

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

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Introduction

Part of the mission of the U.S. Geological Survey (USGS) is to assess the quantity, quality, and trends of the Nation's water resources, to advance the understanding of natural processes related to these resources, and to provide information that will assist resource managers and policymakers in making sound decisions. The USGS has a long history of jointly funded investigations with the Federal Highway Administration (FHWA) and State highway agencies to provide data and information to address various issues related to water resources and the Nation's transportation infrastructure. These issues cover a wide spectrum and include items such as regional flow statistics, flood documentation, regional stream characteristics, bridge scour, and water-quality assessments.

The following table and text provides a partial summary of current or recently completed USGS activities related to highway issues. Table 1 organizes the current and recent activities into categories and subcategories and gives a quick overview of the USGS programs and the State and (or) Federal agencies that are helping sponsor the programs. The text following table 1 provides more detailed information on the various activities. The text initially describes activities that have been, or are being conducted on a national level and is followed by state activities listed alphabetically by State. If you should have questions regarding this information, please contact Stephen Benedict at benedict@usgs.gov.

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

Project Type	Sponsoring Agencies/States
Regional Flow Frequency/Statistics Investigations	
- National Flood Frequency Program	FHWA
- StreamStats Program/automated basin characteristics	AZ, CT, DE, ID, KS, MN, MS, NY, NC, SD, TN, VA, WI
- Investigation of rural flow-frequency	AL, CT, DE, FL, HI, IL, IA, KS, ME, MT, NM, NY, OK, SD, TN, VA, WI
- Investigation of urban flow-frequency	KS, SC
- Investigation of small watershed flow-frequency	KS, ME, VA
- Investigation of low flow frequency	LA, ME, MT
- Investigation of hydrograph timing, rainfall hyetographs, and rainfall-duration-frequency maps	TX
Bridge Scour and Sediment Transport	
- National Bridge Scour Project	FHWA
- Scour at Contracted Bridge Sites	NCHRP
- Near real time scour monitoring	AK, GA
- Data collection and analysis	ME, PA, SC, FHWA
- Channel stability and scour assessment	AK, AZ, LA, MO, MT, PA, SD
- Investigation/modeling of sediment transport	MT, NV, TN, TX
- Investigation of bio-engineered bank protection and A-jacks scour countermeasures	OR, UT
Hydrologic and Hydraulic River Investigations	
- Investigation of bridge site hydrology and hydraulics	AL, GA, MN, MS, NY, NC, TN
- Investigation and modeling of multi-dimensional flows	AK, NC
- Flood documentation	DE, IA, NV, NY
- Investigation of leakage into subway tunnels	DC
Stream Characteristic Investigations	
- Regional channel characteristics/bankfull discharge	MT, NY, OH, WV
- Investigation of Manning's roughness coefficients	AZ, IL
Gages	
- Tidal gages	DE, NJ
- Crest stage gages to estimate annual peak flows	GA, HI, IA, KS, LA, ME, MN, MS, MO, MT, NV, NJ, NM, NY, ND, OH, SC, SD, TN, VT, VA, WV, WI
- Continuous-record discharge and stage gages	FL, IN, IA, LA, ME, MD, MS, MT, NH, ND, SC, TN, WV
- Real time monitoring network on hurricane evacuation routes; monitors stage, rain, wind, and traffic count	LA
Water Quality/Environmental Investigations	
- Evaluation of Stormwater Runoff Models	FHWA, MA
- Monitor water quality/quantity at selected sites	HI, MA, MN, NV, TN
- Investigation of wetland impact/remediation	DE, MT, PA, TN
- Investigation of stream restoration	MD
- Investigation of the impact of deicing chemicals	OH
- Investigation of BMP	SC, WI
Internet Publication of Historic Reports and Data	MS

Partial Summary of USGS National Activities

National Bridge Scour Project (FHWA)

The National Bridge Scour Project was funded by the FHWA to collect field data on scour at bridges during major floods. The project has collected data during six major floods and has compiled data collected by various state-funded projects. An analysis of the pier scour data has been completed and a revised K_2 has been developed. The HEC-18 approach to abutment and contraction scour was applied to two sites in Minnesota and the results compared with measured data. The final report (cited below) will be published in 2005

Mueller, D.S. and Wagner, C.R., 2004, Field observations and evaluations of streambed scour at bridges Washington, D.C., U.S. Department of Transportation, Federal Highway Administration, FHWA-RD-03-052, 116 p.

Scour at Contracted Bridge Sites (NCHRP and University of Louisville)

The main purpose of NCHRP Project 24-14 was to collect field data from which processes affecting scour magnitude in contracted bridge openings could be identified, to support verification of physical and numerical model studies, and to improve guidelines for applying scour-prediction methods at contracted bridge sites. The objectives were accomplished by the collection and analysis of data at 15 bridge sites. A combination of real-time and post-flood data collection activities provided comprehensive field data sets. Detailed directional velocity data were collected throughout the reaches affected by the bridge where flood and site conditions permitted (4 of 15 sites). In addition, streambed, stream bank and floodplain material properties were described. Raw data were reduced and assembled into a database accessible through the World Wide Web (<http://water.usgs.gov/osw/techniques/bs/BSDMS/index.htm>).

Scour predictions based on the methods provided in HEC-18 were compared to the observed scour at each site. Flow velocity and depth data obtained from real-time investigations along with post-flood topographic surveys were used to develop and calibrate two-dimensional hydraulic models (RMA-2 and FESWMS) at two sites. One-dimensional hydraulic models (HEC-RAS or WSPRO) were developed for all sites where sufficient cross sectional data were collected or available. The velocities obtained from numerical simulations were compared to measured velocities.

