# A Partial Summary of 2011 USGS Activities

# of Interest 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. For example, on a national scale the USGS is supporting efforts to enhance and maintain the National Streamflow Statistics Program, the StreamStats flow statistics application and delivery tool, and WaterAlert, a tool for automatic notification of threshold exceedance for stream stage, streamflow, and other water-related data collected by USGS.

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

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).

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

| Project Type | Sponsoring Agencies/States |
|---|---|
| **Regional Flow Frequency/Statistics Investigations** | |
| - National Streamflow Statistics (NSS) Program | USGS |
| - StreamStats Program/automated basin characteristics | AL, AR, CA, CT, CO, HI, IA, IL, ID, IN, KS, MA, MD, MN, MS, MT, NC, ND, NH, NJ, NM, NY, OH, OK, PA, SD, TN, VA, VT, WA, WI |
| - Investigation of rural flow-frequency | CA, HI, IA, KS, MO, MA, MN, MT, MS, NC, , NM, NY, OK, PA, SD, TN, VA, WI, WV, FEMA |
| - Investigation of urban flow-frequency | IL, KS, SC, VA |
| - Investigation of small watershed flow-frequency | IA, KS, ME, MT, NE, TX |
| - Non-stationarity of peak flows | ME |
| - Updating Bulletin 17B Regional Skew Map | CA, MO, AZ |
| **Bridge Scour and Sediment Transport** | |
| - National Bridge Scour Project | None |
| - Evaluation of abutment-scour equations | MD, MN, SC, NCHRP |
| - Near real time scour monitoring | AK, MO, MS, MT, NJ |
| - Data collection and analysis | AK, ME, MN, MO, MS, MT, NE, NJ, NV, SC, SD, FHWA |
| - Investigation of scour in cohesive soils using the EFA | IL |
| - Channel stability and scour assessment | AK, MO, MS, MT, ND, NJ, NE, PA, SD, TN |
| - Investigation/modeling of sediment transport | MN, MO, MT, NE, TN, TX |
| **Hydrologic and Hydraulic River Investigations** | |
| - Investigation of bridge site hydrology and hydraulics | AL, AR, MN, MO, MT, MS, PA, TX |
| - Investigation and modeling of multi-dimensional flows | AK, AR, ND, PA |
| - Flood documentation | IA, MN, NM, NE, NY, PA, SD, TN |
| - Flood inundation mapping | GA, IL, IN, KS, ME, MI, MN, MO, NC, OH, PA, WA, WI |
| **Stream Characteristic Investigations** | |
| - Regional channel characteristics/bankfull discharge | NY, TX, WV |
| **Tidal Gages and Streamgages** | |
| - Tidal gages | FL, NC |
| - Crest stage gages to estimate annual peak flows | AK, AL, FL, GA, HI, IA, KS, LA, ME, MI, MN, MS, MO, MT, NV, NJ, NM, NY, OH, PA, SC, SD, TN, TX, UT, VT, VA, WI, WV |
| - Continuous-record discharge and stage gages | AK, HI, IA, IN, LA, ME, MD, MI, MN, MS, MO, MT, NC, NH, NJ, PA, SC, TN, TX, UT, VT, WV |
| **Water Quality and Environmental Investigations** | |
| - Evaluation of stormwater runoff models | MA, TX, FHWA |
| - Monitor water quality/quantity at selected sites | FL, HI, ME, MI, MN, MO, MT, NC, NE, NC, NV, SC, TN, UT, VT, WI |
| - Investigation of wetland impact/remediation | MN, MT |
| - Investigation of stream restoration | MT, PA |
| - Investigation of the effect of deicing chemicals | CT, NC, VT, FHWA |
| - Investigation of BMP | MN, TN, WI, FHWA |
| - Investigation of potential effects of highway construction to the GW aquifer | AR |

## *Partial Summary of USGS National Activities*

### *USGS WaterAlert*

The USGS has implemented a very popular water-threshold exceedance notification program. The system sends email or text messages when water levels or water-quality conditions meet user-specified criteria. Criteria can include greater-than, less-than, within, and out-of-range thresholds. Reporting frequencies can include once-per-event, once-per-day, or once-per-hour messaging while the condition lasts. In 2011, links were added to National Weather Service (NWS) Flood Impact (E-19) information to help users select high-flow thresholds of interest. NWS E-19 information sets include descriptions of local features such as roads or structures in the vicinity of streamgages and river stages that affect those features. The USGS WaterAlert system can be accessed at *http://water.usgs.gov/wateralert/*.

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

This USGS program is an umbrella over all streamflow information activities of the USGS. The program has five major goals - (1) to maintain a stable streamgage 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 was virtually flat funded in 2011. In FY 2012, program funding was increased by $2.5M to help stabilize the streamgaging network. The NSIP is currently funded at about 20 percent of the design funding level.

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 has now taken 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 focuses 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 the near future, 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.

In addition, the USGS is working with FEMA and various state and local agencies to update the National flood-frequency skew map now used in Bulletin 17B, the document that governs flood-frequency computation methods for Federal projects, such as Federal funded highway projects. Since the first map was published in 1976, some 35 years of additional streamflow information has accumulated, and better spatial estimation procedures have been developed (Stedinger and Griffis, 2008). A new statistical technique, Bayesian Generalized Least Squares (B-GLS) regression, is being used to calculate new regional skewness values. Thus far, this technique has been used in three studies: the Southeastern U.S. (South Carolina, North Carolina, and Georgia), the State of California, and the State of Iowa. These three studies allowed the new methodology to be tested and adapted. Instead of updating the map on a state-by-state basis, we would like to update the map on a multi-state hydrologic basis starting in the Missouri River Basin, but we are supporting efforts in Arizona. Contact Andrea Veilleux (aveilleux@usgs.gov) if you have technical questions related to the National flood-frequency skew map methodology.

Contact Robert Mason (rrmason@usgs.gov) for general information about the flood-frequency program.

## *National Streamflow Statistics*

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

The NSS program has four components—a graphical user interface (GUI), an equation calculation routine, a database, and a help feature. The GUI allows users to control the operation of the software and presents 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 equations 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/.

