and Transportation Department is one of the seven agencies that are helping support this effort. StreamStats is expected to be fully implemented in Arkansas in December 2012.
- The AHTD, in cooperation with the Federal Highway Administration, is developing plans to improve Highway 226 in Craighead County from the City of Cash to Highway 49 near Gibson. Big Creek flows off Crowleys Ridge approximately four miles northeast of the Highway 226 crossing. When the flow in Big Creek Ditch leaves Crowleys Ridge, it spreads out across the floodplain to the west, toward the City of Cash, crossing the drainage basins of two additional creeks. Conventional one-dimensional hydraulic stream models lack the ability to estimate how much of the flow leaving Big Creek will approach the Highway 226 bridges at each of the three proposed crossings (Big Creek, Emerson Ditch, and Johnson Ditch), and also do not account for storage effects within the floodplain north of Highway 226.
- To accurately determine the length and height of bridge openings required for the proposed Highway 226 improvements to meet AHTD's drainage design criteria and to comply with Craighead County's flood damage prevention ordinance, AHTD is working with the U.S. Geological Survey (USGS) Arkansas Water Science Center to develop a two-dimensional, unsteady-flow hydraulic streamflow model. This project is expected to be complete March 31, 2010.

## **California**

- A statewide flood frequency study that is aimed at updating flood-frequency data at gaged sites and developing prediction equations at ungaged sites is underway in California. As part of this study, new values of regional skew have been determined from a Bayesian Generalized Least Squares (GLS) regression analysis. During this past year, using the new regional skew values, flood-frequency data have been updated for selected gaged sites within the Sacramento—San Joaquin River Basin.
- Plans for the next year include conducting a mixed population analysis for a select group of gaged, high-elevation sites in an attempt to account for urbanization and potentially develop a new index-flood type approach for sites in California's southeastern desert region. The new estimation equations will also be implemented in StreamStats.

## **Colorado**

- The Colorado Water Science Center (CWSC), in cooperation with the Colorado Department of Transportation (CDOT), is beginning a new project in FY11 to create a Web-based historic flood information database for Colorado. The database will use an ARCGIS map or similar interface to facilitate easy access to published and unpublished USGS data including high outliers at gages used in the latest Colorado flood frequency report published by the USGS; unpublished USGS indirect and paleoflood measurements; and the peak flood of record at all USGS gages. CDOT is interested in this information so that engineers involved in road and bridge design can consider all flood related data that has been collected for a particular location. The database will also provide an efficient storage and retrieval system for the future updates. The scope of work for this project will include USGS and CDOT data. CDOT is planning to ask other state agencies to have their data added to the database. This additional work would be covered under a separate project.

## **Connecticut**

- Investigating the effects of road salting on stream quality along a stretch of I-95 as part of an environmental impact study of a proposed plan to widen the highway. An Open File report summarizing the first year of data collection was approved in January 2011 and will be released to the web shortly.
- Fieldwork began in the winter of 2009 on 4 streams with monitoring sites upstream and downstream of the highway. Monitoring includes continuous conductance, temperature, pH, and chloride at all 8 sites plus continuous streamflow monitoring at downstream sites. Information from one site, Latimer Brook, is available in real time on the web. Discrete samples for chloride are being collected frequently during runoff events following application of road de-icing chemicals and samples for major ions are being collected periodically. Data collection will continue through winter 2011 and data analysis and final report writing will happen in FY 2012.

## **Delaware**

- No highway related projects at this time.

## **District of Columbia**

- No highway related projects at this time.

## **Florida**

- Updating flood frequencies for all gages and developing regional flood-frequency relations for streams in Florida for the 2-, 5-, 10-, 25-, 50-, 100-, 200-, and 500-years. It has been more than 25 years since flood-frequency characteristics of streams were last evaluated and described. The length of the project has been 48 months. Approximately 320 stations have been analyzed and are being prepared for inclusion in the report. Colleague reviews are completed and the report will be finalized by Spring, 2011 which will complete the project.

## **Georgia**

- Ongoing statewide flood and bridge-site studies at sites selected by GADOT. Project to update urban flood frequency equations for Georgia is underway. Expected report in spring of 2011: Maintain a statewide network of 60 crest-stage gages as part of an ongoing flood-frequency study.

## **Recent Publications**

Gotvald, A.J., 2010, Historic flooding in Georgia, 2009: U.S. Geological Survey Open-File Report 2010-1230, 19 p. (<http://pubs.usgs.gov/ofr20101230/>)

## **Hawaii**

- Operates a network of 63 crest-stage gages to monitor peak stages and discharges at or near highway crossings on the islands of Kaua`i, Oahu, Moloka`i, Maui, and Hawai`i. The peak-flow data collected at these stations adds significantly to peak-flow data collected at continuous stations and improves regional coverage of peak-flow measurements in Hawai`i.

- Monitors rainfall, streamflow, and daily suspended-sediment concentration and load in North Halawa Stream to study impacts in the H-3 freeway corridor and receiving water bodies.
- Operates 26 real-time rain gages and 58 real-time streamflow monitoring stations on the islands of Kaua`i, Oahu, Moloka`i, Maui, and Hawai`i. Data from these gages are used to aid in flood warning and flood forecasting.

### **Recent Publications**

Oki, D.S., Rosa, S.N., and Yeung, C.W., 2010, Flood-frequency estimates for streams on Kaua`i, O`ahu, Moloka`i, Maui, and Hawai`i: U.S. Geological Survey Scientific Investigations Report 2010-5035, 121p. (<http://pubs.usgs.gov/sir/2010/5035/>)

Oki, D.S., Rosa, S.N., and Yeung, C.W., 2010, Hawaii StreamStats: a web application for defining drainage-basin characteristics and estimation peak-streamflow statistics: U.S. Geological Survey Fact Sheet 2010-3052, 4p (<http://pubs.usgs.gov/fs/2010/3052/>)

Presley, T. K. and Jamison, M. T.J., 2010, Rainfall, discharge, and water-quality data during stormwater monitoring, H-1 storm drain, July 1, 2009, to June 30, 2010: U.S. Geological Survey Open-File Report 2010-1161, 26p. (<http://pubs.usgs.gov/of/2010/1161/>)

### **Idaho**

- The Idaho Transportation Department uses the Idaho StreamStats web site extensively in the design of their Idaho Bridge Watch program (an early-warning bridge scour monitoring program based on the Q25 and Q50) as well as for other transportation-related design projects. The Idaho StreamStats website is at <http://water.usgs.gov/osw/streamstats/idaho.html>

### **Illinois**

- Illinois StreamStats — A report on the StreamStats Web application for computing selected basin characteristics and flood-peak quantiles based on the most recently (2010) published regional flood-frequency equations for rural streams in Illinois (Soong and others, 2004) was published in 2010.
- Pier and Contraction Scour Prediction in Cohesive Soils at Selected Bridges in Illinois — This project tested the Scour Rate In Cohesive Soils-Erosion Function Apparatus (SRICOS-EFA) method for estimating scour depth of cohesive soils at 15 bridges in Illinois. Also for this project, disaggregation and estimation techniques to provide continuous hourly streamflow data where streamgage data was unavailable were developed. A final report was approved by the USGS and published by the Illinois Center for Transportation. A follow-up study to evaluate an aspect of the method at additional bridges has been proposed for 2011.

### **Indiana**

- In 2010 the USGS operates 22 streamgages and installed 4 new sites in cooperation with the Indiana DOT.
- Flood inundation map libraries for 7 USGS streamgage sites and collocated NWS flood forecast points, to assist with highway, road, and bridge operations during floods. Two of the libraries are scheduled for completion in FY11.

### **Iowa**

- Cooperatively funds 25 continuous-record gaging stations.
- Cooperatively funds 89 crest-stage gages.
- Cooperatively funds ongoing flood-profiles project to document water-surface profiles of significant flood events. The report "Flood of June 8-9, 2008, Upper Iowa River, northeast Iowa" (Open-File Report 2010-1087) was published in 2010 <<http://pubs.usgs.gov/of/2010/1087/>> and the mock-up for the report "Floods of May 30 to June 15, 2008, in the Iowa River and Cedar River Basins, eastern Iowa" (Open-File Report 2010-1190) has been approved for publication. Floods in 2010 during June

on the Little Sioux River in Cherokee in western Iowa, during July in the Maquoketa and Little Maquoketa River Basins in northeast Iowa, and during August in the South Skunk River Basin in central Iowa were selected for documentation for the flood-profile project and high-water marks were surveyed at 68 bridge sites along five river reaches. Two flood-profiles reports and a letter report are planned to document the 2010 floods.

