

Summary of USGS Activities Related to the FHWA and State Highway Departments

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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 computed abutment and contraction scour was applied to two sites in Minnesota and the results compared with measured data. The report was delivered to the FHWA but is now being revised to update some of the scour equations used in the analysis.

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

This project is funded by the National Cooperative Highway Research Program and is being conducted by the University of Louisville in cooperation with the U.S. Geological Survey. The objectives of this research are (1) to describe and quantify the influence of processes affecting scour magnitude in contracted openings using field data; (2) to collect and process field data for use in verification of physical and numerical model studies; (3) to develop guidelines for applying scour prediction methodology at contracted bridge sites for a wide range of common field situations; and (4) to provide recommendations for future research that will advance scour prediction methodology. The field data collection portion of this project has been completed. Real-time data during floods were collected at 7 sites in Iowa, Minnesota, South Dakota, and Alaska. In addition postflood data have been collected and analyzed at sites in Montana, Mississippi, Alaska, North Carolina, and Maryland. As processing of each site is completed that data are made available at http://ky.water.usgs.gov/Bridge_Scour/BSDMS/index.htm which also includes all of the data collected for the FHWA sponsored national bridge scour project.

National Flood Frequency

The Office of Surface Water (OSW) is hoping to release the next version of NFF in March. The software development has been completed, but confirmation by the districts is pending. Fact sheets that describe new equations for 22 states have been printed. The first draft of a WRIR will be completed by the end of January 2002. The software, fact sheets, and WRIR will all be released simultaneously through the NFF web site (<http://water.usgs.gov/osw/programs/nffp.html>). The web site currently provides a list of all states that have developed new flood-frequency equations since the previous version of NFF was released, and it provides links to on-line reports that describe the new equations.

The new version of NFF will be Windows-based rather than DOS-based, as was the previous version. It will have all the functionality of the previous version, and it adds the ability to weight regression equation estimates with drainage-area ratio estimates based on flows at nearby gaged sites to obtain improved estimates for ungaged sites. By the end of the fiscal year, OSW hopes to release an additional version of NFF that will implement region-of-influence regressions that have been developed by several states. This new version may also include the ability to determine the "cloud of influence" of basin characteristics used in regression analyses to determine whether the basin characteristics for an ungaged site are out of range. Presently, NFF just tests minimum and maximum values of individual basin characteristics to determine whether they are out of range. The "cloud of influence" looks at the multi-dimensional shape of how all the basin characteristics relate to each other to determine whether the basin characteristics for an ungaged site are out of range.

Streamstats Program

The Streamstats program seeks to develop a map-based web application that will provide published descriptive information, basin characteristics, and streamflow statistics for data-collection stations to users over the web, and to provide the ability for users to obtain estimates of streamflow statistics for ungaged sites they select. Streamstats will provide information for data-collection stations to users when they click on the location of a station on a map displayed in their web browser. Streamstats will transfer to a server the coordinates of ungaged sites selected by users from the map, and a GIS program will run to determine the drainage-basin boundary and the basin characteristics for the sites, then Streamstats will solve any available regression equations to provide estimates of streamflow statistics for the sites.

We have two contractors working on elements of Streamstats. One contractor has developed an Access database that will store information for data-collection stations and regression equations needed to estimate the streamflow statistics for ungaged sites. We are in the final stages of testing the database. We expect to distribute it to the districts within a month so that they can begin to populate it. The other contractor is working to implement the GIS and web aspects of Streamstats. His initial contract expires at the end of February, and we expect to have a working prototype by then. The prototype will solve regression equations for all or parts of ID, KS, NH, VT, and MA.

After the prototype is working, we will begin implementing Streamstats for other states. Implementation will require the Districts to populate the database, prepare any custom GIS data layers needed to solve the regression equations, and test the application to determine if results are acceptable for their states. We expect most Districts will need to rely on cooperative agreements with local agencies to complete this work, thus it will likely take years before Streamstats is a reality throughout the nation.

National Highway Runoff Water-Quality Data and Methodology Synthesis (FHWA)

Project Web Page: <http://ma.water.usgs.gov/FHWA/>

Abstracts and text of reports available at URL <http://ma.water.usgs.gov/FHWA/NDAMSP1.html>

Bibliographic database of over 2,500 relevant reports at URL

<http://ma.water.usgs.gov/FHWA/biblio/default.htm>

The U.S. Geological Survey (USGS) and the Federal Highway Administration (FHWA) are currently cooperating in a national project to evaluate FHWA's guidelines for highway-runoff quality. The objectives of the project are to determine if current guidelines for highway runoff quality are up-to-date and technically supportable, or if additional information is needed to update the guidelines. The project will also create a catalog of existing studies and available data. Information collected will be used to determine if available data are sufficient to characterize pollutant loadings and impacts attributable to highway stormwater runoff around the country.