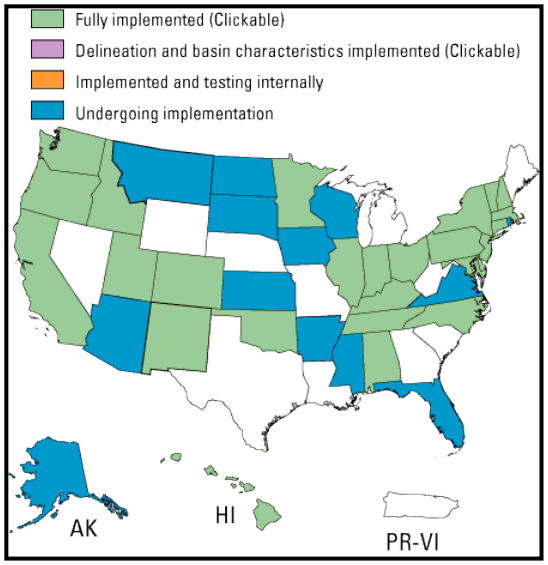
A fact sheet that describes the NSS program was published in 2007 and can be downloaded at: http://pubs.usgs.gov/fs/2007/3010/.

If you should have questions regarding this information, please contact Todd Koenig (tkoenig@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 2011, StreamStats was available to the public (fully implemented) for 26 states – Alabama (partial), California, Colorado, Connecticut, Delaware, Hawaii, Idaho, Illinois, Indiana, Kentucky, Maryland (partial), Massachusetts, Minnesota, New Hampshire, New Jersey, New Mexico (partial), New York, North Carolina (partial), Ohio, Oklahoma, Oregon, Pennsylvania, Tennessee, Utah, Vermont, and Washington. The application also was undergoing quality assurance in preparation for public release in South Dakota and Rhode Island.




(Accessed at http://water.usgs.gov/osw/streamstats/ssonline.html, January 9, 2012)

In addition to the ability to delineate drainage basins and obtain estimates of streamflow statistics for user-selected ungaged sites, StreamStats also has 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 not yet been fully implemented for all states, but is expected to be implemented everywhere that StreamStats is available by the end of fiscal year 2012. In addition, Maryland StreamStats allows users to obtain summaries of water use activities within the drainage basins for user-selected sites.

Plans for fiscal year 2012 include completing state-wide implementation of Alabama, Maryland, Rhode Island, and North Carolina, and implementing five new states - Arkansas, Arizona, Mississippi, North Dakota, and Wisconsin. In addition, updates to regression equations and/or supporting GIS datasets will be made to the applications for Hawaii, Kentucky, Maryland, Oregon, Tennessee, Utah, and Washington.

## *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 and the manual are in final technical review 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 Cazenas, 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

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 complied, about 165 reports have been cataloged and reviewed. Water-quality transport curves for dissolved chloride have been developed for 84 USEPA Nutrient Ecoregions.

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

This project will provide information and statistics that can be used to calculate potential benefits of LID and conventional BMPs using the Stochastic Empirical Loading and Dilution Model (SELDM). SELDM is designed to provide a generalized stochastic representation of BMP treatment mechanisms. BMP treatment mechanisms included in SELDM are flow reduction, hydrograph extension, and water-quality modification. These performance criteria may represent the net effect of one structural BMP or a treatment train of several structural and nonstructural BMPs. This project will provide statistics that will be entered into SELDM so that highway engineers can test different BMPs in a simple point and click environment. This project also will provide a BMP estimator tool to calculate statistics that are necessary for use with SELDM so that highway engineers and scientists can easily update the selections in SELDM as new data become available.

## *Partial Summary of USGS Water Science Center Activities of Interest to State Highway Agencies*

## *Alabama*

- The two current projects that ALWSC have with DOT are 1) Hydrologic and Hydraulic investigations at various bridge sites in Alabama (including crest-stage gage data collection effort for urban streams), 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 2011:
  - Data collected by the USGS at Bridge 339 on the Copper River Highway prompted ADOT&PF to close the bridge indefinitely Conditions were monitored with four pier mounted sonars, two satellite modem cameras, and bi-weekly bridge soundings. Nearly 50 ft of streambed scour in 2010 made the bridge unsafe for travel and ADOT&PF has initiated a bridge replacement project.
  - Monitored pier scour at 20 sites around Alaska in near real time.
  - Surveyed channel cross-sections at 76 scour-critical bridges.

**Recent Publications**

Conaway, J.S., and Brabets, T.P., 2011, Streamflow and streambed scour in 2010 at bridge 339,

Copper River, Alaska, *in* Dumoulin, J.A., and Dusel-Bacon, C., eds., Studies by the U.S. Geological Survey in Alaska, 2010: U.S. Geological Survey Professional Paper 1784-C, 24 p.

Conaway, J.S., 2011, and Knapp, M.W., Development and execution of emergency monitoring at a scour-critical bridge, *in* Proceedings of the 2011 National Hydrologic Warning Council Conference, May9-12, 20011, San Diego, California, 1 p.

## *Arizona*

- In Arizona, the existing regional regression equations used for estimating magnitude and frequency of floods were developed using peak-flow from streamflow records and watershed data through 1986. Since then, 23 years of additional peak-flow data have been collected and advanced geographical information system (GIS) data and tools are available for identifying watershed characteristics related to flood hydrology in Arizona. The AzWSC is in the final year of a project that includes the implementation of StreamStats and the updating of flood frequency relations for Arizona. In addition to flood frequencies, flood volume probabilities will be determined for selected sites. The project is in cooperation with Maricopa County and other counties throughout the state. Project completion is anticipated in September 2012.

## *Arkansas*

- 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 cooperating 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 in FY 2012.

## *California*

- A state-wide flood frequency study aimed at updating flood-frequency at gaged sites and developing prediction equations at ungaged sites is currently underway in California. As part of the flood-frequency study, new values of regional skew have been determined from a Bayesian Generalized Least Squares (GLS) regression analysis. Using the new regional skew values, flood-frequency has been updated for selected gaged sites within the Sacramento—San Joaquin River Basin. The study was done in cooperation with the U.S. Army Corp of Engineers, the Federal Emergency Management Agency and the U.S. Forest Service, and a report is available
- The state-wide flood-frequency study also includes the development of flood-frequency equations for urban ungaged streams in California and updated flood frequency for gaged sites and prediction equations for the southeastern desert region of California using a new parameter estimation method. This second SIR in cooperation with FEMA is currently in review. The new estimation equations will also be implemented in StreamStats for peakflows upon publication of study results.
- In cooperation with the U.S. Army Corps of Engineers, a skew duration study of the Central Valley region of California for the 1-day, 3-day, 7-day, 15-day, and 30-day durations is being conducted. A report describing study results is currently in review.