- Iowa StreamStats—A 2006-2012 investigation to develop a comprehensive flood-estimation method for unregulated, rural streams in Iowa. Specific objectives are to: (1) Implement an interactive StreamStats Web site for Iowa that allows users to easily select stream sites and estimate flood-frequency discharges by automating the measurement of basin characteristics and calculation of regression estimates. (2) Develop two sets of regional regression equations, one set for basins with drainage areas less than 50-100 square miles and another set for basins with drainage areas greater than 10-50 square miles, to estimate flood-frequency discharges. (3) Define the same hydrologic regions for both sets of regional regression equations, unless, the definition of a separate set of hydrologic regions for each set of small- and large-basin regression equations provides a significant improvement in the overall predictive accuracy of both sets of regression equations. (4) Develop the smallest drainage-area range for a transition zone as possible for Iowa to prevent the possibility of small-basin regression estimates exceeding large-basin regression estimates. During 2010, station skew values for 330 streamgages with 25 years or more of record were updated through the 2008 water year using EMA (expected moments algorithm) and the skew data along with basin-characteristics data were provided to Cornell University for the development of new regional skews for the State using Bayesian GLS (generalized least-squares) regression analysis. Cornell University has computed cross correlations, fit a preliminary function using continuous-record streamgages, and has performed redundant site analyses as part of the Iowa regional skew study.

## **Kansas**

- The Kansas Water Science Center streamflow statistics project has provided improved estimates versus the ungaged regression equations for 5427 stream segments for flood frequency and various duration flows.
- The Kansas StreamStats is on the web at <http://ks.water.usgs.gov/Kansas/studies/strmstats/>.
- Currently, there are few active streamgages (<30) in Kansas with drainage areas less than 32 mi<sup>2</sup> used to compute flood frequency. National Weather Service radar precipitation estimates from significant storms were used to locate peak runoff events on streams in Eastern Kansas. The peak discharge at these selected sites was measured by indirect methods. The relation between discharge per unit area (Q/DA) was related to the probability of the precipitation event, and other basin characteristics. These relations were tested to determine if flood frequency equations developed using gaged data from streams less than 32 and less than 5.4 mi<sup>2</sup> using the Q/DA relations were valid. The precipitation/flood frequency determinations at 28 sites were compared to the traditional flood frequency equations, flood-frequency equations using Q/DA, and the rational method equations. The newly developed Q/DA equations were superior to the other methods in this comparison. The full report can be found at <http://pubs.usgs.gov/sir/2008/5112/>.
- The data analysis and interpretation portion of the Kansas program with Kansas Department of Transportation ended September 30, 2009 because of State budget problems. Operation of 25 crest-stage gages was retained.

## **Kentucky**

- No highway related projects at this time.

## **Louisiana**

- A cooperative program with the Louisiana Department of Transportation and Development (LA DOTD) to operate 10 continuous real-time streamflow data collection stations, 13 real-time stage stations, 17 non-recording crest-stage gages, and 7 non-recording flood-profile gages.
- Cooperative program with LA DOTD to operate 12 real-time monitoring network gages specifically located on major hurricane evacuation routes. These gages monitor water levels, precipitation, and wind speed. The gage can eventually be used to transmit traffic volume and average speed data for LA DOTD. Wind speed information could be used to make informed decisions on bridge overpass

closure, and water-level information would be used to make informed decisions on closing evacuation routes due to flooding. This network is expected to expand to 22 sites in the future.

- **Sustainable Yield of Select Streams and Reservoirs in Louisiana**—Because of recent droughts, various government agencies, communities, and private groups are considering various streams, lakes, and reservoirs in Louisiana for alternate or emergency supplies of freshwater for municipal, industrial, or agricultural use. However, the amounts of available water required for local needs may be inadequate or unreliable from many of these sources, especially during drought conditions. In addition, excessive water withdrawals may result in adverse environmental, economic, or social impacts. The USGS in cooperation with the U.S. Department of Transportation (LDOT) is conducting a study to estimate the sustainable yield of selected streams, lakes, and reservoirs in Louisiana. Most of the Streams included are those that have adequate record lengths for computation of streamflow statistics. The reservoirs included are a subset of the Dams/Reservoirs that were constructed or are maintained by LDOT.
- **WATER RESOURCES OF SELECTED PARISHES IN LOUISIANA** -Reservoirs and other water sources are being proposed in several parishes around Louisiana as additional, alternate, or emergency water for public supplies, irrigation, or other uses. In some cases, local officials and the concerned public may not have a good understanding of water availability in their parish and additional development may not be necessary. Short summaries of water resources in each parish are needed for a better understanding of water availability, trends, and resource development. The water resources of most Louisiana parishes were summarized during the 1940's through 1960's and published in Louisiana Parish guides. Since that time, many of these resources have been developed and new resources have been created, commonly in the form of reservoirs. Additional development of existing resources and creation of new reservoirs are sometimes proposed without a full understanding by state officials, local officials, or the public of the existing resources. Data on ground- and surface-water resources also are essential for planning future use of water resources. The USGS, in cooperation with the DOTD, maintains long-term observation networks in major aquifers and streams in Louisiana to monitor changes in water level and stage. Many reports have been published to present aspects of these changes as they occur in various parts of the State.
- **SIMULATION OF GROUND-WATER FLOW IN THE "1,500-FOOT" AND "2,000-FOOT" SANDS AND MOVEMENT OF SALTWATER IN THE "2,000-FOOT" SAND OF THE BATON ROUGE AREA, LOUISIANA** -Saltwater encroachment has been detected in six aquifers, including the "1,500-ft" and "2,000-ft" sands, north of the Baton Rouge fault in East Baton Rouge Parish. The encroachment is in response to groundwater withdrawals, primarily for public supply and industrial uses, in Baton Rouge. Additional information is needed for water planners and managers in the Baton Rouge area to make decisions on future management of ground-water resources in the area. The impact of the pumping wells on ground-water flow and the northward encroachment of saltwater are not well known. The time and route for saltwater to travel from the fault to pumping centers is not known. The need for and possible locations of additional pumping wells, injection wells, or observation wells is not known. A computer model has been proposed to simulate past, current, and a variety of possible future conditions in the "1,500-foot" and "2,000-foot" sands. Such a model would provide a tool to water planners and managers to evaluate possible management alternatives, and increase the understanding of saltwater movement in aquifers in similar hydrogeologic settings.
- **QUALITY OF WATER AND BOTTOM MATERIAL IN THREE NORTH LOUISIANA RESERVOIRS, 2009-2011** -The State and USGS currently are assessing selected reservoirs to determine their viability as sources of drinking water. The primary objective of the proposed study is to describe the quality of water and bottom material in three reservoirs in north Louisiana. Surface water samples will be collected twice each year, once in early summer and once in late summer. If the water column is stratified, both a bottom sample in the hypolimnion and a near surface sample in the epilimnion will be collected. Bottom material will be collected during the first sampling event. Upon review, additional bottom material samples will be collected only if determined to be necessary based on the results of the initial screening. Water samples will be collected and analyzed for physicochemical properties, a comprehensive list of chemicals constituents, and biological indicators of water quality. Bottom material will be analyzed for trace elements, nutrients, organic carbon, waste water compounds, and pesticides. An emphasis will be placed on emerging contaminants, namely wastewater compounds, throughout the period of the study. Water-quality data will be

compared to selected USEPA drinking-water standards. Statistical techniques will be used to determine the degree to which land use affects the quality of water. This study will provide water managers and planners with information to help assess the use of these reservoirs as future sources of drinking water. The results of the proposed study will be published in an online report.

- **STRUCTURE MAPS OF THE CARRIZO-WILCOX AQUIFER AND RED RIVER ALLUVIAL AQUIFER IN NORTHWESTERN LOUISIANA** -Groundwater resources in northwestern Louisiana may be needed for future development of energy supplies, including natural gas production from the Haynesville Shale. The development of groundwater resources for natural gas production may lower water levels and alter groundwater flow directions in the aquifers. The proposed study area in northwestern Louisiana where groundwater resources could be affected by development includes Bossier, Caddo, Desoto, and Red River Parishes and parts of Bienville, Sabine, and Webster Parishes. Ground-water resources in northwestern Louisiana include the Carrizo-Wilcox, Red River alluvial, upland terrace, and Sparta aquifers. In most of the proposed study area, aquifers contain fresh groundwater to depths of 200 ft below NGVD or less, but freshwater is present locally to depths of 500 ft below NGVD.
- **CHLORIDE CONCENTRATIONS IN THE MISSISSIPPI RIVER ALLUVIAL AQUIFER IN NORTHEASTERN LOUISIANA** -The Mississippi River alluvial aquifer (MRVA) is a major source of freshwater in northeastern Louisiana. Saltwater could be increasing in some areas of the aquifer because of concentrated pumping, primarily for irrigation. Recent queries to the USGS from farmers in the area indicate that this could be occurring. The objectives of the proposed study are to 1) document the present day (2011) chloride concentrations and specific conductance in water from the MRVA; 2) identify areas where additional saltwater encroachment may have occurred; and 3) determine whether significant changes have occurred since the regional study of chloride concentrations in the aquifer in 1975. Knowledge of present-day chloride concentrations and specific conductance in the MRVA are critical to understanding the aquifer's suitability for uses such as domestic, public supply, and agriculture. Results of the study are needed by federal, State, and local agencies to understand the current usefulness of the aquifer and whether the aquifer can be considered a viable source for freshwater under drought conditions. Information on chloride concentrations in areas wells also is needed by farmers and residents who could be directly impacted by the presence of saltwater in the aquifer. To accomplish the objectives of the study, available chloride concentration and specific conductance data from wells screened in the MRVA in northeastern Louisiana will be compiled from a variety of sources, including the LSU AgCenter, Louisiana Department of Health and Hospitals, and the Louisiana Department of Natural Resources. These data and USGS data, along with information in previous reports, will be used as a screening tool to select wells for additional sampling. Water from selected wells will be analyzed for specific conductance and temperature in the field using a hand-held meter. Water samples will be analyzed for chloride concentrations and specific conductance by the USGS National Water Quality Lab in Denver. The resulting data will be spatially analyzed using a GIS and compared to maps and information in previous reports to identify areas where additional saltwater encroachment may have occurred. Resulting data also will be compared to historical data to determine whether significant changes have occurred over time.