The observations and measured data demonstrate the inaccuracies of the current scour prediction methods as specified in HEC-18 related to contraction scour and abutment and the effectiveness of the Melville and Dongol method for predicting scour at a pier with debris. The most important finding is that the main sources of error in the abutment scour-prediction methods presented in HEC-18 (2001) are the scour prediction equations and not the hydraulic parameters typically obtained from one-dimensional models. Scour topography computed with the two-dimensional hydraulic model and two-dimensional sediment-transport model were also compared. A series of conclusions were provided pertaining to the following topics: factors not included in laboratory models, scour components, contraction scour, abutment scour, numerical models, and scour at pier with debris. Recommendations for future research that will advance scour-prediction methods were provided including suggested modifications to the Strategic Plan for Scour Research (NCHRP Project 24-8). An Appendix that includes 10 detailed bridge scour case studies is also provided.

Wagner, C.R., Mueller, D. S., Parola, A. C., Hagerty, D. J., and S.T. Benedict "NCHRP Project 24-14 Scour at Contracted Bridges" Transportation Research Board, National Research Council, Washington D.C. (2004).

National Flood Frequency

The National Flood Frequency Program, Version 3, (NFF) is a Windows-based computer program, developed by the USGS Office of Surface Water (OSW), that compiles into a single, user-friendly package more than 2,000 regression equations developed by the USGS for estimating flood-frequencies in 289 regions of the Nation, the Commonwealth of Puerto Rico, and the island of Tutuilla, American Samoa. NFF

also has the ability to generate flood-frequency plots and unit hydrographs, and to weight regression equation estimates with drainage-area ratio estimates based on flows at nearby gaged sites to obtain improved estimates for ungaged sites. The software and documentation can be downloaded from the NFF Web site at <http://water.usgs.gov/software/nff.html>. Documentation for the program includes: Water Resources Investigations Report 02-4168, which discusses the technical approaches used to develop the regression equations and other functionality of NFF, and provides a manual that explains use of the software; and Fact Sheet 084-02, which briefly explains the software and its use. In addition, links to on-line reports, fact sheets, and other documents are provided from the NFF Web site to document procedures for individual states.

During fiscal year 2003, the NFF database was updated with new equations for Alaska, Idaho, Ohio, Tennessee, Vermont, Wisconsin, and Wyoming. Along with the new database comes the ability to display 90-percent prediction intervals with the estimates for some of the updated States. In addition, testing was completed and a draft report was written to document version 4 the software, which will be named the National Streamflow Statistics Program (NSS). The name change was required because the new version will provide the ability to solve regression equations for estimating any types of streamflow statistics that are available for each state, such as mean flows and 7-day, 10-year low flows. NSS will also implement region-of-influence regressions that have been developed for several states. A release during winter 2005 is expected.

StreamStats Program

The USGS Office of Surface Water (OSW) has partnered with ESRI, Inc. to develop a prototype Web application named StreamStats that greatly reduces the time needed to estimate streamflow statistics for ungaged sites and to make published streamflow statistics for USGS data-collection stations easily accessible. A prototype version of StreamStats is now available for review on the Web at <http://streamstats.usgs.gov> for all of Idaho. The StreamStats prototype incorporates (1) a map-based user interface for site selection, (2) a GIS program that determines boundaries of the drainage basins for ungaged sites, measures the physical characteristics of the drainage basins, and solves regression equations to estimate streamflow statistics for the sites, and (3) a GIS database needed to display maps and determine the physical characteristics of the drainage basins. In addition, a database that provides streamflow statistics and other information for data-collection stations will be available by the end of 2004. Work also is underway to implement StreamStats in Vermont, New Hampshire, Massachusetts, Connecticut, Rhode Island, Pennsylvania, Delaware, Kentucky, Tennessee, Mississippi, Colorado, Arizona, Oregon, Utah, and Washington. Several enhancements to the program are planned. The USGS encourages review of the prototype application, and requests comments be sent GS-W StreamStats@usgs.gov.

Evaluation and Update of the Federal Highway Administration Pollutant Loadings Model for Highway Stormwater Runoff

Valid, current, and technically defensible stormwater runoff models are needed to interpret data collected by field studies, support existing highway and urban runoff planning processes, meet National Pollutant Discharge Elimination System (NPDES) requirements, and provide methods for calculation of Total Maximum Daily Loads (TMDLs) in a systematic and economic manner. The FHWA formulated a model to predict pollutant loadings and impacts from highway stormwater runoff in 1990. Unfortunately, the FHWA model currently has several limitations that affect the use of the model; defensibility and representativeness of model results, and documentation of model results. The current FHWA model was written for the DOS operating system, and does not work on newer (Windows 2000/XP) operating systems. The model was based on older data collected from the mid 1970's through the mid 1980's. Changes in materials used to build roads and vehicles, the advent of vehicular emission controls, and changes in the formulation of fuels and lubricants have substantially changed the composition of runoff in the last 20 years. Research also indicates that water-quality monitoring methods may substantially effect measurements of concentrations, and flows and the resultant calculation of runoff loads.

The existing FHWA model was framed as a dilution model with the assumption that background concentrations were zero. This approach was chosen to examine the effects of highway runoff on receiving waters and to highlight the potential effects of best management practices (BMPs) on receiving waters. Today (2004), however, regulators and decision makers will not accept a model with a background concentration of zero, and regulators are focusing on concentrations at low-flows such as the 7Q10 or 4B3, which are included in state and federal water-quality standards. This investigation will evaluate the existing model and update the model using new information and data. More specifically, the study will implement a monte-carlo model in a new software platform as a prototype for a new national model, update the existing model with more recent streamflow and water-quality information, expand the model to address regulatory concerns, and include a data-quality advisory system. This model will provide a "best estimate" (mean or median) and confidence intervals for expected EMCs. The model will utilize this best estimate and estimates of precipitation, and runoff coefficients to produce a population of estimates for loads based on the location and site characteristics of highway sites of interest.