- Planned studies for next year include the proposal of a low-flow and/or duration study.

**Recent Publications**

Parrett, C., Veilleux, A., Stedinger, J.R., Barth, N.A., Knifong, D.L., and Ferris, J.C., 2011, Regional skew for California, and flood frequency for selected sites in the Sacramento–San Joaquin River Basin, based on data through water year 2006: U.S. Geological Survey Scientific Investigations Report 2010–5260, 94 p. ( http://pubs.usgs.gov/sir/2010/5260/ )

## *Colorado*

- The Colorado Water Science Center (CWSC), in cooperation with the Colorado Department of Transportation (CDOT), is in the second and final year in FY12 of a project which will 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 indirect discharge measurements published in USGS Water Supply Papers and Water-Data Reports; unpublished USGS indirect and paleoflood measurements published in peer-reviewed journal articles; and the peak flood of record at all USGS gages in Colorado. CDOT is interested in this information so that engineers involved in road and bridge design can consider all flood related data that have been collected for a particular location or basin. The database will also provide an efficient storage and retrieval system for the future updates. The database will also provide one location for documenting and storing USGS indirect measurements. The scope of work for this project will include only USGS data. However, the CWSC and CDOT is planning to ask other state or federal agencies to have their data added to the database. This additional work would be covered under a separate project. In FY11, all the data that will comprise the database was successfully compiled along with the database structure and composition. For FY12, the Web interface will be constructed along with several tools and functions used for data retrievals before going live to the Web at the end of the year. A USGS Open-File Report will also be published in FY12 to document the flood data found in the database and its functionality.

## *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 completed January 2011. Available at: http://pubs.usgs.gov/of/2011/1018/
- Fieldwork began in the winter of 2009 on 4 streams with monitoring sites upstream and downstream of the highway. Monitoring includes continuous conductance, temperature, and pH 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 was completed September 30, 2011. Data analysis and final report will be completed in FY2011.

## *Delaware*

- No highway related projects at this time.

## *District of Columbia*

- No highway related projects at this time.

## *Florida*

- Florida's update of the statewide flood frequency study was published May 24, 2011 (see Recent Publications below). This report supersedes the 1982 statewide report authored by Wayne Bridges.

- During fiscal year 2011 the Florida Water Science Center began a baseline monitoring project in collaboration with the Florida DOT to better understand the current hydrologic setting of the Cecil Webb and Yucca Pens managed areas. The hydrology of these two areas has been altered by recent development that includes the corridor of Interstate Highway 75 (I-75). The project includes the construction of 16 Staff and Crest Stage Gages to monitor water level peaks within managed areas, 2 real-time stage stations, and 2 tidal flow/salinity/temperature stations within Charlotte Harbor Preserve State Park, one also recording rainfall and air temperature data.

**Recent Publications**

Verdi, R.J., and Dixon, J.F., 2011, Magnitude and frequency of floods for rural streams in Florida, 2006: U.S. Geological Survey Scientific Investigations Report 2011-5034, 69p., 1pl. (http://pubs.usgs.gov/sir/2011/5034/)

## *Georgia*

- Maintain a statewide network of 60 crest-stage gages as part of an ongoing flood-frequency study.

**Recent Publications**

Gotvald, A.J and Knaak, A.E., 2011, Magnitude and frequency of floods for urban and small rural streams in Georgia, 2008: U.S. Geological Survey Open-File Report 2011-5042, 39 p. (http://pubs.usgs.gov/sir/2011/5042/)

## *Hawaii*

- Operates a network of 66 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 56 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.

## *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*

- **Pier and Contraction Scour in Cohesive Soils**--The published report below presents the results of testing the Scour Rate In Cohesive Soils-Erosion Function Apparatus (SRICOS-EFA) method for estimating scour depth of cohesive soils at 15 bridges in Illinois. In the follow-up study, a component of the SRICOS-EFA method, which includes the calculation of the maximum contraction and pier scour, known as Zmax, is further tested for 15 additional bridge sites. The sites meet geotechnical criteria for cohesive soils, and are to be modeled with scour depths calculated using SRICOS Zmax, HEC-18 and the Illinois DOT cohesive soil reduction-factor method. The results will then be compared to measured scour data. The hydraulic parameters for the Zmax calculation will be obtained from HEC-RAS/HEC-18. The soil parameter (critical shear stress) will come from the relationship published in the 2010 report, which requires input of a laboratory-determined compressive soil strength, Qu. An evaluation of the relation of laboratory with field Qu values will be completed to develop a correlation to allow field Qu values to be used to provide the critical shear stress. The approximate historic peak flow will be determined for each site, and the historic scour hole will be measured using Ground Penetrating Radar or seismic technologies to compare with modeled results.
- **Urban Flood Frequency**--In October 2010, the USGS Illinois Water Science Center, in cooperation with the U.S. Army Corps of Engineers-Chicago District, began an investigation to examine the effects of urban developments on peak streamflows. The objective is to adjust peak-flow data in urbanized northeastern Illinois to a stationary series consistent with current land-use conditions, to be used for urban flood-frequency analysis. Annual maximum series (AMS) were selected from 143 USGS streamflow stations in the seven-county area of metropolitan Chicago. AMS representing basin drainage area larger than 200 square miles or having less than 10 years of record were excluded. Among the 143 AMS, 83 ended before 1980 and 83 were crest-stage stations (CSGs); among the 60 stations that have data after 1980, two were CSGs. With the construction of flood-protection reservoirs and implementation of stormwater ordinances prompting the use of detention basins, there is evidence of decreases in peak-flood magnitudes offsetting some potential increases from increased imperviousness, and evidence of slope changes in the time series data. The historical data will be adjusted by using causative factors including precipitation, land-uses (at applicable scales and affecting runoff generation), and reservoirs (at applicable large scales and affecting channel routing) as the explanatory variables for adjusting past historical records to the 2006 NLCD land-use conditions. The next phase of the study will develop regional equations for urbanized basins. Funding is being sought from State cooperators, including the DOT.
- **StreamStats**--for rural frequency estimates was implemented for Illinois in cooperation with the IDOT and the Dept. of Natural Resources in 2009 and continues to be heavily used. The Illinois Center for Transportation briefly described StreamStats in their 6-minute video: http://ict.illinois.edu/ICT-Video.aspx. The report describing the implementation and testing of the Web application was published.