## **Maine**

- **The Effect of road-salt on bedrock wells**—USGS, in cooperation with MaineDOT, is studying possible long-term effects of road-salting practices on the quality of bedrock ground water. USGS is using geophysical data, water-quality analyses, and continuously recorded water level, water temperature, and specific conductance data from 4 wells to understand the roles of fractures on the persistence of chloride in bedrock. Report is currently in review.
- **Impact of future peak-flow stationarity on bridge design**—The USGS, in cooperation with MaineDOT, will project future annual peak streamflows for 4 basins in coastal Maine, using the PRMS distributed-parameter watershed model, with input from multiple global climate models and future scenarios. Future design peak flows for selected recurrence intervals will be computed based on projected future flows and compared to design peak flows based on historical flows. As part of this project, historical peak flows and design peak flows will be modeled with PRMS and the accuracy of the models will be determined.

- **Small-watershed data collection**—Peak-flow data collection (crest-stage gages) continues on 12 streams, all with basins less than one square mile. Nine sites have 10 complete years of data collection, three sites have 9 complete years of data collection, and two have less than 6 years of data. In addition, 7 seasonal rain gages have been installed to prepare for a future time-of-concentration study. Five basins were selected for rain gages and two rain gages have been installed in each of two basins; one rain gage near the flow monitoring point and the other in the headwaters of the basin.
- **Continuous streamflow data collection**—Continuous data collection continues at 18 USGS streamflow gages and one tide gage.

### Recent Publications

Hodgkins, G. A., 2010, Historical changes in annual peak flows in Maine and implications for flood-frequency analyses: U.S. Geological Survey Scientific Investigations Report 2010-5094, 38 p.

Hodgkins, G. A., 2010, Historical changes in annual peak flows in Maine and implications for flood-frequency analyses: U.S. Geological Survey Fact Sheet 2010-3034, 2 p.

### Maryland

- Thirteen streamgages were operated cooperatively with the Maryland State Highway Administration (MDSHA).
- StreamStats coverage is to be expanded to include the entire State of Maryland by way of an ongoing (non-MDSHA, Non-FHA) project. Through an informal collaboration with MDSHA (and that agency's support of the Maryland Hydrology Panel) new peak-flow frequency estimation equations developed by Dr. Glenn Moglen and Mr. Will Thomas will be served for the State of Maryland using the StreamStats application.

### Massachusetts

- **The Quality of Stormwater Runoff Discharged from Massachusetts Highways** (Completed): The purpose of the project is to document current concentrations of suspended sediment, particle size, selected dissolved ions, total nutrients, selected total-recoverable metals, and semivolatile compounds in highway runoff discharge from common highway-drainage conveyance structures in MA. Highway-monitoring stations were installed on 8 highways at 12 locations in MA. Automatic-monitoring techniques were used to collect composite samples of highway runoff and make continuous measurements of several physical characteristics. Flow-weighted samples of highway runoff were collected automatically during 140 rain and mixed rain, sleet, and snow storms from September 2005 and to September 2007. These samples were analyzed for physical characteristics and concentrations of 6 dissolved major ions, total nutrients, 8 total-recoverable metals, suspended sediment, and 85 semivolatile compounds (SVOCs). The study resulted in storm-event monitoring data from 1,523 storms with 14,563 EMC values. The final report also includes information about the quality and grain-size
- **Effectiveness of catch basin hoods for retaining floatable debris, oil and grease, and total petroleum hydrocarbons in highway catch-basin sumps** (Completed): Catch-basin hoods are intended to enhance catch-basin performance by retaining floatable debris at the water surface within the sump of the catch basin. Evidence from recent highway-runoff quality studies in MA indicated that these hoods may not be highly effective. At the conclusion of the 14-month study targeting a hooded catch basin, the structure was virtually absent of floatable debris. Additional evidence indicating that catch-basin hoods were not effective in retaining floatable debris included the observation of large amounts of floatable debris found not only in the downstream water-quality inlet of the catch basin under study, but in four other water-quality inlets located along the Southeast Expressway that also received discharge from hooded catch basins. The purpose of the project is to document the effectiveness of cast-iron hoods in reducing the amount of floatable debris discharged from Southeast Expressway near Boston, Massachusetts. The results of this study will be useful for determining the physical and hydrologic circumstances that affect catch-basin hood performance. The amount of debris in catch basins at the beginning and end of the study are measured. Precipitation and runoff are monitored using automated methods. Samples of floatable debris were collected from six catch-basin outfalls. Water samples were collected and analyzed for oil and grease, and total petroleum hydrocarbons. Surveys are taken to assess the potential available mass

of debris and to characterize the type of debris potentially available for washoff. The final report is in press.

#### **Recent Publications**

Smith, K.P., and Granato, G.E., 2010, Quality of stormwater runoff discharged from Massachusetts highways, 2005–07: U.S. Geological Survey Scientific Investigations Report 2009–5269, 198 p. URL: <http://pubs.usgs.gov/sir/2009/5269/>

#### **Michigan**

- Ten streamgages and five crest-stage gages were cooperatively funded by the Michigan Department of Transportation.

#### **Minnesota**

- Operating a network of 77 crest-stage gages for flood frequency analysis.
- Data from all gages will be analyzed for a report that will generate flood frequency estimates for all gages in Minnesota. This report is scheduled for publication in FY 12.
- StreamStats operation and maintenance for FY 11.
- Provide hydraulic investigation support as requested, including bridge scour.

#### **Recent publications**

- Lorenz, D.L., Sanocki, C.A., and Kocian, M.J., 2010, Techniques for estimating the magnitude and frequency of peak flows on small streams in Minnesota based on data through water year 2005: [U.S. Geological Survey Scientific Investigations Report 2009–5250](#), 54 p.
- Fallon, J.D., and Yaeger, C.S., 2009, Water- and bed-sediment quality of Seguchie Creek and selected wetlands tributary to Mille Lacs Lake in Crow Wing County, Minnesota, October 2003 to October 2006: U.S. Geological Survey

#### **Mississippi**

- Continue to provide streamflow records, hydrologic analyses of basins, and hydraulic analyses of the flooding potential at selected stream crossings, known as bridge-site studies. Scour analyses are also conducted at selected sites.
- Continue to operate and maintain 88 crest-stage gages and 2 flood hydrograph gages.
- Continue to operate a near real-time scour-monitoring gage at a coastal bridge. Streambed soundings are obtained at this and other selected bridges to document scour.
- Continue to prepare an updated version of the 1991 flood-frequency reports to include the use of GIS determined basin characteristics for development of regional flood-frequency equations and the implementation of StreamStats. Unable to complete as planned last year, but will be completed in FY 2011.
- Selected historical flood reports are no longer available at the MS Water Science Center (MSWSC) page at: <http://ms.water.usgs.gov>

Working on making many of these available at the USGS publication warehouse. For the time being, all of these reports can be accessed at:

[http://choctaw.er.usgs.gov/new\\_web/reports/other\\_reports/index.html](http://choctaw.er.usgs.gov/new_web/reports/other_reports/index.html)

- During FY 2010-11, involved in a FHWA funded project, *Impacts of Climate Change Variability on Transportation Systems and Infrastructure: Gulf Coast Study, Phase 2*. This study is for the Mobile, Alabama metropolitan area. Estimates of rates of vertical land surface change based on past surveys of benchmarks, tide gages, Continuously Operated Reference Stations (CORS), and satellite Interferometric Synthetic Aperture Radar (InSAR) will be provided to FHWA for their use in adjusting the land surface for modeling probable storm surge inundations and sea level rise that may occur in the future and affect transportation infrastructure in the Mobile area.