Partial Summary of USGS District Activities Supported by the State Highway Agency

Alabama

- Performed 1-D hydrologic, hydraulic, and scour studies for bridge replacement sites as requested by the ALDOT.
- Currently updating statewide flood frequency equations.
- Recent publications:

Hedgecock, T.S., 2004, Magnitude and frequency of floods on small rural streams in Alabama, U.S. Geological Survey, Scientific Investigations Report 2004–5135,

Alaska

- Monitored near real time pier scour at 11 sites around Alaska with pier-mounted sonars.
- Surveyed channel crossings at 28 scour-critical bridges.
- Collected an extensive topographic, bathymetric, and hydraulic data set on the Knik River for the construction of a multi-dimensional hydraulic model.
- Published: Conaway, J.S., and Moran, E.H., 2004, Development and calibration of a two-dimensional hydrodynamic model of the Tanana River near Tok, Alaska: U.S. Geological Survey Open-File Report 2004-1225, 13 p.
- Launched a streambed scour website: http://ak.water.usgs.gov/usgs_scour/

Arizona

- Currently engaged in a small channel morphology/bridge scour program with Maricopa County.
- In planning stages of a multi-year project for upgrading a portion of the State's flood-frequency equations and implementing Streamstats.
- In planning stages for an investigation to determine values for Manning's roughness coefficients with a local flood control district.

Arkansas

- No highway related projects at this time.

California

- No highway related projects at this time.

Colorado

- No highway related projects at this time.

Connecticut

- Completed in FY04 development of new regression equations for estimating flood magnitudes for rural watersheds. Also, completed an evaluation of the streamflow-gaging network to determine whether the spatial coverage and range of geographic and hydrologic characteristics are adequately represented for transferring flood characteristics. Findings are documented in:

Ahearn, E.A., 2004, Regression Equations for Estimating Flood Flows for the 2-, 10-, 25-, 50-, 100-, and 500-Year Recurrence Intervals in Connecticut: U.S. Geological Survey Scientific Investigations Report 2004-5160.

accessible at <http://water.usgs.gov/pubs/sir/2004/5160/>

- In process of implementing StreamStats; Mapping Division completed in 2004 the centerline hydrography data layer with stream and watershed attributes.

Delaware

- Monitoring a remediated wetland created by DeIDOT in a former borrow pit, along with an adjacent natural wetland. Monthly water level and rainfall data are reported to DeIDOT annually.
- DeIDOT partially funds two tide gages on Atlantic coastal bays.
- Completed mapping of high-water marks throughout the Red Clay Creek basin in northern Delaware and indirect measurements of discharge at streamgaging stations in the basin to define water surface elevations and discharges for a new peak of record that occurred on Sept. 15, 2003, as a result of record rainfall generated by remnants of Hurricane Henri.
- A 2-year study in cooperation with DeIDOT was begun to update flood-flow frequency regression equations, and to implement StreamStats in Delaware.

District of Columbia

- Investigation of leakage into subway tunnels of the Washington Metropolitan Transit Authority was completed and findings are documented in the following report:

Earl A. Greene, Allen M. Shapiro, and Andrew E. LaMotte, Hydrogeologic Controls on Ground-Water Discharge to the Washington METRO Subway Tunnel Near the Medical Center Station and Crossover, Montgomery County, Maryland, 33 p., at <http://md.water.usgs.gov/publications/wrir-03-4294/>.

Florida

- Working on a 10-year coop program with the Florida State Department of Transportation that began in 1996. The intermediate goal of this program is to determine annual peak stages and discharges for 30 small basin sites in northern Florida. The anticipated climax of this program will be an update of the flood frequencies for all Florida gages, probably in the 2007 program.

Georgia

- Ongoing statewide flood and bridge-site studies at sites selected by GADOT. Open-File Reports published as needed.
- Maintain a statewide network of 50 crest-stage gages as part of ongoing flood-frequency study.
- Continue bridge scour research project. The overall investigation combines the field monitoring data of bridge scour with physical modeling in the Georgia Tech laboratory, and 3 dimensional numerical modeling also at Georgia Tech. USGS is monitoring scour at four bridges in Georgia that have been instrumented with an array of recording fathometers and Acoustic Velocity Meters on two of the bridges. The four sites transmit the scour data via satellite telemetry, and the data can be viewed near real-time via the web.

Hawaii

- Operates a network of 50 crest-stage gages to monitor peak stages and discharges at or near highway crossings on the islands of Kauai, Molokai, Maui, and Hawaii. 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 Hawaii.
- Monitors storm-water quality and quantity from a portion of the H-3 freeway and receiving water bodies. Samples are collected quarterly at 5 stations, and streamflow is continuously monitored at 3 of these stations.
- Updating flood-frequency estimates for ungaged streams in Hawaii.
- Recent publications:

Young, S.T.M., and Ball, M.T.J., 2004, Rainfall, streamflow, and water-quality data during stormwater monitoring, Halawa Stream drainage basin, Oahu, Hawaii, July 1, 2003 to June 30, 2004: U.S. Geological Survey Open-File Report 2004-1275, 30 p.

Idaho

- No highway related projects at this time.