### Recent Publications


Straub, T.D., and Over, T.M., 2010, Pier and Contraction Scour Prediction in Cohesive Soils at Selected Bridges in Illinois: Illinois Center for Transportation Report FHWA-ICT-10-074, 119 p. http://ict.illinois.edu/Publications/report%20files/FHWA-ICT-10-074.pdf

Ishii, A.L., Soong, D.T., and Sharpe, J.B., 2010, Implementation and evaluation of the Streamflow Statistics (StreamStats) Web application for computing basin characteristics and flood peaks in Illinois: U.S. Geological Survey Scientific Investigations Report 2009–5197, 25 p. http://pubs.usgs.gov/sir/2009/5197/ Also published as:

Ishii, A.L., Soong, D.T., and Sharpe, J.B., 2010, Implementation and evaluation of the Streamflow Statistics (StreamStats) Web application for computing basin characteristics


## *Indiana*

- In 2011 the USGS operated 26 streamgages 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 libraries were under development in 2011 for publication in 2012; an additional three are scheduled to be completed in 2012.

### *Iowa*

- Cooperatively funds 21 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 "Floods of May 30 to June 15, 2008, in the Iowa and Cedar River Basins, Eastern Iowa" (Open-File Report 2010-1190) was published in 2011 <http://pubs.usgs.gov/of/2010/1190/pdf/of2010-1190.pdf>. The report "Floods of July 23-26, 2010, in the Little Maquoketa River and Maquoketa River Basins, Northeast Iowa" has been revised according to peer and editorial review comments and is ready for approval. The report "Floods of August 11-16, 2010, in the South Skunk River Basin, Southeast Iowa" is currently being prepared. High-water marks were surveyed for a flood in July 2011 in the Little Maquoketa River Basin in northeast Iowa.
- Iowa StreamStats—A 2006-2013 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 2011, thresholds for EMA station-analysis input files were revised for CSGs and for streamgages with historic information and redundant streamgages were identified for the Iowa Bayesian GLS skew study. EMA weighted-analysis input files through the 2010 water year were prepared for 515 streamgages included in the peak-flow study. The Iowa Bayesian GLS skew study was completed in November by OSW and EMA input files for the 515 streamgages are currently being updated with the new skew values.

### *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/.
- The Kansas Water Science Center operated 25 crest-stage gages in small drainage basins, some urban and some rural, for use in future flood frequency determinations. Annual peaks for 2010 were compiled and published in the USGS Peak Flow File.

### *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.

- **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 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 pro-vide a tool to water planners and managers to evaluate possible management alternatives, and in-crease the understanding of saltwater movement in aquifers in similar hydrogeologic settings.

- **Quality of Water and Bottom Material in Three Northern 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.

- **Potentiometric Maps of the "200-," "500-," and "700-Foot" Sands of the Lake Charles area in Southwestern Louisiana –** In the Calcasieu and Cameron Parishes, the Chicot aquifer system consists of the "200-," "500-," and "700-foot" sands of the lake Charles area, which are the principal sources fo fresh groundwater in the parishes. The declines of groundwater levels produce gradients favorable for saltwater encroachment towards the Lake Charles area. Observation wells have indicated a northward progressive movement of the freshwater-saltwater interface. The objective is to document current (2012) water levels and water-level trends in the aforementioned aquifers, and determine the general direction of ground-water flow in these aquifers.
- **Potentiometric Surface, 2010, and Water-Level Changes from 2007 to 2012 in the Sparta Aquifer in Northcentral Louisiana. –** The potentiometric surface of the Sparta aquifer in Louisiana was last documented in 2007. A current (2012) potentiometric map is needed to document water levels and water-level changes in the aquifer since 2007. Area with water-level declines will be documented, and pumping center identified.

## *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. Report is currently at peer review.
- **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 11 complete years of data collection, three sites have 10 complete years of data collection, and two have less than 7 years of data. In addition,10 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*

- Fourteen 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 semi-volatile 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 semi-volatile 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. In addition, 26 other crest-stage gages provide peak stage and flow information that is, or could be, used by local and state transportation agencies.

## *Minnesota*

- Operate a network of 77 crest-stage gages that record peak-flow at or near highway crossings. The peak-flow data collected at these stations augments data collected at the 155 continuous recording stations operated in Minnesota and enhances coverage of peak-flow measurements in the region.

- Methods used to estimate peak-flow at USGS gages in Minnesota 2011-2012--Project Objectives: Document methods used to compute peak-flow statistics for all USGS Minnesota Water Science Center peak-flow gaging stations. A web mapping application will display all high-flow gaging stations documented in the report, and provide a hyperlink to graphs, statistical tables, and period of record documentation. The first year of this project fiscal year 2011 will involve data collection, analysis, and documentation of all peak-flow stations. The web page and report will be completed in fiscal year 2012.
- StreamStats operation and maintenance for FY 12, also adding a Zoom To bridge location utility that will allow users of StreamStats to select a bridge from a list and zoom to that location.
- Provide hydraulic investigation support, and bridge scour monitoring as requested.

**Recent Publications**

Ellison, Christopher A.; Sanocki, Chris A.; Lorenz, David L.; Mitton, Gregory B.; Kruse, Gregory A., Floods of September 2010 in Southern Minnesota; 2011; SIR-2011-5045;

Robert A. Blanchard, Christopher A. Ellison, Joel M. Galloway, and Dennis A. Evans, Sediment Concentrations, Loads, and Particle-Size Distributions in the Red River of the North and Selected Tributaries near Fargo, North Dakota, during the 2010 Spring High-Flow Event; http://pubs.usgs.gov/sir/2011/5064/

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.

## *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.
- During FY 2011, continued to operate and maintain 88 crest-stage gages and 2 flood hydrograph gages. In FY 2012, added 10 crest-stage gages, of which 8 were continuous gages being lost due to other cooperator funding cuts, and 2 were at future bridge replacement sites.
- 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. Plan to be completed in FY 2012.
- 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. In FY 2011, draft reports summarizing 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) were 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.
- During FY 2010-11, as part of the Southeast Regional Assessment Project (SERAP) expanded the AL-MS Sea Level Rise (SLR) Viewer web page at: http://gom.usgs.gov/slr/index.html
- Now includes 1, 2, 3, 4, 5, and 6 ft SLR inundations for AL, MS, and FL to the east side of St. Mark's Wildlife Refuge, east of Apalachicola, FL.
- During FY 2010-11, also as part of SERAP, installed Surface Elevation Tables (SETs) at six locations to monitor vertical change in coastal marshes along the AL and MS Gulf Coast. Four SETs are located at each of the six locations. SETs are described at: http://www.pwrc.usgs.gov/set/
- During FY 2010-11, began and continued making SET readings. Working towards securing funding to continue these readings during FY 2012.