## **Missouri**

- Continued operation of a network of 38 crest-stage gages to be used with future flood frequency study.
- Continued operation and maintenance of 7 stream-gaging stations as part of the statewide stream-gaging network.
- Continued operation of a near-real-time scour monitor at Chariton River near Novinger, Missouri, and installation of near-real-time scour monitors at both main channel piers of Missouri River at Jefferson City, Missouri. Also installed an ADCP on the downstream pier at Jefferson City to monitor bed movement (Bob Holmes, OSW (??not sure if this is FHWA/MoDOT or other??)).
- Bathymetric surveys of Missouri and Mississippi Rivers using multibeam echosounder: 2 bridges at Jefferson City (no report), 9 bridges at 7 sites in Kansas City (report listed below), and 12 bridges at 7 sites in St. Louis (ongoing).
- 3 bathymetric surveys at site of new bridge for US 59 over the Missouri River at Atchison, KS for Kansas DOT. One additional scan is planned after removal of cofferdam in March 2011.
- Level 2 scour assessment at Poplar Street Bridge (I-70) over the Mississippi River in St. Louis, Missouri.
- **Revision of rural regression equations for Missouri** Existing regression equations for rural basins in Missouri are based on skew values derived from data through the 1973 water year. Since then 37 years of additional data has been collected to improve the accuracy of the skew map. The Bulletin 17B skew map does not distinguish between model and sampling errors in the data. Thus, it is likely that station skews are over weighted resulting in a bias in the final streamgage flood frequency analyses. Historical floods were primarily ignored in the 1995 study because of the limited methodology of treating censored data. An in-depth analysis of historical information and use of historical peaks is needed. Development of areal comparisons of peak runoff rates is also needed for historical floods. Results will be used to extend streamgage records. Bayesian Generalized Least Squares technique for regional skew analyses will be performed to develop more accurate skew(s) values for Missouri. Expected Moments Algorithm (EMA) released in November 2007 by the USGS will be used to analyze censored data more rigorously. Record extension improves the accuracy and reliability of at-site streamgage flood frequency analyses. Extending streamgage records where historical flood events have been recorded will result in much improved at-site flood frequency estimates. Revision of the skew map will improve the accuracy of at-site flood frequency estimates and resulting regional regression equations. The EMA technique improves the estimation of flood frequency discharges for streamgage records that include censored data such as historical events and less-than-value discharges. About 25 percent of the streamgages in Missouri have censored data.

### **Recent Publications:**

- Rydlund, P.H., Jr., 2009, Real-time river channel-bed monitoring at the Chariton and Mississippi Rivers in Missouri, 2007–09: U.S. Geological Survey Scientific Investigations Report 2009–5254, 27 p.
- Huizinga, R.J., Elliott, C.M., and Jacobson, R.B., 2010, Bathymetric and velocimetric survey and assessment of habitat for pallid sturgeon on the Mississippi River in the vicinity of the proposed Interstate 70 Bridge at St. Louis, Missouri: U.S. Geological Survey Scientific Investigations Report 2010–5017, 28 p.
- Huizinga, R.J., 2010, Bathymetric surveys at highway bridges crossing the Missouri River in Kansas City, Missouri, using a multibeam echo sounder, 2010: U.S. Geological Survey Scientific Investigations Report 2010–5207, 61 p.

## **Montana**

- The Idaho Transportation Department uses the Idaho StreamStats web site extensively in the design of their Idaho Bridge Watch program (an early-warning bridge scour monitoring program based on the Q25 and Q50) as well as for other transportation-related design projects. The Idaho StreamStats website is at <http://water.usgs.gov/osw/streamstats/idaho.html>

## **Nebraska**

- The Nebraska Water Science Center is working in cooperation with the Nebraska Department of Roads to document changes in cross sections at bridges before, during, and after flooding events. Cross-section data mined from historic discharge measurements are being compiled and presented in a database.

## **Nevada**

- Maintain a Statewide network of 24 crest-stage gages.
- USGS and Nevada Department of Transportation entered into an agreement in FY06 to compute sediment loads in the Clear Creek Drainage. This study will assess the impact of runoff from a U.S. Highway. The study is event driven where the sample collection intensifies during snowmelt and summer thunderstorms. A Scientific Information Report was published in FY09. A three-year agreement with the Nevada Department of Transportation to continue monitoring sediment and selected water quality constituents in the Clear Creek drainage was signed agreement in October 2009. The report for the continuation of this project will be published in FY11.
- A web based flood chronology of the Carson River Basin in cooperation with the State of Nevada and FEMA is available at <http://nevada.usgs.gov/crflid/index.htm>. The web site shows frequency plots, lists of flood discharge with Return Periods or Recurrence Intervals, and digital photographs of floods in the Carson River Basin.

## **Recent Publications**

Seiler, Ralph L.; Wood, James L., 2009, Sediment Loads and Yield, and Selected Water-Quality Parameters in Clear Creek, Carson City and Douglas County, Nevada, Water Years 2004-07: U.S. Geological Survey Scientific Information Report 2009-5005, 45 p.  
(<http://pubs.er.usgs.gov/usgspubs/sir/sir20095005>)

## **New Hampshire**

- New Hampshire Department of Transportation (NHDOT) funds approximately one-third of New Hampshire's stream-gaging network

## **New Jersey**

- Operate and maintain 38 crest-stage gages on small drainage basins of less than 2 square miles, and 15 older crest-stage gages under 9 square miles in drainage area. A proposal was written to compute flood frequencies at the gages with 10 or more years of record. The results at the gages will be compared with various flood magnitude and frequency estimation methods.
- A bridge scour data collection project was started in April 2008. The general objectives of this program are to monitor and validate the effects of scour at NJDOT bridge structures designated as scour critical and to obtain updated flow and velocity data. This is a long-term project with additional monitoring locations added each year. The monitoring work being done in FY2010 includes:
  - Operate and maintain continuous-record discharge gaging stations at 10 locations to provide discharge data to improve models to calculate scour. Gage height and discharge data available in near real-time on our website <http://nj.usgs.gov>
  - Continuous monitoring of streambed elevations at selected locations near bridge piers and abutments at 3 sites. The effects of scour at these bridge sites will be evaluated by NJDOT by monitoring streambed elevations over time at selected locations. Streambed elevation is available in near real-time from our website [http://waterdata.usgs.gov/nj/nwis/current/?type=bridge&group\\_key=basin\\_cd](http://waterdata.usgs.gov/nj/nwis/current/?type=bridge&group_key=basin_cd)
  - Survey channel cross-sections at multiple locations upstream and downstream of the bridge at the gages and at bridges at an additional 20 sites to monitor changes in channel geometry over time.
  - A crest-stage gage is operated and maintained at 1 bridge to record peak stage and discharge.
  - An acoustic Doppler current profiler is operated and maintained to record a continuous-record of velocity at one gaging station.
- A new proposal is being prepared with NJDOT for the expansion of the bridge scour data collection project to include the addition of new monitoring locations in fiscal year 2011. The agreement will include an as yet undetermined number of new continuous-record monitoring stations. Stations selected will collect data continuously for one or more of the following parameters: gage height,

discharge, velocity and streambed elevation. Additional locations will have channel cross sections surveyed. Gage height, discharge, velocity and streambed elevation will be made available in near real-time from the New Jersey Water Science Center's website at <http://nj.usgs.gov>.

## **New Mexico**

- **Flood Analysis**
  - Operate and maintain the New Mexico crest-stage gage network of 86 gages. Fifty-four of the crest-stage gages operated in ephemeral streams around the State are currently equipped with automated pressure transducers.
  - Continued documentation of notable floods through collection of flood information such as high-water marks, peak stages and discharges by indirect measurements at miscellaneous flooded sites.
- **Streamstats**
  - The USGS Web application for stream information for New Mexico has been partially funded by the USGS in cooperation with the USDA (Forest Service) and the New Mexico Department of Transportation (NMDOT) for FY 2011. Total reduction in funding from FY 2010 is 55%. Information about the StreamStats program and each States project status can be found at: <http://water.usgs.gov/osw/streamstats>.
  - The New Mexico StreamStats project submitted a "pilot area" to the National StreamStats Team, for comprehensive web-site testing. Refinements have been made to the program's abilities as well as database updates.
  - GIS data creation efforts are currently being coordinated with USGS cooperators for the Carson National Forest areas as a second test area.