Illinois

- Statewide Flood Frequency Update

Published an updated flood-frequency analysis for Illinois, which was partially funded by the Illinois Department of Transportation (along with Illinois Department of Natural Resources and USGS coop funds). The conventional flood-frequency analysis is conducted with data through water year 1999. Physiographically based hydrologic regions were developed, and regional skew coefficients and basin characteristics were updated and used in the analysis. In response to needs from IDNR on stream restoration, this project used the partial duration series to determine flood magnitudes corresponding to recurrence intervals lower than 5 years. The definition of recurrence interval for annual maximum series and partial duration series is different. Findings are published in the following report:

Soong, T.W., Ishii, A.L., Sharpe, J.B., Avery, C.F., 2004, Estimating Flood-Peak Discharge Magnitudes and Frequencies for Rural Streams in Illinois: U.S. Geological Survey Scientific Investigations Report 2004-5103, 147 p.

- Determine Manning's roughness coefficient for Illinois streams

Continuing data collection for n values of Illinois streams. No funding has been provided by IDOT, although project information is useful to them. Both IDOT and IDNR have provided cross-sectional data necessary for determining n values at various study sites. Data have been collected from both natural and urban streams; characteristic matrix has been developed to guide site selection; and the design for data presentation has been completed. The design format will allow users to better understand the factors contributing to the n values from field photographs and site descriptions.

Indiana

- INDOT cooperatively funds 20 continuous-record gaging stations.

Iowa

- Cooperatively funds 31 continuous-record gaging stations.
- Cooperatively funds 92 crest-stage gages.
- Cooperatively funds ongoing flood-profiles project to document water-surface profiles of significant flood events.
- Investigation to develop and evaluate flood-frequency discharge estimation methods for rural, ungaged streams in Iowa with drainage areas less than 50 square miles. Develop regional regression and probabilistic rational methods for flood estimation. Evaluate the predictive accuracy of flood estimates calculated using the newly developed regional regression equations, the probabilistic rational method, the 2001 regional regression equations, and the Iowa Runoff Chart by comparing estimates computed using these four methods to estimates computed using Bulletin 17B flood-frequency analyses.

Recent reports:

Eash, D.A., 2004, Flood of June 4, 2002, in the Indian Creek Basin, Linn County, Iowa: U.S. Geological Survey Open-File Report 2004-1074, 31 p.

Eash, D.A., 2004, Flood of June 4-5, 2002, in the Maquoketa River Basin, east-central Iowa: U.S. Geological Survey Open-File Report 2004-1250, 29 p.

Kansas

- The Kansas District 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/>.
- Cooperatively funds 32 crest-stage gages.
- The Kansas District continues to verify theoretical stage-discharge ratings using direct measurement of flow at Flood Alert streamgages operated by Johnson County. Once the ratings for all stations are verified, peak-flow information can be used to develop flood-frequency equations for urban sites.
- Currently, there are few active streamgages with drainage areas less than 10 mi² used to compute flood frequency. National Weather Service precipitation estimates from significant events shortly after their occurrence will be used to determine areas where indirect measurements are needed. The relation between discharges per unit area (Q/DA) will be related to the probability of the precipitation event, the season of the year, and other basin characteristics. These relations will be tested to determine flood frequency at ungaged sites for streams less than 10 mi² and if successful will improve flood frequency estimates for ungaged sites in small watersheds. Initially data collection will focus on the Topeka NWS radar area.

Kentucky

- No highway related projects at this time.

Louisiana

- Cooperative program to operate 14 continuous real-time streamflow data collection stations, 16 real-time stage stations, 21 crest-stage gages, and 14 flood-profile gages.
- Cooperative program to operate a real-time monitoring network located on hurricane evacuation routes. Presently operating eight real-time stations monitoring water level, precipitation, wind speed and direction, and traffic count. Network used to determine when flood inundation or wind speed will close highway evacuation routes in coastal Louisiana. Network is planned to be expanded to 22 sites.
- Recent publications:

Ensminger, P.A., and Wright L.S., 2003, Low-Flow Characteristics of Louisiana Streams: : Louisiana Department of Transportation and Development Water Resources Technical Report No. 70, 159p

Gilbert, J.J., and Green, E.J., 2003, Estimation of scour and channel stability for selected highway crossings of streams in Louisiana: Louisiana Department of Transportation and Development Water Resources Technical Report No. 67C, 114p.

Wright, L.S., and Ensminger, P.A., 2004, Regionalized Regression Equations for Estimating Low-Flow Characteristics for Selected Louisiana Streams: Louisiana Department of Transportation and Development Water Resources Technical Report no. 75, 32 p

Maine

- **Abutment Scour**—The USGS is collecting abutment-scour information during low flows at 50 older bridges in Maine with vertical concrete abutments and wingwalls. The information collected at the bridges, along with hydraulic modeling, will provide the necessary data to test the computation of abutment scour predicted by several common methods against actual abutment scour.
- **Small watershed peak flows**—For 17 basins that have drainage areas of between 1 and 10 square miles, peak flows for selected recurrence intervals are being computed with the Rational Method, TR-20, Probabilistic Rational Method and statewide regression equations. Computed flows are being compared to peak flows of selected recurrence intervals at USGS streamflow gages. Actual peak flows for 9 rainfall events at 4 sites with drainage areas of less than 1 square mile are being computed by the Rational Method and TR-20, using actual rainfall data. Computed peak flows are being compared with actual peak flows at USGS crest-stage gages.