**Recent Publications**

Stoker, J., Turnipseed, D. Phil, and Wilson, K. Van, 2011, Using regional-scale pre- and post Hurricane Katrina lidar for monitoring and modeling, Recent Hurricane Research - Climate, Dynamics, and Societal Impacts, Anthony Lupo (Ed.), ISBN: 978-953-307-238-8, InTech, Available from: http://www.intechopen.com/articles/show/title/using-regional-scale-pre-and-post-hurricane-katrina-lidar-for-monitoring-and-modeling

Wilson, K. Van, and others, 2011, Sea level rise visualization on the Alabama-Mississippi and Delaware coastlines [abs.]: Proceedings of the 2010 Mississippi Water Resources Conference, Bay St. Louis, Mississippi, Nov. 3-5, 2010, p.51, Available from: http://www.wrri.msstate.edu/pdf/2010_wrri_proceedings.pdf

Selected historical reports of floods, flood frequency, low-flow frequency, basin characteristics, hydraulics, channel stability, and scour are currently available on the MS Water Science Center (MSWSC) page under publications at: http://ms.water.usgs.gov

## *Missouri*

- Continued operation of a network of 38 crest-stage gages to be used with future flood frequency study.
- Continued operation and maintenance of the statewide stream-gaging network, 7 of which are operated in cooperation with MoDOT.
- Continued operation of near-real-time scour monitors at Chariton River near Novinger, Missouri, and at both main channel piers of Missouri River at Jefferson City, Missouri.
- Bathymetric surveys of Missouri and Mississippi River bridges using multibeam echosounder during spring and summer flooding: 1 bridge on the Mississippi River near Caruthersville in early May (no report), all the bridges on the Missouri River in Missouri except Rulo, NE (35 bridges at 27 sites; work is ongoing)
- Bathymetric surveys at 7 Missouri and Yellowstone River bridges in North Dakota using multibeam echosounder in cooperation with ND-DOT, ND-WSC and NE-WSC during June flooding from required reservoir releases (no report).
- Ongoing 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 construction trestle in 2012 with report to follow.
- **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**

Huizinga, R.J., 2011, Bathymetric surveys at highway bridges crossing the Missouri and Mississippi Rivers near St. Louis, Missouri, 2011: U.S. Geological Survey Scientific Investigations Report 2011–5170, 75 p.

## *Montana*

- Bridge-scour data collection and analysis program ongoing since 1991. As part of this program, near real-time scour monitoring is being conducted at four sites.
- Small-stream peak-discharge data collection program ongoing since 1955. Currently operating 96 crest-stage gages and 3 flood-hydrograph continuous-record streamflow gages.
- Ongoing cooperative project to investigate the hydrology of selected wetland areas affected by proposed highway projects.
- Monitor scour and related hydraulic conditions at the I-90 bridge near the mouth of the Blackfoot River following the 2008 removal of Milltown Dam, which was located just downstream on the Clark Fork.
- Determine flood-frequency estimates and the impact of climate change for more than 660 USGS gaging stations in Montana based on data through water year 2011.

**Recent Publications**

Holnbeck, S.R., 2011, Investigation of pier scour in course-bed streams in Montana, 2001-2007: U.S. Geological Survey Scientific Investigations Report 2011-5107, 68 p.

## *Nebraska*

- The USGS Nebraska Water Science Center (NEWSC) documented changes in cross sections at selected bridges before, during, and after flooding events in cooperation with the Nebraska Department of Roads. Cross-section data were retrieved from historic discharge measurements and compiled and presented in a database.
- NEWSC cooperated with the NDOR to conduct sequential bathymetric surveys of the Missouri River using a multi-beam echosounder at all 16 highway bridges along the Nebraska-Iowa/South Dakota/Missouri border to monitor the effects of scour on bridge infrastructure during the 2011 Missouri flood.
- NEWSC conducted bathymetric surveys using a multi-beam echosounder of 14 pipelines crossing the Missouri River bordering Nebraska for the Pipeline Safety Hazardous Materials Administration, Department of Transportation, during the 2011 Missouri flood.

## *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 in October 2009. The report for the continuation of this project will be published in FY12.

## *New Hampshire*

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

## *New Jersey*

- 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 this year. The monitoring work being done in FY2011 includes:
    - Operate and maintain continuous-record discharge gaging stations at 11 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 2 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
    - 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.

## *New Mexico*

- **Flood Analysis**
    - Operate and maintain the New Mexico crest-stage gage network of 86 gages in ephemeral streams around the State. Fifty-two of the crest-stage gages i network 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 was partially funded by the USGS in cooperation with the USDA (Forest Service, Southwestern Region) and the New Mexico Department of Transportation (NMDOT) for FY 2011. Information about the StreamStats program and each States project status can be found at: http://water.usgs.gov/osw/streamstats/new_mexico.html.
    - The New Mexico StreamStats pilot area (the portion of the San Juan Basin within New Mexico) is complete, tested, and available online (see url above). StreamStats development efforts currently are focused on Carson National Forest areas in northern New Mexico. StreamStats development for the remainder of the state will be follow as funding allows.

## *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.
- Three to five inches of warm rain combined with significant snowmelt to produce widespread flooding in northeastern New York on April 27 – May 2, 2011. Ten US Geological Survey (USGS) streamgages in the Hudson and St. Lawrence River basins recorded new record maximums during this event, including the Hudson River at North Creek streamgage, in operation since 1907, which recorded a new period-of-record maximum discharge of 36,100 $ft^3/s$ on April 28, 2011.