FHWA Reports to be published in the next few months (currently in final USGS QA/QC process):

Granato, G.E., Zenone, C., and Cazenias, P.A. (eds.), 2002, National Highway Runoff Water-Quality Data and Methodology Synthesis, Volume I --Technical issues for monitoring highway runoff and urban stormwater: Washington, D.C., U.S. Department of Transportation, Federal Highway Administration, FHWA-EP-02-007, 479 p.

Granato, G.E., Dionne, S.G., Tana, C.T., and King, T.L., 2002, National Highway Runoff Water-Quality Data and Methodology Synthesis, Volume II -- Project documentation: Washington, D.C., U.S. Department of Transportation, Federal Highway Administration, FHWA-EP-02-008, 22 p. with CD-ROM

Granato, G.E., 2002, National Highway Runoff Water-Quality Data and Methodology Synthesis, Volume III -- Availability and documentation of published information for use in regional or national highway-runoff quality data synthesis: Washington, D.C., U.S. Department of Transportation, Federal Highway Administration, FHWA-EP-02-009, 71 p.

Reports approved for the National Highway Runoff Data and Methodology Synthesis are available as limited distribution open file reports pending publication by the Federal Highway Administration.

Bent, G.C., Gray, J.R., Smith, K.P., and Glysson, G.D., 2001, A synopsis of technical issues for monitoring sediment in highway and urban runoff: U.S. Geological Survey Open File Report 00-497, 51 p.

Breault, R.F., and Granato, G.E., 2000, A synopsis of technical issues for monitoring trace elements in highway runoff and urban stormwater: U.S. Geological Survey Open File Report 00-422, 67 p.

Bricker, O.P., 1999, An overview of the factors involved in evaluating the geochemical effects of highway runoff on the environment: U.S. Geological Survey Open File Report 98-630, 28 p.

Buckler, D.R., and Granato, G.E., 1999, Assessing biological effects from highway-runoff constituents: U.S. Geological Survey Open File Report 99-240, 45 p.

Church, P.E., Granato, G.E., and Owens, D.W., 1999, Basic requirements for collecting, documenting, and reporting precipitation and stormwater-flow measurements: U.S. Geological Survey Open File Report 99-255, 30 p.

Colman, J.A., Rice, K.C., and Willoughby, T.C. 2001, Methodology and significance of studies of atmospheric deposition in highway runoff: U.S. Geological Survey Open-File Report 01-259, 63 p.

Dionne, S.G., Granato, G.E., and Tana, C.K, 1999, Method for examination and documentation of basic information and metadata from published reports relevant to the study of stormwater runoff quality: U.S. Geological Survey Open File Report 99-254, 156 p.

Granato, G.E., Bank, F.G., and Cazenias, P.A., 1998 Data Quality Objectives and Criteria for Basic Information, Acceptable Uncertainty, and Quality-Assurance and Quality-Control Documentation: U.S. Geological Survey Open File Report 98-394, 17 p.

Granato, G.E., Driskell, T.R., and Nunes, Catherine, 2000, CHEMICAL HELP--A computer help application for classification and identification of stormwater constituents: U.S. Geological Survey Open-File Report 00-468, 10 p.

Granato, G.E., and Tessler, Steven, 2001, Data model and relational database design for highway runoff water-quality metadata: U.S. Geological Survey Open-File Report 00-480 25 p.

Granato, G.E., 1999, Computer Program for Point Location and Calculation of ERror (PLACER): U.S. Geological Survey Open File Report 99-99, 36 p.

Jones, B.E., 1999, Principles and Practices for Quality Assurance and Quality Control: U.S. Geological Survey Open File Report 98-636, 17 p.

Lopes, T.J., and Dionne, S.G., 1998, A Review of Semivolatile and Volatile Organic Compounds in Highway Runoff and Urban Stormwater: U.S. Geological Survey Open File Report 98-409, 67 p.

Smieszek, T.W., and Granato, G.E., 2000, Geographic information for analysis of highway runoff-quality data on a national or regional scale in the conterminous United States: U.S. Geological Survey Open-File Report 00-432, 15 p.