- **Small watershed data collection**—Ongoing peak-flow data collection (crest-stage gages) on 15 streams, all basins less than one square mile. Ten sites have 5 complete years of data collection, five sites have 4 complete years of data collection.
- **Continuous streamflow data collection**—Ongoing data-collection at 10 USGS streamflow gages.
- Recently completed work:
Update of statewide flow equations—Cooperative study with MDOT and two other cooperators:

Dudley, RW, 2004, Estimating monthly, annual, and low 7-day, 10-year streamflows for ungaged rivers in Maine: U.S. Geological Survey Scientific Investigations Report 2004-5026, 22 p.

August median flows—Cooperative study MDOT and four other cooperators:

Lombard, PJ, 2004, August median streamflow on ungaged streams in eastern coastal Maine: U.S. Geological Survey Scientific Investigations Report 2004-5157, 15 p.

Maryland

- MDSHA provided 50 percent funding for 20 streamgaging stations during fiscal year 2004.
- A study is underway of the effects of stream restoration activities on streamflow, water quality, and ground water in a small urban watershed with a major highway in its headwaters.
- Technical and field assistance was provided on an as needed basis, including assessments of flood frequency under special conditions.

Massachusetts

- Final year of a cooperative project with the FHWA to evaluate and update the Federal Highway Administration Pollutant Loadings Model for highway stormwater runoff
- An assessment of stormwater discharged from state highways in Massachusetts and the development of a statewide predictive model

The purpose of the project is to document highway runoff and constituent concentrations discharged from common highway-drainage conveyance structures in Massachusetts from four primary highway sites and four additional test sites during a two-year period. This study will also evaluate the potential transferability of these data to other highway sites by relating constituent concentrations to average daily traffic volumes. These data will be used to populate a statewide version of the new national highway-runoff model (currently being developed by the USGS under agreement with the FHWA), which will be used for estimating highway-runoff concentrations and loads throughout Massachusetts.

Minnesota

- Operating a network of 77 crest-stage gages and one continuous discharge gage for flood frequency analysis.
- Provide hydraulic investigation support as requested, including bridge scour.
- Continued year two of a multi-year cooperative project to investigate the effects of a proposed four-lane divided highway on the water quality and hydrology of relatively pristine streams and wetlands that drain to a large lake important for fisheries and tourism.
- The Basin Characteristics project prepares hydrologically enhanced 1:24,000 Digital Elevation Model (DEM) data for use with automated basin characteristic and flood frequency ArcView extension. The Basin Characteristics project is updating basin characteristics for over 10,000 level 4-7 HUs in Minnesota and surrounding States.
- Stream-Slope Research: Testing automated methods of generating stream-slopes with DEMs against the manual and semi-manual methods.
- All basin characteristics data is available on-line at the Minnesota Watershed Information Project <http://gisdmnsp.cr.usgs.gov/watershed/index.htm>. This web page allows users to get basin characteristics and watershed areas for over 10,000 level 4-7 watersheds in and around Minnesota.

Mississippi

- Continued to provide streamflow records, hydrologic analyses of basins, and hydraulic analyses of the flooding potential at selected stream crossings, known as bridge-site studies. Provide MDOT the capability to query and view the bridge-site-study data and provide all current reports with embedded figures in MS Word. In FY 2004, provided data for 40 bridge-site studies, 3 scour evaluation studies, and 1 stage-duration table, and also responded to numerous data requests.
- Continued to operate and maintain 96 crest-stage gages and 1 flood hydrograph gage. In FY 2005, added 4 additional crest-stage gages.
- In FY 2004, the digitized and processed inundation boundaries for the April 1979 flood atlas of the Jackson metro area and the Hurricane Camille and Betsy flood atlases along the Mississippi Gulf Coast were made available via ArcIMS at the MS District home page at: <http://ms.water.usgs.gov/> When accessing the home page, the inundation boundaries can be found under the heading: **Surface-Water Data and Maps**, which is within the listing along the left side of the home page.
- Continued to prepare an updated version of the 1991 flood-frequency reports to include the use of GIS determined basin characteristics and the implementation of StreamStats.
- 166 historical reports are available for viewing or downloading at: <http://ms.water.usgs.gov> 106 of these reports are historical flood and flood frequency reports. HA-590 – 611, presenting bridge backwater data for 35 floods at 22 sites, were included in FY 2004. When accessing the home page, the historical reports can be found under the heading: **Publications**, which is within the listing along the left side of the home page

Missouri

- Bridge scour data collection and analysis at selected sites completed. A summary report of the Level 1, Level 1+, and Level 2 work is nearly complete.
- Operation of network of 38 crest-stage gages to be used with future flood frequency study.

Montana

- Bridge-scour data collection and analysis program ongoing since 1991.
- Small-stream peak-discharge data collection program ongoing since 1955. Currently operating over 100 crest-stage gages and 2 flood-hydrograph continuous-record streamflow gages.
- Currently working on a cooperative project to investigate the hydrology of selected wetland areas affected by proposed highway projects.
- Updated regional flood-frequency equations and put equation solver on web page. Flood-frequency analysis documented in a Water-Resources Investigations Report (WRIR 03-4308).
- Recently completed hydraulic and hydrologic investigations for a cumulative impacts study of the Upper Yellowstone River. Included were flood-plain mapping, some sediment data (bed and suspended) collection, and sediment transport modeling (BRISTARS). Flood-plain map report (Scientific Investigations Map SIM-2868) approved but not yet published, and sediment-transport modeling report expected in 2005.
- Recently completed a project to determine bankfull discharge and various channel morphologic characteristics at small, gaged streams in western Montana. Data were used to develop relations between stream characteristics and discharge at ungaged sites. Scientific Investigations Report (SIR 2004-5263) approved but not yet published.
- Initiated a project for estimation of streamflow characteristics, including low-flow, at ungaged sites.