- Hurricane Irene weakened to a tropical storm as the center of circulation moved over New York City on August 28, 2011. Heavy rains associated with this tropical storm caused major flooding and damage throughout many parts of eastern New York. The National Weather Service (NWS) reported rainfall totals that ranged from about 4 inches to over 16 inches as a result of this storm. This major flooding caused many road closures, destroyed several bridges, and almost completely destroyed several small towns. More than 50 USGS streamgages recorded new period-of-record maximums during this flood and preliminary estimates indicate that several peak discharges exceeded the estimated 100-year recurrence interval (1-percent annual exceedance probability). The USGS NY WSC in cooperation with FEMA and New York State Department of Transportation (NYSDOT) collected about 200 high-water-marks along the Schoharie Creek to document the peak water-surface profile during this flood.
- Heavy rains associated with Tropical storm Lee caused major flooding in parts of eastern New York on September 8-9, 2011. At least 7 USGS streamgages in the Susquehanna River basin recorded new period-of-record maximums during this event. The recently de-certified levees that protected the City of Binghamton during the major flooding in 2006 were overtopped and millions of dollars in flood damage was reported. Preliminary estimates indicate that about 6 USGS streamgages in the Susquehanna River basin recorded peak discharges that exceeded the 100-year recurrence interval (1-percent annual exceedance probability). The USGS NY WSC has submitted a proposal to document the flooding of September 8-9, 2011, but currently no agreement has been signed.
- The USGS NY WSC has performed 21 indirect discharge measurements to compute peak discharges for the floods of April 27- May 28, 2011, and Sept 8-9, 2011.
- 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.
- The USGS NY WSC prepared a draft report to update the previously published Maximum Known Stages and Discharges report for NY. This report updates these statistics at nearly 1400 streamgages in New York, but the scope of this report was revised after the major flooding experienced in 2011. The release of this draft report for review will be delayed so that it can include the many period-of-record maximums recorded in 2011. 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 continues into the 2011-2012 season.
- 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/)

Mulvihill, C. I. and B. P. Baldigo. in press. Optimizing bankfull discharge and hydraulic geometry relations for streams in New York State. Journal of the American Water Resources Association. volume(issue): pages.

## *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. A Factsheet (http://pubs.usgs.gov/fs/2009/3088/) was published to document the StreamStats application.

  As an extension of the pilot 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. The pre-delineated basins that serve as the foundation layers for basin delineations in the final application were completed during 2011. Basin characteristics and other data layers are being compiled for inclusion in the statewide application. The statewide application is targeted to be available for use in early calendar year 2012.

- 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 became 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 semi-volatile organic compounds. The final Scientific Investigations Report for the project was published in 2011 (Wagner and others, 2011).

- Began a new project to establish baseline bed-sediment chemistry and water-quality conditions of Currituck Sound in Northeastern North Carolina in the vicinity of the planned alignment of the new Mid-Currituck Bridge, which will be used to evaluate the environmental effects associated with the bridge construction and bridge deck stormwater runoff on Currituck Sound in the second phase of the study. Sampling to establish baseline conditions will be conducted over a 13-month period leading up to the planned start of bridge construction. Samples will be analyzed for a wide range of constituents that are both informative and applicable to the receiving waters and are mainly those analytes that were identified as parameters of concern in the recently completed study that characterized bridge deck stormwater runoff across North Carolina (Wagner and others, 2011). The analytes being sampled for include metals, nutrients, pH, suspended solids, polycyclic aromatic hydrocarbons (PAHs) and other organic compounds.
- 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.
- Collected approximately 2-months of continuous water-level data in Pamlico Sound near Rodanthe, NC to help NCDOT evaluate a potential change in the tidal range of Pamlico Sound as a result of the Pea Island breach of NC Highway 12 created by Hurricane Irene.

**Recent Publications**

Wagner, C.R., Fitzgerald, S.A., Sherrell, R.D., Harned, D.A., Staub, E.L., Pointer, B.H., and Wehmeyer, L.L., 2011, Characterization of stormwater runoff from bridges in North Carolina and the effects of bridge deck runoff on receiving streams: U.S. Geological Survey Scientific Investigations Report 2011–5180, 95 p. + 8 appendix tables, available online at http://pubs.usgs.gov/sir/2011/5180/.

## *North Dakota*

- Due to the high discharge of the Missouri River in 2011, hydrographic surveys were completed by the USGS to confirm any scouring that may be occurring at 7 bridges along the Missouri and Yellowstone Rivers in North Dakota. An initial survey was completed from June 3 to June 11, 2011. To monitor how the bridge scour had changed through the period of high-flows and what the channel configuration was through the Bismarck area, an additional survey was done from June 27 through July 8, 2011. The second survey included the entire 15 mile reach of the Missouri River through the Bismarck-Mandan area including around the bridge piers for three bridges. The hydrographic surveys were completed using a multibeam echosounder. The multibeam data was processed into x, y, z coordinates and the bed elevation was calculated using a Real Time Kinematic Global Positioning System (RTK GPS). A final USGS Scientific Investigations report will be completed by March 2012 describing the methods and the fully processed data collected in the surveys.

## *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*

- StreamStats is fully operational and public availability occurred in 2011.

**Recent Publications:**

Smith, S.J., and Esralew, R.A., 2010, StreamStats in Oklahoma-- Drainage-basin characteristics and peak-flow frequency statistics for ungaged streams: U.S. Geological Survey Scientific Investigations Report 2009-5255, 58 p.

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*

- SELDM - In a proposed project, the Oregon Department of Transportation (ODOT) is responsible for storm water runoff from roads, which is a significant contributor to the degradation and pollution of Oregon surface water and groundwater. The proposal is to implement the Stochastic Empirical Loading and Dilution Model (SELDM) to estimate combinations of contaminant loads and concentrations from upstream basins and highway runoff affecting the water quality of receiving streams. Specific objectives are to: 1. Develop and refine precipitation and hydrologic data needed for SELDM .2. Install precipitation and hydrologic data into the USGS Oregon StreamStats program.3. Develop and compile upstream basin and highway water-quality transport curves and data sets for Oregon applications.4. Evaluate the impacts of storm water runoff on downstream water quality at five Oregon highway sites using SELDM
- StreamStats capabilities are planned to be added in 2012 for updates to StreamStats regression equations for a past Oregon DOT project (Risley, Stonewall, and Haluska, 2008).