## **New York**

- Documentation of notable floods through collection of flood information such as peak stages and discharges at discontinued gages, flood profiles along flooded streams, and indirect flood discharge measurements at miscellaneous flooded sites.
- The interaction of two storm systems over western New York produced heavy rains and severe flash flooding in parts of Cattaraugus, Chautauqua, and Erie Counties during the early morning of August 10, 2009. Rainfall amounts of almost 6 inches in 1.5 hours produced extensive flooding in the villages of Gowanda and Silver Creek, New York. Peak water-surface elevations exceeded the 500-year (0.2-percent annual exceedance probability) flood profile elevations from the FEMA flood insurance studies by 2 to 4 feet in Gowanda and as much as 6 to 8 feet in Silver Creek. The USGS NY WSC computed four indirect discharge measurements and surveyed over 240 high-water marks, which were used to create flood-water-surface profiles for four streams and to delineate the areal extent of flooding in the two villages. A report titled, Flash floods of August 10, 2009 in Gowanda and Silver Creek, New York, has been reviewed and is awaiting approval.
- Maintain a statewide network of 48 crest-stage gages.
- The use of GIS techniques to automate the computation of estimated flood frequency discharges at any unregulated stream location in New York using STREAMSTATS is operational.
- USGS NY WSC continues to support GIS software included on a DVD in the report of updated flood-frequency relations for New York (Lumia, 2006) to provide an automated method of calculating flood frequency discharges until STREAMSTATS supports all methods presented in this report.
- An effort to update a report showing the maximum known stages and discharges at nearly 1500 gaging stations in New York is in progress. Recurrence intervals will be assigned to each peak discharge, where feasible. The scope of this report was revised to include peaks through the 2009 water year due to significant flooding in 2006 and localized flooding events in 2007-2009.
- USGS NY WSC is a member of the Technical Advisory Group for the use of natural brine for road deicing/anti-icing in the Syracuse, NY area. The project began in the 2009-2010 deicing season and will continue in the 2010-2011 season with a report due sometime in the fall of 2011.

- USGS NY WSC worked with the State Emergency Management Office, NYSDOT, NYSGS, and others to develop a statewide landslide susceptibility mapping project. Schenectady County was completed in 2008, but continuation of the project is currently on-hold. Landslide monitoring continues in and around the Tully Valley, New York area, with one landslide just down-gradient of Interstate-81 in southern Onondaga County.
- USGS NY-WSC presented a paper on landslide monitoring and prediction at the Transportation Geohazards Conference in Columbus Ohio on August 3-4, 2010. The paper was titled "Dendrogeomorphology and Landslides in the Tully Valley, Onondaga County, NY".

### Recent Publications

Mulvihill, C.I., Baldigo, B.P., Miller, S.J., DeKoskie, Douglas, and DuBois, Joel, 2009, Bankfull discharge and channel characteristics of streams in New York State: U.S. Geological Survey Scientific Investigations Report 2009–5144, 51 p. (<http://pubs.usgs.gov/sir/2009/5144/>)

Suro, T.P., Firda, G.D. and Szabo, C.O., 2009, Flood of June 26-29, 2006, Mohawk, Delaware and Susquehanna River Basins, New York: U.S. Geological Survey Open-File Report 2009-1063, 354p. (<http://pubs.usgs.gov/of/2009/1063/>)

Tamulonis, K.L., Kappel, W.M., and Shaw, S.B., 2009, Causes and movement of landslides at Rainbow Creek and Rattlesnake Gulf in the Tully Valley, Onondaga County, New York: U.S. Geological Survey Scientific Investigations Report 2009–5114, 18 p. (<http://pubs.usgs.gov/sir/2009/5114/>)

Tamulonis, Kathryn, and Kappel, W.M., 2009, Dendrogeomorphic assessment of the Rattlesnake Gulf landslide in the Tully Valley, Onondaga County, New York: U.S. Geological Survey Scientific Investigations Report 2009–5134, 14 p. (<http://pubs.usgs.gov/sir/2009/5134/>)

### North Carolina

- The USGS in cooperation with the North Carolina Department of Transportation (NCDOT) completed a pilot project in 2008 to develop and implement the StreamStats application for the Upper French Broad River basin in western North Carolina. The pilot project utilized the local resolution NHD product, 20-foot DEMs (derived from LIDAR data), and the most current regional streamflow regression equations, and datasets of landscape characteristics. Basin characteristics developed for the streamflow regression application, including National Oceanic and Atmospheric Association (NOAA) rainfall intensity data, topographic variables (for example slope and drainage area) and best available land cover classifications, were incorporated into StreamStats. A Factsheet (<http://pubs.usgs.gov/fs/2009/3088/>) was published to document the StreamStats application. As an extension of that StreamStats project, work was started during 2010 to establish a statewide implementation of StreamStats. The elevation and stream data layers that will be part of the statewide application are currently being developed. Basin characteristics and other data layers (that can be indexed) will be compiled during 2011 for inclusion in the statewide application. The statewide application is targeted to be available for use in late calendar year 2011.
- On July 1, 2008, the North Carolina General Assembly passed House Bill 2436, Session Law 2008-107, Stormwater Runoff from Bridges Section 25.18. (a,b,c). This bill requires the North Carolina Department of Transportation (NCDOT) to study 50 bridges to (1) quantify the constituents in stormwater runoff from bridges across the state, (2) evaluate the treatment practices that can be used to reduce constituent loadings to surface waters from bridges, and (3) determine the effectiveness of the evaluated treatment practices. Working collaboratively, NCDOT and USGS identified study objectives which could provide information valuable in helping understand the effects of bridge deck runoff on receiving water quality and in managing stormwater runoff from bridges. In order to better understand the effects of stormwater runoff from bridges on receiving waters the following tasks are being performed: (a) characterize stormwater runoff quality and quantity from selected representative bridges in North Carolina; (b) determine if the chemistry of bed sediments upstream and downstream from selected bridges differs substantially; (c) measure stream water quality upstream from selected bridges in order to compare bridge deck stormwater concentrations and loads to stream constituent concentrations and loads; and (d) estimate the length of the mixing zone at the bridge deck study

sites under a range of flow conditions, where the mixing zone is defined here as the stream reach required for a point source of stormwater entering the stream from the bank to become fully mixed across the stream.

This investigation measured bridge deck runoff from 15 bridges across NC. Bridges represent a range of physiographic and climatic conditions, a range of average daily traffic (ADT), and a range in size. Runoff from both concrete deck and asphalt deck bridges are being sampled. At least 12 runoff events were sampled at each bridge during the study. Samples were analyzed for a wide range of constituents, including nutrients, major ions and trace metals, oil and grease, and semivolatile organic compounds. The final report for the project is being prepared and will be published in 2011.

- Continued to operate continuous streamflow gaging stations on Goose Creek at Fairview, NC (02124692) and Waxhaw Creek near Jackson, NC (02147126) just outside of Charlotte in cooperation with the NCDOT.

### **Recent Publications**

Wagner, C.R., Tighe, K.C., and Terziotti, Silvia, 2009, Use of StreamStats in the upper French Broad River basin, North Carolina—A pilot water-resources Web application: U.S. Geological Survey Fact Sheet 2009–3088, 4 p. (<http://pubs.usgs.gov/fs/2009/3088/>)

Weaver, J.C., Feaster, T.D., and Gotvald, A.J., 2009, Magnitude and frequency of rural floods in the Southeastern United States, through 2006—Volume 2, North Carolina: U.S. Geological Survey Scientific Investigations Report 2009–5158, 111 p. (<http://pubs.usgs.gov/sir/2009/5158/>)

### **North Dakota**

- No activities underway.

### **Ohio**

- A network of 18 crest-stage gages was operated in cooperation with the Ohio DOT and the Ohio Department of Natural Resources. The crest-stage gage data will be used to augment existing flood-frequency information available for Ohio.
- The U.S. Geological Survey (USGS) Ohio Water Science Center and a coalition of seven partner agencies (including the Ohio DOT) are currently developing a state-of-the-art advanced flood-warning system for about 40 stream miles in Licking County, Ohio. The objectives of the work are to (1) enhance the flood-forecasting ability of NWS by reestablishing a previously discontinued stream gage, upgrading an existing lake-level gage, and installing two new stream gages, (2) develop static flood-inundation boundaries for a range of stages along selected reaches of four streams that will be linked to NWS flood forecasts and served on the NWS Advanced Hydrologic Prediction Service (AHPS) Web pages, (3) facilitate advanced flood warning to the area of Buckeye Lake and Interstate 70 by developing an unsteady-flow hydraulic model to be used by the NWS in conjunction with NWS forecast flows, and (4) publish a report detailing the methods used in and results from development of the system.

### **Oklahoma**

- Work continues on implementation of StreamStats with input of newer equations and basin characteristics data.

#### **Recent Publication:**

Lewis, J.M., 2010, Methods for Estimating the Magnitude and Frequency of Peak Streamflows for Unregulated Streams in Oklahoma: U.S. Geological Survey Scientific Investigations Report SIR 2010-5137, 41 p.

### **Oregon**

- No ongoing projects.