Nebraska

- No highway related projects at this time.

Nevada

- Maintain a Statewide network of 24 crest-stage gages.

- Second year of project to monitor sediment transport in a small (16 square miles) erosion plagued drainage basin in the Carson Range of the Sierra Nevada. Limited water-chemistry samples will also be collected once at three sites and quarterly at a fourth.
- Fact sheet is being written on a thunderstorm event that resulted in some localized flooding north of Reno.

New Hampshire

- New Hampshire Department of Transportation funds approximately one-third of New Hampshire's stream-gaging network.

New Jersey

- Operate and maintain the New Jersey Tide Telemetry System, which includes 27 real-time tide gages, 29 tidal crest-stage gages, and 5 computer base stations. These gages are located on various back bays and tidal estuaries of coastal rivers. The purpose of the System is to provide real-time data for road closures and evacuations, and also to develop a long-term tide database for design purposes.
- Operate and maintain 48 crest-stage gages on small drainage basins of less than 2 square mile, and 16 older crest-stage gages under 9 square miles in drainage area. After 10-years of record have been recorded, a study to compare the gaged results with the various flood magnitude and frequency estimation methods will be initiated.

New Mexico

- 80 crest-stage gages are operated in which 35 gages have recording pressure transducers inside the 2-inch pipe. The data loggers are programmed to record at 5-minute intervals based on event sampling. Several events were recorded and validated using cork lines registered in the crest-stage gages.
- A 2005-06 flood-flow frequency report is planned which will include new and updated basin/climatic characteristics using the USGS National Elevation Dataset (NED) and other raster data layers (NOAA Atlas 14, etc).

New York

- Flood investigations including bridge-site studies and localized flood-frequency analyses.
- 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. Hurricane Ivan resulted in near 100-year discharges in the Delaware River Basin. Documentation of this is in progress.
- Have computed basin characteristics for more than 500 gaged basins throughout New York using GIS techniques and coverages. These characteristics include several land use categories, meteorological parameters, and numerous morphometric variables (based on the physical shape, drainage structure, and relief of each basin and main channel). These characteristics have been used in an update of flood-frequency relations for New York, in conjunction with updated at-site flood frequencies for nearly 400 rural, unregulated gages within and surrounding New York.
- Maintain a statewide network of 48 crest-stage gages.
- Continuing to investigate the use of GIS techniques and coverages to automate the computation of flood discharges at any unregulated site on streams in New York.
- Have initiated an effort to update a report showing the maximum known stages and discharges at nearly 1500 gaging stations in New York. Recurrence intervals will be assigned to each peak discharge, if feasible.
- A multi-year effort to develop regional hydrologic curves and regional channel-geomorphologic characteristics at bankfull discharge for streams of New York State. Relations have been developed by hydro-physiographic region and by Rosgen stream type to help define stable reach characteristics for stream-channel restoration projects. About half of the State is completed at this time. Selected references follow:

Guidelines for Surveying Bankfull Channel Geometry and Developing Regional Hydraulic-Geometry Relations for Streams of New York State (OFR 03-092)
it is available at "<http://ny.water.usgs.gov/pubs/of/of03092/>"

Regionalized Equations for Bankfull-Discharge and Channel Characteristics of Streams in New York State: Hydrologic Region 5 in Central New York (SRI 2004-1259).

The NYCDEP report for region 4/4A is:

Miller, S.J., and Davis, Dan, in press, Identifying regional relationships for bankfull discharge and hydraulic geometry at USGS stream gage sites in the Catskill Mountains New York: New York City Department of Environmental Protection, Kingston, NY.

North Carolina

- Two-Dimensional and One-Dimensional Numerical Models for Bridges in North Carolina

The objectives of the proposed study are to (1) provide the NC DOT hydraulics unit a two-dimensional numerical modeling workshop to familiarize staff engineers with the process and techniques associated with two-dimensional modeling at bridges and (2) develop a one-dimensional step-backwater model and two-dimensional hydrodynamic model for an NCDOT selected riverine bridge and compare results to field data to evaluate the ability of each model to represent field conditions. This information will help to provide an initial basis for ongoing development (through additional modeling studies at other bridge sites across the state) of modeling guidelines that will ensure cost-effective hydraulic analysis.

- Maintain Flood Frequency Estimates and Information on the Web

Continuing flood frequency project with an objective to "produce, provide and maintain flood frequency estimates on the web". The project is currently focused on developing a GIS and Microsoft ACCESS database for 15,000 bridge crossings that will include lat/long, station number, drainage area, and a digital image of selected USGS data available at those sites. The information for the 15,000 bridge sites will be made web accessible in FY05.

North Dakota

- Operate and maintain 30 crest-stage gages
- Operate and maintain 1 streamflow gaging station
- Operate and maintain 1 lake gage

Ohio

- Long-term study on the effects of highway deicing chemicals on shallow, unconsolidated aquifers in Ohio was completed. An interim report was published in 1997. The final report will be published in late 2004 or early 2005. The reference for the interim report is: Jones, A. L., and Sroka, B. N., 1997, Effects of highway deicing chemicals on shallow unconsolidated aquifers in Ohio, interim report, 1988-93: U.S. Geological Survey Water-Resources Investigations Report 97-4027, 139 p.
- A network of 18 crest-stage gages were operated in cooperation with ODOT and the Ohio Department of Natural Resources. The crest-stage gage data will be used to augment existing flood-frequency information available for Ohio.
- As part of a study to develop curves or equations for estimating bankfull depths and widths of natural streams, channel morphology and bed- and bank-material characteristics were measured at 50 stream sites in Ohio. Field data were analyzed and regionalized using a combination of graphical and statistical techniques, resulting in a set of regional curves and regression equations to estimate bankfull width, mean bankfull depth, bankfull cross-sectional area, and bankfull discharge. Using peak discharges from 40 of the sites located at streamflow-gaging stations, multiple-regression equations were developed to estimate flood-peak discharges from bankfull cross-sectional area for recurrence intervals ranging from 2 to 100 years. A report on the findings is scheduled to be completed in spring of 2005.