## *Pennsylvania*

- **StreamStats—** The current application of StreamStats for Pennsylvania is located at http://water.usgs.gov/osw/streamstats/pennsylvania.html. StreamStats for Pennsylvania can be used to estimate the following flow statistics:
  - Low-flows: 7-day, 10-year; 7-day, 2-year; 30-day, 10-year; 30-day, 2-year; 90-day, 10-year
  - Base-flows: 10-year, 25-year, and 50-year recurrence intervals
  - Mean flows: including the harmonic mean and mean annual flow
  - 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. An Open-file Report to update streamflow statistics for low flows, base flows, peak flows, mean annual and harmonic mean flows, and flow durations was published in 2011 and is available at http://pubs.usgs.gov/of/2011/1070/.
- **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 ADVM 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 and was published in 2011. The second study on the West Branch Susquehanna River at Lewisburg and Milton, Pa. is in the final stages of completion and will be completed in 2012. The final inundation maps for Jersey Shore are displayed on the NWS Advanced Hydrologic Prediction Service web site (http://water.weather.gov/ahps2/inundation/inundation.php?gage=jrsp1) and on the Susquehanna River Basin Commission Inundation Mapping Viewer (http://maps.srbc.net/).
- **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 2011 in the Delaware River Basin, ratings at 4 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. The link (http://waterdata.usgs.gov/nwisweb/cgi-src/get_ratings) will provide the direct URL to each rating, nationally, that was changed in the last day. Alternatively, the link (http://waterdata.usgs.gov/nwisweb/cgi-src/get_ratings?site_no= XXXXXXXX) will return a direct URL to all ratings (base and corrected) for a streamgage of interest when XXXXXXXX is substituted with the 8-digit USGS station number associated with the streamgage.
- **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. A USGS Open-File Report was published in 2011 (Hittle, 2011)
- **Streamgages—** 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.

**Recent Publications**

Hittle, Elizabeth, 2011, Simulations of flow and prediction of sediment movement in Wymans Run, Cochranton Borough, Crawford County, Pennsylvania: U.S. Geological Survey Open-File Report 2011–1223, 25 p.

Roland, M.A., and Hoffman, S.A., 2011, Development of flood-inundation maps for the West Branch Susquehanna River near the Borough of Jersey Shore, Lycoming County, Pennsylvania: U.S. Geological Survey Scientific Investigations Report 2010–5057, 9 p.

Stuckey, M.H., and Roland, M.A., 2011, Selected streamflow statistics for streamgage locations in and near Pennsylvania: U.S. Geological Survey Open-File Report 2011–1070, 88 p.

## *Puerto Rico*

- No projects to report.

## *Rhode Island*

- No highway related projects at this time.

## *South Carolina*

- Operates 7 continuous-record gaging stations and 48 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. A journal article documenting the findings was published in the Journal for the Transportation Research Board in late 2010.
- **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 FY2012.
- **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.

- **Modification of selected South Carolina bridge-scour envelope curves -** The USGS and the SCDOT recently (2010) began a cooperative effort to test the application of the South Carolina bridge-scour envelope curves at selected bridges in South Carolina with unknown foundations. During the initial phase of that investigation it became apparent that the clear-water abutment-scour and live-bed contraction-scour envelope curves, developed in previous investigations, could be modified to include a family of curves. This modification would provide a refined assessment of the upper limit of observed historic scour depths in South Carolina, in particular for sites associated with smaller drainage areas. A review of the patterns in laboratory and field data for abutment and contraction scour led to the formulation of conceptual models for developing the modified envelope curves. Application of the conceptual models to the South Carolina field data and limited data from other locations in the United States produced a family of curves that can be used to assess the potential for clear-water abutment and live-bed contraction scour at bridges in the Piedmont and Coastal Plain of South Carolina. A report documenting this investigation is currently in review and projected to be published in 2012
- **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 which was completed in 2009, the urban investigation will include urban stations from South Carolina, North Carolina, and Georgia. The project is ongoing and expected to be completed in FY 2013.
- **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 eight samples at the Ballentine site, eight samples at the Conway Outfall#1 and seven samples at the Conway Outfall#2, and nine samples each at the North Charleston Upstream and Downstream sites. Data collection is scheduled to be completed by December 31, 2011. As of December 1, 2011, one event remains to be sampled at the Conway site. 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). The results of the investigation will be published during the final year of the project.

**Recent Publications**

Benedict, S.T., 2010, Evaluation of the Maryland abutment-scour equation through selected threshold-velocity methods: Washington, D.C., Transportation Research Board of the National Academies, Transportation Research Record, v. 2195, p. 153-167.

## *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 subsequently extended to allow incorporation of high-resolution topographic data that have since been completed. A separate project (with different cooperators) to develop a 6$^{th}$ level Hydrologic Unit Map for South Dakota also was completed and serves as another cornerstone for StreamStats digital base layers. The project is very close to completion and limited public availability of the StreamStats application was achieved late in 2011. Full-scale implementation is anticipated early in 2012.
- 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.

  A subsequent study phase that involved three other cooperating agencies (besides SDDOT and USGS) was implemented within four major stream basins in the area. The approach primarily involved extrapolation of peak-flow records through stratigraphic analysis and age dating of flood slack-water deposits, which was used to develop chronologies of very large flood events that date back as much as several millennia. The project was completed during 2011 and a final report is available (http://pubs.usgs.gov/sir/2011/5131/).

  An ancillary report also was published (http://pubs.usgs.gov/sir/2010/5187/) 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. An associated chronology of storm and flood events is available at: http://sd.water.usgs.gov/projects/FloodHistory/floodhistory.html

**Recent Publications**

Harden, T.M., O'Connor, J.E., Driscoll, D.G., and Stamm, J.F., 2011, Flood-frequency analyses from paleoflood investigations for Spring, Rapid, Boxelder, and Elk Creeks, Black Hills, western South Dakota: U.S. Geological Survey Scientific Investigations Report 2011–5131, 136 p.

## *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 FY2012.

## *Texas*

- **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 (Ted Cleveland), University of Houston (Kyle Strom), and University of Texas at San Antonio (Hatim Sharif and Xiaofeng Liu) 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 generalized the relation between discharge and hydraulic, watershed, and channel properties. For the former, an equation such as Vbar=a * (Qdesign)^b * (TopWidth)^c * (OtherStuff)^(etc) could be forthcoming and in the later, an equation such as Q=a * (CrossArea)^b * (TopWidth)^c * (ChannelClassification)^d * (OtherStuff)^(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. Several papers are now in progress or already submitted to Journals, stay tuned.