Tasker, G.D., and Granato, G.E., 2000, Statistical approaches to interpretation of local, regional, and national highway-runoff and urban-stormwater data: U.S. Geological Survey Open-File Report 00-491, 59 p.

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

Alaska (note this is FY01 list due to Internet restrictions imposed by the court)

- Surface-water modeling and scour analysis at selected sites
- Installation of scour monitoring equipment at two bridge sites.
- Publication of “ Methodology and Estimates of Scour at Selected Bridge Sites in Alaska”, U.S. Geological Survey Open File Report. Currently in press.
- Manning’s n verification on steep streams (48% slopes) continues.
- Flood frequency study using updated GIS routines is in progress.
- Operation of stream gages and crest-stage gages.
- Provide hydraulic investigation support as needed.

Arkansas

- Operating a network of 68 crest-stage gages for the purpose of flood frequency analysis.
- Conducting a 2-D hydrodynamic model at a complex bridge site on the White River near Clarendon, Arkansas. Two National Wildlife Refuges locate near this site are concerned about the potential effects of the proposed bridge openings on the stream velocities and backwater.

Delaware

- A remediated wetland created by DelDOT in a former borrow pit is monitored by the USGS, along with an adjacent natural wetland. Monthly water level and rainfall data are reported to DelDOT annually. Project is funded through FY2004.

Georgia

- Published: Gotvald, Anthony J., Landers, Mark N., 2001, Field monitoring of bridge scour in Georgia, Proceedings of the 2001 Georgia Water Resources Conference, pgs 518-520
- Continue 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.
- Initiated a bridge scour monitoring project. Four bridges in Georgia have been instrumented with an array of recording fathometers; and Acoustic Velocity Meters have been installed on two of the bridges. The overall investigation combines this field monitoring data with physical modeling in the Georgia Tech laboratory, and 3 dimensional numerical modeling also at Georgia Tech.

Hawaii

- Published: Wong, M.F. 2001, Sedimentation history of Waimaluhia Reservoir during highway construction, Oahu, Hawaii, 1983-98: U.S. Geological Survey Water-Resources Investigations Report 01-4001, 20p.
- Published: Wong, M.F., and Young, S.T.M., 2001, Statistical summary of hydrologic and water-quality data from the Halawa, Haiku, and Kaneohe drainage basins before, during, and after highway construction, Oahu Hawaii 1983-99: U.S. Geological Survey Open-File Report 01-64, 69p.
- In press: Wong, M.F., and Yeatts, D.S., 2002, Streamflow and suspended-sediment loads before, during, and after H-3 highway construction, North Halawa, Haiku, South Fork Kapunahala, and Kamooalii drainage basins, Oahu, Hawaii, 1983-99: U.S. Geological Survey Water-Resources Investigations Report 02-4005, 48p.
- Maintains a network of about 50 crest-stage gages to provide peak stage and discharge data to supplement Hawaii's flood frequency data base.
- Supports a project to monitor storm-water quality from the H-3 interstate and in the receiving water bodies.

- Supports a project to update the techniques used to estimate flood frequency data on ungaged streams in Hawaii.

Iowa

- Cooperatively funds 30 continuous-record gaging stations.
- Cooperatively funds 96 crest-stage gages.
- Cooperatively funds ongoing flood-profiles project to document water-surface profiles of significant flood events.
- Cooperatively funded recently completed flood-frequency estimation study.
- Published: Eash, D.A., 2001, Techniques for estimating flood-frequency discharges for streams in Iowa: U.S. Geological Survey Water-Resources Investigations Report 00-4233, 88 p.

Indiana

- A report describing a geophysical study of a salt-water plume moving from an INDOT facility has been approved, published, and distributed. The report is, "Use of Borehole and Surface Geophysics to Investigate Ground-Water Quality near a Road-Deicing Salt-Storage Facility, Valparaiso, Indiana," WRI Report 00-4070, by Martin R. Risch and Bret A. Robinson.
- A report describing the fate of road deicing salt in a shallow ground-water system in northern Indiana has been approved for publication. It will be published and distributed this coming year. The report is "Effects of Highway-Deicer Application on Ground-Water Quality in a Part of the Calumet Aquifer, Northwestern Indiana," WRI Report 01-4260, by Lee R. Watson, E. Randall Bayless, Paul M. Buszka, and John T. Wilson.
- INDOT provides full or partial funding for 7 surface-water gaging stations in Indiana.