## **Pennsylvania**

- **StreamStats**— The current application of StreamStats for Pennsylvania is at <http://water.usgs.gov/osw/streamstats/pennsylvania.html>. StreamStats for Pennsylvania can be used to estimate the following flow statistics:
  - a) Low-flows: 7-day, 10-year; 7-day, 2-year; 30-day, 10-year; 30-day, 2-year; 90-day, 10-year
  - b) Base-flows: 10-year, 25-year, and 50-year recurrence intervals
  - c) Mean flows: including the harmonic mean and mean annual flow
  - d) Flood-flows: 2- year, 5- year, 10- year, 50- year, 100- year, and 500-year recurrence intervals.

The recent statistics were generated using methods described in <http://pubs.usgs.gov/fs/2010/3086/>. The application also can be used to determine selected basin characteristics at ungaged sites throughout the state.

In 2010, streamflow statistics were generated for 526 streamgages located in Pennsylvania and surrounding states using data collected through 2008. Update streamflow statistics for low flows, base flows, peak flows, mean annual and harmonic mean flows, and flow durations will soon be published in a USGS Open-File report and will eventually be available on StreamStats.

- **Alternative streamflow measurement methods**—Continuous radar equipment will continue to be used collect water-surface velocities at the Susquehanna River at Bloomsburg, Pa. (01538700) gaging station. The installation of an upward-looking ADVN is planned for an as yet undetermined Susquehanna River site. Both installations will test a method of streamflow determination using a single-point surface-velocity method.

The use of these instruments and the method is ideal especially during unsteady flow events such as those created by debris and ice jams and will help to provide real-time streamflow estimates throughout the year without the need for a series of flow measurements. A journal article describing the work is available at: [Measuring real-time streamflow using emerging technologies](#). Additional velocity data are being collected in open-water and ice-cover conditions at other sites that are a high-priority for the National Weather Service. The additional data will be corroborated with recently acquired acoustic velocity meters and an enhanced radar antenna.

- **Flood inundation mapping**—Development of flood inundation maps for selected water-surface elevations at National Weather Service (NWS) flood forecast points in the Susquehanna River basin. The initial study was located on the West Branch Susquehanna River at Jersey Shore, Pa. The final inundation map will be displayed on the NWS Advanced Hydrologic Prediction Service web site and is currently displayed on the Susquehanna River Basin Commission Inundation Mapping Viewer (<http://maps.srb.com>). Paper versions of the flood-inundation plates have been made available to county and local emergency management agencies. The project was completed in 2010.

A second study was initiated late in 2010 and is located on the West Branch Susquehanna River at Lewisburg and Milton, Pa. As with the previous project, digital and paper maps will be available. The project is scheduled to be completed in 2011.

- **Definition of high-flow stage-discharge relationships**—The primary use of extended ratings is to support river-basin flood forecasting and local flood warning. However, relating stage to streamflows that have not yet occurred or have occurred very infrequently can be useful to engineering studies related to the design and maintenance of structures. In 2009 and 2010 in the Susquehanna River Basin, ratings at 42 streamgages were evaluated and extended as necessary to 125 percent of the period-of-record flood. Stage-discharge ratings used to produce real-time streamflow are available at the USGS Ratings Depot ([http://nwis.waterdata.usgs.gov/nwisweb/data/exsa\\_ratXXXXXXXXX.rdb/](http://nwis.waterdata.usgs.gov/nwisweb/data/exsa_ratXXXXXXXXX.rdb/)), where XXXXXXXX is substituted with the 8-digit USGS station number to retrieve a rating table for the selected streamgage.

In 2011, an additional set of ratings at streamgages located in the Delaware River basin will be evaluated.

- **Stream restoration**—Erosion and sedimentation, hydrologic alterations, channel/streambank modification, and the associated effects on aquatic habitat have been identified as threats in the

French Creek basin in Crawford County, and are especially problematic in Wymans Run, a tributary to French Creek. Streambank erosion and sedimentation are evident throughout the watershed and contribute to flooding upstream of PA 285 bridge. Hydrologic alterations within the floodplain near the bridge, and channel modifications through the reach upstream of the bridge also factor into the flooding problems. Changes to hydrologic and sediment-transport dynamics may have adversely affected the conveyance within the channel, and its ability to transport sediment. The hydraulic impact of various stream restoration and flood control measures along the main stem of Wymans Run will be evaluated with a one-dimensional model. Results will be delivered in a USGS report that is currently being prepared.

- **Highway Runoff Load Estimation**—The MA WSC is developing a model that estimates loads of sediment and other water-quality constituents contained in runoff from highways. It is called the Stochastic Empirical Loading and Dilution Model (SELDL). PA WSC staff are involved in testing a Beta version of the model to determine its effectiveness and applicability to environmental conditions observed in PA.
- **Gages**— A cooperative network of peak-flow and continuous-record streamgages is operated statewide to provide real-time and historical stage and streamflow data to support real-time flood-warning and forecasting efforts. Streamflow data collected from streamgages in the network will also be used in the development of streamflow statistics to describe and predict low-flow and peak-flow conditions. These streamflow statistics are critical to the design of structures in, over, and near waterways.

Stations located within the Pennsylvania network and the data collected at each streamgage can be viewed at <http://waterdata.usgs.gov/pa/nwis/rt>.

Conducting weekly point sampling to determine the turbidity levels at the Laguna del Condado in San Juan, as part of the construction of a new bridge at the site highway.

### ***Puerto Rico***

- No projects to report.

### ***Rhode Island***

- No highway related projects at this time.

### ***South Carolina***

- Operates 6 continuous-record gaging stations and 49 partial-record crest-stage stations. (Number of gaging stations fluctuates slightly from year to year.)
- **Evaluation of the Maryland abutment-scour equations using field data** -The USGS, in cooperation with the Maryland State Highway Administration, used field measurements of scour to evaluate the sensitivity of the Maryland abutment-scour equation to the critical- (or threshold-) velocity variable. This evaluation was accomplished by applying four selected methods for estimating threshold velocity to the Maryland abutment-scour equation and comparing the predicted scour to the field measurements. Results indicated that performance of the Maryland abutment-scour equation was sensitive to the threshold velocity with some threshold-velocity methods producing better estimates of predicted scour than others. Additionally, results indicated that regional stream characteristics can affect the performance of the Maryland abutment-scour equation with moderate-gradient streams performing differently than low-gradient streams. Based on the findings of the investigation, guidance for selecting threshold-velocity methods for application to the Maryland abutment-scour equation are provided and limitations noted. This project was completed in the fall of 2008 and the journal article documenting the findings has been approved for publication with the Journal for the Transportation Research Board. The paper was presented at the 2010 TRB Conference and is cited below:

Benedict, S.T., 2010, Evaluation of the Maryland abutment-scour equation using selected threshold-velocity methods: *in* The Transportation Research Board 89th Annual Meeting, Washington, D.C., 2010, Proceedings: Transportation Research Board, Washington, D.C.

- **Evaluation of recently developed NCHRP abutment-scour equations** -The USGS in cooperation with the National Cooperative Highway Research Program (NCHRP) will evaluate the performance

of recently developed abutment-scour equations using 324 field measurements of abutment scour collected in South Carolina (Benedict, 2003), Maine (Lombard and Hodgkins, 2008), and the USGS National Bridge Scour Database (NBSD; <http://water.usgs.gov/osw/techniques/bs/BSDMS/index.html>, accessed May 14, 2009; Wagner and others, 2006). Results from the analysis will identify performance characteristics for each scour-prediction method and will help formulate application guidance. This project is scheduled to start in FY2011.

- **Application of South Carolina envelope curves to selected bridges in South Carolina** -The Federal Highway Administration (FHWA) has begun an initiative to encourage states to determine the characteristics of bridge foundations over waterways that are currently classified as having unknown foundations. The South Carolina Department of Transportation (SCDOT) has initiated an investigation to estimate foundations at approximately 600 bridges with unknown foundations. Once the foundation characteristics have been defined, the SCDOT will need to evaluate the bridges for scour vulnerability. The U.S. Geological Survey (USGS) has developed regional bridge-scour envelope curves for each component of scour based on three field investigations of historic scour in South Carolina. The bridge-scour envelope curves can be used to help assess the potential for scour at selected bridges without the need for a detailed hydraulic model. The purpose and objective of this investigation is to develop a protocol and template for applying the South Carolina bridge-scour envelope curves, and then assess the scour vulnerability using the envelope curves at the bridges provided by the SCDOT. The project started in late FY2010 and will be completed in FY2012.
- **Urban flood-frequency investigation** -Urbanization can produce significant changes in the flood-frequency characteristics of streams; consequently, rural basin flood-frequency relations are typically not applicable to urban streams. Updates and improvements of South Carolina's highway infrastructure at stream crossings require an ongoing understanding of flood characteristics especially for urban watersheds. In addition, urban planners and engineers need current information for establishing flood-insurance rates and other water-resource management decisions. One of the tools necessary for such management are techniques that allow for the estimation of the magnitude and frequency of floods at sites on urban streams where gaged data are not available.