Oklahoma

- Continued a two-year project: "Trends in Peak Flows of Selected Streams in Oklahoma". The objectives are to: document whether significant trends exist in the magnitude of annual peak flows and mean-annual flow; evaluate possible causes of the trends, to include analysis of trends in precipitation and water use; and document if these trends have a significant effect on flood magnitudes as indicated by flood-frequency analyses of selected streamflow sites.

Oregon

- Currently investigating existing bio-engineered sites at four gaging stations in Oregon to document how bio-engineered bank protection performs over a range of hydraulic conditions. The stage, discharge, and velocity information, combined with the covering, design and construction of the bio-engineered bank protection installations will assist in evaluating and improving current design procedures.

Pennsylvania

- Currently evaluating the wetlands, riparian zones, and channel stability at Valley Creek and Saucon Creek. A database is being developed to store similar data for multiple sites with the anticipation of further data analysis as the database builds.
- Provide technical assistance on an as-needed basis for wetland bank citing. Hydrology and soils are evaluated.
- Currently evaluating channel hydraulics before and after pier replacement using an innovative design. The purpose of the re-designed piers is to protect substrate that serves as habitat for endangered mussels. A model will be used to help determine the impact.

South Carolina

- Operates 4 continuous-record gaging stations and 50 partial-record crest-stage stations.
- Based on the flood-frequency estimates at 20 urban stations, generalized least squares regression was used to develop regional regression equations. These equations can be used to estimate the 2-, 5-, 10-, 25-, 50-, and 100-year recurrence-interval flows for small urban streams in the Piedmont, upper Coastal Plain, and lower Coastal Plain physiographic provinces of South Carolina. Findings are documented in the following report:

Feaster, T.D., and Guimaraes, W.B., 2004, Estimating the magnitude and frequency of floods in small urban streams in South Carolina, 2001: U.S. Geological Survey Scientific Investigations Report 04-5030, 67 p.

Report available at <http://water.usgs.gov/pubs/sir/2004/5030/>

- A previous investigation of clear-water scour has demonstrated that field data can be used to develop tools for assessing scour in South Carolina. At present, envelopes are available to assess clear-water abutment-scour depths in the Piedmont and Coastal Plain of South Carolina and clear-water contraction-scour depths in the overbanks of Piedmont streams. In October 2002, the USGS and SCDOT began a cooperative 3-year investigation to develop similar methods to estimate clear-water pier scour in the Piedmont and Coastal Plain and clear-water contraction scour in the Coastal Plain. Data has been collected at about 120 bridges and is currently being analyzed.
- The U.S. Geological Survey, in cooperation with the Federal Highway Administration, compared predicted abutment-scour depths with field measurements of abutment-scour depth collected at 144 bridges in South Carolina. The assessment used five equations published in the Fourth Edition of "Evaluating Scour at Bridges" (Hydraulic Engineering Circular 18) including the original Froehlich, the modified Froehlich, the Sturm, the Maryland, and the HIRE equations. Final computations will be completed this year and a report documenting this investigation will be published in 2005.
- The U.S. Geological Survey, in cooperation with the Federal Highway Administration, has begun a new investigation to look at soil erosion rates selected sites in South Carolina with measured abutment scour depths. Soil samples will be collected at 5 sites and soil erosion rates will be determined using the EFA. In addition, data from previous field investigations will be compiled into a database for use by other researchers. Results will be published in 2005.

South Dakota

- Operate a network of 48 crest-stage gages for the purpose of peak flow analysis
- Work is continuing on updating our peak-flow frequency estimates for gaged streams. Analyses for a majority of the stations within the state have been completed and results are under review by DOT staff. Because of a complex situation in the Black Hills area, an effort is currently underway to evaluate an approach of using L-moments to determine reasonable frequency estimates for problematic stations in the Black Hills area.
- Work is continuing on a multi-year study initiated in 2003 to evaluate scour potential at all bridges on primary roads and highways over scourable streams using a combination of Level 1.5 and Level 2 analyses.
- Technical assistance is currently being given to evaluate the feasibility of developing an integrated approach to efficiently providing statewide GIS datasets necessary for the Watershed Modeling System in conjunction with the implementation of Streamstats in South Dakota

Tennessee

- Providing hydraulic interpretative support and miscellaneous flood-measurement support to Tennessee Department of Transportation (TDOT) as needed.
- Operating an ongoing network of 40+ crest-stage gages at or near highway crossings and operating another 15 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.
- Continuously monitoring turbidity and relating turbidity to sediment concentrations on a stream in West Tennessee. This was initiated in FY2004.
- Quantifying of the efficiency of constructed wetlands as a means of wetland remediation in West Tennessee—including an analysis of the vegetative response to changes in hydrologic regime. This study is concluding in FY2004.
- 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 should continue through FY2009.
- Building GIS coverages and developing necessary analytical protocols to adapt Streamstats for application in Tennessee. This work began in January of FY2004 and will be completed in 18 months.