Kentucky

- Computing mean-annual flows.
- Updating regional flood-frequency regression equations.

Maine

- Evaluation of pier scour in Maine: This project will compare predicted pier scour and observed pier scour at bridges in Maine. High-flow pier scour measurements have been made at 8 bridges since 1997.
- An examination of the effects of urban sprawl on peak-flow hydrographs at Collyer Brook, Maine: This project will examine peak flow hydrographs from the mid-1960's and the late-1990's at Collyer Brook in southern Maine. Statistical tests will be run to look for significant differences in the hydrographs. Report published: Evaluation of the Effects of Development on Peak-Flow Hydrographs for Collyer Brook, Maine; USGS Water-Resources Investigations Report 01-4156.
- Evaluating flood-flow estimation methods for very small, rural, ungaged drainage basins in Maine: Fifteen crest-stage gages and rainfall gages have been established across Maine on drainage basins from 0.2 to 1.0 square miles. After about 3 years of data collection, a preliminary report will examine the accuracy of several simple rainfall-runoff models such as the Rational Method and TR-55. After 10-12 years of data collection, a final report will examine the accuracy of 50-year peak flows computed by the rainfall-runoff models.
- Operation and maintenance of 10 continuous-record streamflow gages

Maryland

- MDSHA provides 50 percent funding for 24 stream gages, full funding for 1 other gage, and about 10 percent on 1 other. They have money invested in 26 gages of state's 118-station network.
- Participating in a small role on the a statewide project with MDSHA and the U.S. Fish and Wildlife Service to develop regional curves of channel geometry characteristics by physiographic region in Maryland. The USGS is redeveloping stage-discharge ratings at discontinued sites to increase the number of stations available for the study.

- A project of the Baltimore Ecosystem Study (National Science Foundation Long-Term Ecological Research) is investigating urban ground water and leaking water infrastructure, which is often collocated with highway infrastructure. An inventory of about 500 soil boring and well records has been compiled.
- A project of the Baltimore Ecosystem Study is investigating an approach to making indirect measurements of flashy high discharge from a storm sewer outflow.
- Provide technical assistance and field assistance on an as needed basis.

Minnesota

- Watershed updates at the HUC levels 4,5 and 6
- Automated method of generating Level 4 HUC Base maps at 1:100,000
- Research on manual and semi-manual methods of obtaining stream slope from DEMs
- Compilations of Basin-Watershed Characteristic information for flood frequency estimation
- Preparation of enhanced Watershed Web Page to include automated watershed delineation and possibly land use and slope information.
- High-low data program at 79 sites

Missouri

- Bridge scour data collection and analysis at selected sites continues.
- Published: R.J. and Rydlund, P.H. Jr., 2001, "Simulation of flow and evaluation of bridge scour at Horse Island Chute near Chester, Illinois," USGS-WRIR 01-4176, 28 p.
- 10-year crest-stage gage project throughout the state continues.

Mississippi

- Continue to provide hydrologic and hydraulic bridge site reports documenting channel instabilities and scour problems.
- Making velocity and bathymetry measurements at selected sites.
- Operate and maintain 74 crest-stage gages.
- Provided MDOT with electronic access to bridge site data via State's network.
- In FY 2001, began a 3-year project to prepare an updated version of the 1991 flood-frequency reports.
- Published the following reports:

Storm, J.B., and Turnipseed, D.P., 2001, A tethered acoustic Doppler current profile platform [abs.]: Proceedings of the 31st Mississippi Water Resources Conference, Raymond, Mississippi, April 10-11, 2001, p. 159.

Wilson, K.V., Jr., 2001, Use of USGS discharge measurements to determine scour and fill at selected stream sites in Mississippi: Proceedings of the 7th Federal Interagency Sedimentation Conference, Reno, Nevada, March 25-29, 2001, v. 1, poster 83-86.

_____, 2001, Stage, discharge, and selected water-quality data collected September 20-22, 2000, in the Pascagoula, Biloxi, and Jourdan River basins near the Mississippi Gulf Coast [abs.]: Proceedings of the 31st Mississippi Water Resources Conference, Raymond, Mississippi, April 10-11, 2001, p. 237.

_____, 2001, Relative sea-level rise as indicated by gage data along the Mississippi and Alabama Gulf Coasts: Proceedings of the American Society of Civil Engineers World Water and Environmental Resources Congress Conference, May 20-24, 2001, Orlando, Florida, 7 p.