- **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 Texas Tech University (Ted Cleveland, David Thompson) and Auburn University (Xing Fang) 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. Three journal articles on a (1) volumetric runoff coefficient equation, (2) a rate-based runoff coefficient equation, and (3) recurrence interval adjustments to runoff coefficient are in progress---one accepted (Dhakal and others, 2012), two submitted. A chapter authored by Asquith (Asquith, 2011) in the final report to TxDOT (Cleveland, T.G., Fang, X., and Thompson, D.B., 2011) 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 done (Cleveland and others, 2011). An ancillary report on unit hydrographs and the rational method for the Houston metropolitan area in cooperation with TxDOT and Harris County Flood Control District is published (Asquith, Cleveland, and Roussel, 2011).
- **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 of 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 grain size. The research group has contributed to the physical modeling of culverts and sediment transport at the hydraulics laboratory at Texas Tech University. The laboratory experiments were completed in summary 2011.
- **Establish Effective Lower Bounds of Watershed Slope for Traditional Hydrologic Models**: (FY09--11) The SW research group with the Texas Water Science Center has been engaged in a peer-to-peer research consortium with Texas Tech University (Ted Cleveland, David Thompson), Auburn University (Xing Fang), and Texas A\&M (Ming-Han Li) in a project funded by the Texas Department of Transportation to investigate low-slope hydrology in Texas. Traditional hydrologic methods such as the modified rational method, unit hydrographs, as well as modeling tools such as HEC-HMS, NRCS TR-20, and EPA-SWMM rely either on an estimate of the time response characteristics of the watershed that is related to distances and slopes or directly upon slope. As slope approaches zero, relationships that contain slope in the denominator [nearly all] predict very small speeds and correspondingly large travel times. These large travel times can be quite unrealistic and alternate approaches are appropriate. The consequence of poor timing computations is likely to be under-sizing (as slope diminishes, estimated time increases, and estimated peak discharge decreases), but over-sizing using arbitrary timing values is also quite possible. Appropriately estimating characteristic times on low-slope watersheds will enhance confidence in predicting design discharges resulting in better decisions on structure size and corresponding cost, better use of money, and reduced risk of underestimation or of costly overestimation. The purpose of this project is to identify from literature, data, modeling and experiments, the dimensionless slope when alternate approaches should be considered, and to provide guidance on what approaches are appropriate in such low-slope situations. Final report is pending.

- **Small Watershed Gaging Program**: (FY06--15, and two 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 with 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 tract for the first 5-year extension (FY11-15) on the program. To date, we have computed discharge for about 300 peaks.

**Recent Publications**


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.

Asquith, W.H., 2011, A proposed unified rational method for Texas in Cleveland, T.G., Fang, X., and Thompson, D.B., 2011, Use of the rational and modified rational methods for TxDOT hydraulic design: Texas Department of Transportation Research Report 0--6070--1, section 3, pp. 18--58.

Asquith, W.H., Cleveland, T.G., and Roussel, M.C., 2011, A method for estimating peak and time of peak streamflow from excess rainfall for 10- to 640-acre watersheds in the Houston, Texas, metropolitan area: U.S. Geological Survey Scientific Investigations Report 2011--5104, 38 p.

Cleveland, T.G., Fang, X., and Thompson, D.B., 2011, Use of the rational and modified rational methods for TxDOT hydraulic design: Texas Department of Transportation Research Report 0--6070--1, 143 p.

Dhakal, N., Fang, Xing, Cleveland, T.G., Thompson, D.B., Asquith, W.H., Marzen, L.J., 2012, Estimation of runoff coefficients for Texas watersheds using land-use and rainfall-runoff data: accepted by ASCE Journal of Irrigation and Drainage, (should be Jan. 2012), doi:10.1061/(ASCE)IR.1943-4774.0000368.


Dhakal and others: There are two more papers in progress.

## *Utah*

- The Colorado River Salinity Control Forum has cooperatively funded research to investigate the effects of public lands motor vehicle “play” areas on sediment transport, by both wind and water in south-central Utah. The research area is adjacent to state highway 24 and the Fremont river in the vicinity of Factory Butte. This project is a multi-discipline effort between water, biology, and geology and is currently in the data collection phase. Four crest stage gages are being operated on culverts that pass under highway 24 and event samplers have been installed in tributaries to the Freemont. The project has also paid for the operation and maintenance of the Freemont nr Cainville (09330230) stream gage and real time temperature and conductance probe during WY 2011.

## *Vermont*

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

## *Virginia*

- A network of 45 crest-stage gages are operated in coordination with the Virginia Department of Transportation (VDOT) to determine annual peak flows, document extreme flow events, and improve flood frequency estimates.
- A cooperative study between VDOT and USGS began in Fiscal Year 2011 to develop analytical tools and equations to estimate peak flows specific to urban areas. The study will build on recently completed statewide data collection and analysis of the magnitude and frequencies of peak discharges in Virginia streams.
- A cooperative effort to implement StreamStats in Virginia is underway. StreamStats is expected to be fully implemented by the end of 2012.

**Recent Publications**

Austin, S.H., Krstolic, J.L., Wiegand, Ute, Peak-Flow Characteristics of Virginia Streams, U.S Geological Survey Scientific Investigations Report, 2011-5144.

## *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.

## *Wisconsin*

**Effectiveness of Grass Swales at Reducing Stormwater Runoff from Urban Highways**

- 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 Stormwater 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 channels. 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.
- In FY2011 equipment to monitor the grass swales was installed to evaluate infiltration rate capacity. To measure infiltration rates on the swale side slopes, three side-slope runoff collection systems were install tangentially towards the swale channel. To measure flow entering the swale, a flume was installed at a curb-cut section of the roadway. To determine the channel infiltration rate, upstream and downstream flumes were installed in the swale channel.
- Plans for FY2012 - measure and collect samples to determine infiltration rates and pollutant reductions from the swale site. Characterize the soils in the swale through geoprobing and double ring infiltration test.

**Flood Frequency Analysis**

- A network of 91 crest-stage gages was operated in cooperation with WisDOT to provide on-going peak-flow data for flood-frequency information and analysis.
- Updated frequency estimates for 367 gages with at least 10 years of record through the 2010 water year, including 47 regulated sites. The analyses used a new skewness map developed in FY2011.
- Continued working on updated regression equations using GIS-based basin characteristics and data through the 2010 water year. The updated “Flood Frequency in Wisconsin” report is expected to be finished in early FY2012.
- Worked with StreamStats personnel to determine the steps necessary to implement StreamStats for the State. Decided to use NHDPlus data to develop the GIS layers necessary for StreamStats; final data are expected to be delivered in early FY2012. Expect implementation of StreamStats late in FY2012.

**Bridge Scour**

- Continued monitoring for bridge scour using acoustic distance-sensing equipment at one site.

## *Wyoming*

- No highway related projects at this time.