Texas

- Timing Parameters of Hydrograph (FY04-05)

The SW research group with Texas District is engaged in a peer-to-peer research consortium with Texas Tech University, Lamar University, and University of Houston in a project funded by the Texas Department of Transportation to investigate the timing characteristics for runoff hydrographs on small to moderately sized rural and urban watersheds in Texas. This project was built on the foundation laid by an on-going unit hydrograph research project and a now-completed rainfall hyetograph project.

- Bed Mobility in Edwards Plateau, Central Texas (FY04-05)

The SW research group with Texas District is engaged in a peer-to-peer research consortium with Texas Tech University, Lamar University, and University of Houston in a project funded by the Texas Department of Transportation to investigate gravel transport phenomena within the Plateau. Gravel transport within high gradient streams is contributing to recurring infrastructure damage in the study area. The Department hopes that the research will contribute to enhanced design guidance on bridges and low-water crossings. The Department seeks a four-year extension (FY06-09) for the project based on preliminary findings.

- Rainfall Hyetographs (FY00-04)

The SW research group with Texas District is engaged in a peer-to-peer research consortium with Texas Tech University, Lamar University, and University of Houston in a project funded by the Texas Department of Transportation into rainfall hyetographs for small watersheds and from a 155 million value NWS rainfall data base. The project also investigated the distribution of storm depth across Texas. The project was successfully completed and several reports were produced.

- Depth-Duration Frequency Atlas (FY03-04)

The SW research group with Texas District developed 96 maps of the depth of precipitation for selected values of duration (15 minutes to 7 days) and selected values of recurrence interval (2 to 500 year)

Utah

- Continuing a multi year (2003-2007) investigation with UDOT to monitor and assess the performance of A-Jacks scour countermeasures at two bridge sites. The sites being studied consist of high gradient gravel to cobble river channels dominated by snowmelt runoff of considerable duration.

Vermont

- Vermont Agency of Transportation is currently funding a crest-stage gage network.

Virginia

- Simulation of Flood Hydrographs for Small Drainage Basins in Virginia

The objectives of the study are to evaluate existing methods used by VDOT to estimate flood hydrographs from small drainage basins, and evaluate the use of dimensionless hydrographs to estimate runoff volumes.

- Basin Boundary Delineation and Annual Flood Peaks of Streams in Virginia

The objectives of the study are (1) to develop digital basin boundaries at approximately 550 current and historic surface-water gaging stations and (2) to update annual flood-peak data for these gages in preparation for a flood frequency analysis study.

- Maintain and operate a network of 44 crest-stage gages to determine annual peak flows, document extreme flow events, and improve flood frequency estimates.

Washington

- No highway related projects at this time.

West Virginia

- Operates and maintains 20 crest stage gages.
- Provides some funding for operation and maintenance of streamflow-gaging stations.
- Collection of stream geomorphic data in the Valley and Ridge physiographic province at USGS streamflow-gaging stations. A final report is presently in review.

- Recent publications:
Messinger, Terence, and Wiley, J.B., 2004, Regional relations in bankfull channel characteristics determined from flow measurements at selected stream-gaging stations in West Virginia, 1911-2002: U.S. Geological Survey Water-Resources Investigations Report 03-4276, 43 p.

Wisconsin

- A study to update flood-frequency statistics and regional flood-frequency equations for Wisconsin in cooperation with the WIDOT was recently completed. The reference for the final report is:

Walker, J. F., and Krug, W. R., 2003, Flood-frequency characteristics of Wisconsin Streams: U. S. Geological Survey Water-Resources Investigations Report 03-4250, 37 p.

- A network of about 90 crest-stage gages will continue to be operated in cooperation with WIDOT to provide on-going peak-flow data for flood-frequency information and analysis.
- Currently working towards using automated GIS techniques to determine basin characteristics for gaged sites and allow use of the StreamStats application for ungaged sites. Future regressions will be based on watershed characteristics using GIS techniques.
- Pollutant Loadings to Storm Water Run-Off from Highways: The Impact of a Highway Sweeping Program-Phase II - This study is funded by the National Cooperative Highway Research Program and is being conducted by the WisDOT in cooperation with the U.S. Geological Survey. The objective of this study is a continuation of a previous highway sweeping study that will evaluate the effectiveness of a highway-sweeping program as a best management practice (BMP) for reducing pollutant levels. Phase II would address the data collection and analysis issues that occurred during the Phase I study and explore further the effect of material collecting in the freeway median area.

Waschbusch, R.J. 2003, Data and Method of a 1999-2000 Street Sweeping Study on an Urban Freeway in Milwaukee County, Wisconsin, U. S. Geological Survey Open file Report 03-03, 41P.

- Evaluation of Storm Water Treatment Technologies for Highway Runoff: Comparing Structural BMPs at Milwaukee's Historic Third Ward River Walk and I-794 Freeway Test Site -The Wisconsin Department of Transportation (WisDOT) is required to improve the quality of runoff from roadways under their control as part of the National Pollution Discharge Elimination System (NPDES) and an agreement with the Wisconsin Department of Natural Resources (WDNR). In addition, future state and federal regulations will prescribe new performance standards for non-point runoff management and calculation requirements for total maximum daily loads (TMDLs) of contaminants discharging in watershed basins.

One way to improve the quality of roadway runoff, particularly in urban areas, is to use structural Best Management Practices (BMPs). There are several commercially available BMPs that could be used, but these new technologies lack field performance testing and validation, especially in Wisconsin type climates. So it is essential to field test these devices to determine their contaminant removal efficiency and practical application for WisDOT.

This study is funded by the National Cooperative Highway Research Program and is being conducted by the WisDOT in cooperation with the U.S. Geological Survey. The objective of this study will evaluate two structural BMPs to determine their removal efficiency.

Wyoming

- No highway related projects at this time.