In May 2010, the USGS South Carolina Water Science Center began a cooperative investigation with the South Carolina Department of Transportation to update urban flood-frequency estimates in South Carolina. The specific objectives of the investigation are to (1) update the magnitude and frequencies of peak-flows at urban stations, (2) update basin characteristics for the urban stations using consistent geographical information system methods, and (3) update the regional urban-flood-frequency equations for the 50-, 20-, 10-, 4-, 2-, 1-, 0.5-, and 0.2-percent chance exceedance flows. Similar to the rural flood-frequency investigation that was completed in 2009, the urban investigation will include urban stations from South Carolina, North Carolina, and Georgia.

- **Characterization of storm runoff from selected SCDOT Maintenance Yards** -The South Carolina Department of Transportation (SCDOT) operates maintenance yards throughout the State. At this time, the SCDOT has no data to define the quality of stormwater leaving these sites. To provide these data, the USGS, in cooperation with the SCDOT, began a 4-year investigation in October 2009 to identify and quantify constituents that are transported in stormwater runoff from two maintenance yards and a section shed. The two maintenance yards, located in North Charleston and Conway, S.C., represent facilities where equipment and road maintenance materials are stored and that conduct complete equipment repair operations. The section shed, located in Ballentine, S.C., (about 15 miles west of Columbia, S.C.) is a facility that stores equipment and road maintenance material. Water-quality samples and flow measurements of stormwater runoff are currently being collected at these sites. In addition to identifying and quantifying constituents that are transported in stormwater runoff from SCDOT maintenance facilities, the information collected in this investigation also may be used by the SCDOT in the development of stormwater management plans and to address future, potential National Pollutant Discharge Elimination System (NPDES) permit requirements to characterize and mitigate stormwater quality at these sites.

The objective of this investigation is to collect sufficient stormwater water-quality and flow data to document the type, concentration, and load of selected constituents transported from SCDOT maintenance yards by stormwater runoff. Water-quality samples are being taken from 1 to 2

locations at each site. A total of 5 sites are being sampled at this time. The total sample locations at each facility are Ballentine (1), North Charleston (2), and Conway (2). Over a two-year period, one sample per season (winter, spring, summer, and fall) will be collected at each site as a flow-weighted composite or a grab sample, as appropriate. A total of eight samples will be collected at each location. As of the end of November 2010, USGS personnel have collected four samples at the Ballentine site, three samples each at the Conway Outfall#1 and Outfall#2 sites, and two samples each at the North Charleston Upstream and Downstream sites. These samples are being analyzed for selected constituents including suspended sediment, total suspended solids, turbidity, total organic carbon, biochemical oxygen demand, selected metals, nutrients, oil and grease, and polyaromatic hydrocarbons. Flow measurements are being made at the time of sampling in order to composite the samples and compute constituent load leaving the yards. Rainfall data are being collected at each site ([http://waterdata.usgs.gov/sc/nwis/current/?type=precip&group\\_key=basin\\_cd](http://waterdata.usgs.gov/sc/nwis/current/?type=precip&group_key=basin_cd)). The results of the investigation will be published during the final year of the project.

## **South Dakota**

- Operate a network of about 50 crest-stage gages for the purpose of peak-flow analysis.
- Implementation of StreamStats in South Dakota was initiated in 2005 and was recently extended to allow incorporation of high-resolution topographic data that now have been completed. A separate project (with different cooperators) to develop a 6<sup>th</sup> level Hydrologic Unit Map for South Dakota also was recently completed and will serve as another cornerstone for StreamStats digital base layers. The project is rapidly nearing completion and public availability of the StreamStats application is anticipated by late 2010 or early 2011.
- A recent reconnaissance-level study demonstrated the utility of using paleoflood hydrology techniques to improve peak-flow frequency estimates for the Black Hills area of South Dakota. Results of the reconnaissance-level study are provided through an online-only report that is available via the SDDOT Office of Research web site at: [http://www.state.sd.us/Applications/HR19ResearchProjects/oneproject\\_search.asp?projectnbr=SD2005-12](http://www.state.sd.us/Applications/HR19ResearchProjects/oneproject_search.asp?projectnbr=SD2005-12). A subsequent study phase that involves three other cooperating agencies (besides SDDOT and USGS) was implemented within four major stream basins in the area. The approach primarily involves extrapolation of peak-flow records through stratigraphic analysis and age dating of flood slack-water deposits, which is used to develop chronologies of very large flood events that may date back as much as several millennia. The project is nearing completion and a final report currently is undergoing technical peer review. An ancillary report has been completed that describes (1) flooding associated with a recent exceptionally large thunderstorm; (2) an analysis of climatological factors affecting generation of exceptional thunderstorms in the Black Hills area; and (3) a history of large storm and flood events in the area. The citation for this report is: SIR 2010-5187: Thunderstorms and flooding of August 17, 2007, with a context provided by a History of other large storm and flood events in the Black Hills area of South Dakota ( <http://pubs.usgs.gov/sir/2010/5187/>). An associated chronology of storm and flood events is available at: <http://sd.water.usgs.gov/projects/FloodHistory/floodhistory.html>
- SDDOT and USGS recently implemented two new project starts. One project involves analysis of potential bridge scour for sites along local government roads. An important component of this work will be to develop regression equations specific to South Dakota for bridge velocity and head loss, which should substantially improve the scour predictions. The other project involves updating of statewide regression equations for estimating peak-flow magnitudes and frequencies for ungaged streams, which will improve estimates of peak-flow magnitudes for the numerous ungaged locations associated with the local government bridge sites.

## **Tennessee**

- Providing hydraulic interpretative support and miscellaneous flood-measurement support to Tennessee Department of Transportation (TDOT) as needed.
- Operating an ongoing network of 60 crest-stage gages at or near highway crossings and operating another 12 stage-discharge gages across the state for the purpose of flood-frequency analysis and general resource evaluation.
- Routinely updating basin characteristics files and statewide flood-frequency equations for ungaged

streams in Tennessee. Our most recent update was based on the region-of-influence statistical model and was completed in FY 2003.

- Large-scale study of the effects of highway construction on stream ecology throughout Tennessee—looking specifically at sediment export from disturbed areas, the efficiency of sediment control structures (EPSCs) at construction sites, sediment transport processes, the effects of sediment on downstream habitat and biotic communities, and improved methods for monitoring sediment-related effects. This work began in FY2004 and will continue through FY2014.
- Refining GIS coverages and enhancing tools and analytical protocols for the Tennessee Streamstats page (<http://water.usgs.gov/osw/streamstats/tennessee.html>). This page was completed and released in 2007.
- Developing and applying GIS techniques to identify karst features on a regional scale and producing a GIS karst dataset for Tennessee. The dataset of karst features will span the eastern 2/3 of Tennessee classified as karst and will include closed depressions and their watersheds. The GIS techniques will be applied to the highest-resolution and most accurate digital elevation datasets available for Tennessee. This work began in FY2009 and will continue through FY2011.

#### **Recent Publication:**

Diehl, T. H. and Wolfe, W. J., 2010, Suspended-Sediment Concentration Regimes for Two Biological Reference Streams in Middle Tennessee: *Journal of the American Water Resources Association*, v. 46, p. 824–837.

Diehl, T. H., and Wolfe, W. J., 2010. Suspended-Sediment Concentration Regimes for Biological Reference Streams in Tennessee, in *Proceedings of the 2<sup>nd</sup> Joint Federal Interagency Conference*, Las Vegas, NV, June 27 – July 1, 2010:  
[http://acwi.gov/sos/pubs/2ndJFIC/Contents/3F\\_Diehl\\_02\\_25\\_10.pdf](http://acwi.gov/sos/pubs/2ndJFIC/Contents/3F_Diehl_02_25_10.pdf)

#### **Texas**

- A general information product in form of fact sheet concerning the SW research program in Texas was published during the reporting period:
  - Asquith, W.H., 2010, Recent (2001--09) hydrologic history and regionalization studies in Texas: Statistical characterization of storms, floods, and rainfall-runoff relations: U.S. Geological Survey Fact Sheet 2010--3063, 2 p.
- Rational Method Assessment (FY08—10; Completed) The SW research group with the Texas Water Science Center has been engaged in a peer-to-peer research consortium with Lamar University and University of Houston in a project funded by the Texas Department of Transportation to investigate the rational method for small to moderately sized rural and urban watersheds in Texas. Over 20,000 storms from about 200 watersheds around Texas and the United States have been "parsed" through the algebra of the rational method. Two journal articles on a (1) volumetric runoff coefficient equation and (2) a rate-based runoff coefficient equation are in progress. A chapter authored by Dr. Asquith in the final report to TxDOT contains a unification of the rational method in Texas by coupling through the method the Texas flood-frequency equations of Asquith and Roussel (2009) and the Texas depth-duration frequency of rainfall atlas of Asquith and Roussel (2004). The final report is close to submission to TxDOT.

Asquith, W.H., and Roussel, M.C., 2004, Atlas of depth-duration frequency of precipitation annual maxima for Texas: U.S. Geological Survey Scientific Investigations Report 2004--5041, 106 p.

Asquith, W.H., and Roussel, M.C., 2009, Regression equations for estimation of annual peak-streamflow frequency for undeveloped watersheds in Texas using an L-moment-based, PRESS-minimized, residual-adjusted approach: U.S. Geological Survey Scientific Investigations Report 2009--5087, 48 p.

- Staggered-Barrel Culvert Research: (FY10--12) The SW research group with the Texas Water Science Center has been engaged in a peer-to-peer research consortium with Texas Tech University and University of Houston in a project funded by the Texas Department of Transportation to

investigate whether staggered or culvert barrel inlets, inlets with overlapping crowns and inverts, can be arranged to maintain gravel and similar bed-material transport through the system by frequent storm events. The project will largely be executed by physical modeling at the Texas Tech University Hydraulics lab. As of this writing, special provisions to the capR software described in the following section have been made. Further, a cohort of students at Texas Tech University under direction of Dr. Cleveland and Dr. Asquith with considerable collaboration with Kyle Strom at University of Houston have digitally recovered about 12,000 records of flume data from the literature that include conventional measures such as discharge, sediment charge, froude number, and grainsize. The research group has contributed to the Physical modeling of culverts and sediment transport at the hydraulics laboratory at Texas Tech University. The laboratory has some real-time data-collection platforms and can be seen at [http://waterdata.usgs.gov/tx/nwis/uv/?site\\_no=333509101470800](http://waterdata.usgs.gov/tx/nwis/uv/?site_no=333509101470800).

- Small Watershed Gaging Program: (FY06--10, and three more 5-year increments) -The Texas Department of Transportation and the USGS have returned in earnest to small watershed data collection. A program of about 50 crest-stage gages for flood-peak recording on small watersheds in western Texas. About ten of these gages will have autonomous stage recording and rainfall for production of rainfall and runoff data sets to drive the TxDOT research program in future decades. About three of the gages will also be operated as continuous real-time (conventional gages). An emergent contribution to hydraulic computations from this project is the development of a R-based implementation "capR" of the FORTRAN-based USGS-Culvert Analysis Program (CAP). Numerous extensions have been made. We have a functional tool that can readily process time series of contemporaneous headwater and tailwater conditions. We appear to be on track for the first 5-year extension (FY11-15) on the program. To date, we have computed discharge for about 300 peaks.
- Measurement File Data Mining and Regionalization: (FY10--13, new project) -The SW research group with the Texas Water Science Center has been engaged in a peer-to-peer research consortium with Texas Tech University, University of Houston, and University of Texas at San Antonio in a project funded by the Texas Department of Transportation to investigate the approximately 90,000 entries for 427 stations of discharge, top width, area, and mean velocity for the streamflow measurement database in Texas. The purpose of this research is to develop tools (equations) to generalize the relation between mean velocity and a given discharge along with hydraulic, watershed, and channel properties to help guide TxDOT designers in analysis and review of hydraulic models. Another purpose is to generalize the relation between discharge and hydraulic, watershed, and channel properties. For the former, an equation such as  $V_{\text{bar}} = a * (Q_{\text{design}})^b * (\text{TopWidth})^c * (\text{OtherStuff})^{\text{etc}}$  could be forthcoming and in the later, an equation such as  $Q = a * (\text{CrossArea})^b * (\text{TopWidth})^c * (\text{ChannelClassification})^d * (\text{OtherStuff})^{\text{etc}}$ . Very preliminary statistical analysis suggests that with cross-section area, top width, and mean annual precipitation that near 0.25log10 error in discharge estimation might be possible and hence useful in a variety of investigative and interpretative settings. Stay tuned.
- The Texas Department of Transportation and the USGS have returned in earnest to small watershed data collection. A program of about 50 crest-stage gages for flood-peak recording on small watersheds in western Texas. About ten of these gages will have autonomous stage recording and rainfall for production of rainfall and runoff data sets to drive the TxDOT research program in future decades. About three of the gages will also be operated as continuous real-time (conventional gages). An emergent contribution to hydraulic computations from this project is the development of a R-based implementation "capR" of the FORTRAN-based USGS-Culvert Analysis Program (CAP). We have a functional tool that can readily process time series of contemporaneous headwater and tailwater conditions.

## **Utah**

- No ongoing highway projects.

## **Vermont**

- Vermont Agency of Transportation (VTTrans) is currently funding a network of 28 crest-stage gages located in small headwater watersheds throughout the state.
- VTTrans funds approximately one-third of Vermont's stream-gaging network including gages on small

urban streams for continuing research of storm water management.

- A cooperative investigation between VTrans and the USGS began in Fiscal Year 2005 to investigate the effects of road salting on stream quality. During Fiscal Years 2006 to 2008, monitoring of stream water-quality (continuous conductance and discrete samples for chloride, sodium and calcium) and discharge were performed at 3 streams at locations upstream and downstream of state highways and data were analyzed. In Fiscal Year 2010, a USGS interpretative report was published summarizing the results of the study.

## **Virginia**

- Maintain and operate a network of 45 crest-stage gages to determine annual peak flows, document extreme flow events, and improve flood frequency estimates.
- Completion and publication of a flood frequency analysis study for streams in Virginia.
- Begin a study of flood frequency analysis for urban streams in Virginia.

### **Pending Publications**

Austin, S.H., Krstolic, J.L., Wiegand, Ute, Peak-Flow Characteristics of Virginia Streams, Scientific Investigations Report, 2011.

## **Washington**

- The WAWSC sits on a multiagency Stormwater Workgroup, which includes the Washington State Department of Transportation. This workgroup is developing a strategy for designing a coordinated stormwater-monitoring program in the Puget Sound area. Federal, State, and local agencies, Native American Tribes, business, and environmental groups are represented on the workgroup.

## **West Virginia**

- A network of crest-stage gages will continue to be operated in cooperation with WVDOT to provide on-going peak-flow data for flood-frequency information and analysis.
- WVDOT provides funding in support of operating and maintaining the streamflow-gaging stations.

### **Recent Publications:**

Messinger, Terence, 2009, Regional curves for bankfull channel characteristics in the Appalachian Plateaus, West Virginia: U.S. Geological Survey Scientific Investigations Report 2009–5242, 43 p. (<http://pubs.usgs.gov/sir/2009/5242/>)

Wiley, J.B., and Atkins, J.T., Jr., 2010, Estimation of flood-frequency discharges for rural, unregulated streams in West Virginia: U.S. Geological Survey Scientific Investigations Report 2010–5033, 78 p. (<http://pubs.usgs.gov/sir/2010/5033/>)

## **Wisconsin**

- **Effectiveness of Grass Swales at Reducing Stormwater Runoff from Urban Highways in Wisconsin-** The Wisconsin Department of Transportation (WisDOT) has a Cooperative Agreement with the Wisconsin Department of Natural Resources (WDNR) (November 2002), Trans401 (December 2002), and NR 216 (September 2002), that require the Department to establish a Storm water Management program to reduce Total Suspended Solid (TSS) loading from highway surfaces. The purpose of this study is to evaluate the performance of grass swales as a stormwater management practice. The primary objective of this study will be focused on measuring the effectiveness of grass swales at reducing stormwater runoff flowing from urban highways. It will evaluate the infiltrative capacity of grass swales and their potential to reduce pollutants such as TSS. This will be done by monitoring a section of grass swale separated into two contributing components: 1) vegetated side slopes and, 2) grassed channel. An additional section will be instrumented to monitor the grass swale as a whole.

Another goal is to transfer the results from this study to determine if Wisconsin DOT is meeting federal and state standards. The state of Wisconsin allows the use of computer models to determine

both volume and TSS reduction. By isolating individual parts of grass swales, parameters in models can be modified to simulate the site conditions.

- **Flood Frequency Analysis in Wisconsin**

- A network of 91 crest-stage gages were operated in cooperation with WisDOT to provide on-going peak-flow data for flood-frequency information and analysis.
- Completed a historic analysis of peaks from the 2008 floods that were identified as high outliers using Bulletin 17B criteria.
- Updated frequency estimates for 358 gages with at least 10 years of record through the 2008 water year.
- Completed a skewness map for the state using estimates from 323 sites unaffected by regulation or urbanization with at least 25 years of record through the 2008 water year. The map will be included in the updated “Flood Frequency in Wisconsin” report.
- Continued working on updated regression equations using GIS-based basin characteristics and data through the 2008 water year. The updated “Flood Frequency in Wisconsin” report is expected to be finished in FY2011.
- Continued working with StreamStats personnel to compile information necessary to implement StreamStats for the State. Expect implementation of StreamStats near the end of FY2011.

### ***Wyoming***

- No highway related projects at this time.