Winters, K.E., 2001, Simulations of flooding on Tchoutacabouffa River at State Highways 15 and 67 at D'Iberville, Mississippi: U.S. Geological Survey Water-Resources Investigations Report 01-4007, 29 p. Available: http://ms.water.usgs.gov/ms_proj/main/reports.html

_____, 2001, Simulations of flooding on Tchoutacabouffa River at State Highways 15 and 67 at D'Iberville, Mississippi: Proceedings of the 31st Mississippi Water Resources Conference, Raymond, Mississippi, April 10-11, 2001, p. 201-214.

Montana

- Bridge-scour data collection and analysis program ongoing since 1991.
- Operate and maintain over 100 crest-stage gages and 5 flood-hydrograph continuous-record streamflow gages. Published Open-file Report 99-62 documenting flood-hydrograph and rainfall data collected from 1992-97.
- Currently working on a cooperative project to investigate the hydrology of selected wetland areas affected by proposed highway projects.
- Currently updating regional flood-frequency equations and developing a web-based tool for estimation of peak flows in ungaged basins. Report to be completed in 2002.
- Currently working on hydraulic and hydrologic investigations for a cumulative impacts study of the Upper Yellowstone River. This involves flood-plain mapping, some sediment data (bed and suspended) collection, and sediment transport modeling (BRISTARS).
- Initiated a project to determine bankfull discharge and various channel morphologic characteristics at small, gaged streams in western Montana. Data will be used to develop relations between stream characteristics and discharge at ungaged sites.

New Mexico

- 81 crest-stage gages are operated in which 6 gages are being test with pressure transducers. The data loggers are programmed to record on 5-minute interval for specific events.
- 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.
- Relation for estimating unit-hydrograph parameters in New Mexico (WRIR 01-4154) was released. The research presents characteristics on time to peak, lag time, and time of concentration, unit peak discharge, and runoff coefficient (Kp). Regression equations are presented to estimate the above characteristics at ungaged sites.
- A report on the geomorphic effects of channelization of the Canadian River near Raton, New Mexico is in progress. The study is in response to a 22-year recurrence interval discharge event in 1999, which resulted in flooding and road damage along portions of the river west of Ration.

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.
- Currently determining basin characteristics for more than 400 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 will be used in an update of flood-frequency relations for New York in the very near future. This analysis includes digitizing delineated drainage areas of flood-frequency sites.
- Currently updating at-site flood-frequencies for more than 400 gaging stations in New York. These log-Pearson type 3 analyses will be used in conjunction with the electronically determined GIS basin characteristics to update Statewide flood-frequency relations.
- Currently 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.
- Presented report, "Evaluating Selected Scour Equations for Bridge Piers in Coarse Streambeds in New York", by Laurence J. Welch and Gerard K. Butch at the Seventh Federal Interagency Sedimentation Conference (March 2001). Paper describes methods used to develop the New York scour equation and compares scour depths estimated from the New York equation to other scour equations. Project completed.
- Proposed program to develop regional, hydraulic-geometry models for New York streams (pending availability of funds).

Ohio

- Monitor Ohio for opportunities to collect real-time bridge scour data on floods exceeding 10-year recurrence interval. This project has only minimal funding to maintain equipment, monitor for floods, and complete visual assessment at a few bridges. Funding can be increased in the event of major floods.
- Mean-annual flows have been computed and a report is being published.
- Updating regional flood-frequency regression equations. Project scheduled for completion in 2002.
- 18 crest-stage gages were installed with the operation and maintenance funded by ODOT.
- Developing regional bankfull stage regression equations. Site selection in process. Data collection to begin in spring 2002.
- Nearing the completion of a study on the fate of road-deicing salt in various shallow Ohio groundwater systems. Funding has been received to complete the final report.

Pennsylvania

- Bridge Scour Assessment--The statewide program, started in 1993, has completed reports describing channel instability and scour condition on CD-ROM for all 13,647 bridges assessed. Flood statistics based on revised flood-frequency regression equations were added to 12,488 bridge assessment reports. A World-Wide-Web based tool that allows PennDOT to calculate scour indices was produced, and a users guide is being readied for publication. This tool is the initial phase of a product that will allow PennDOT to access Bridge Scour assessment reports on the web. The Bridge Scour Assessment program is scheduled for completion in 2002.
- Wetland "banks" inventory--USGS is assisting PennDOT in identifying acreage that is suitable for creating wetlands. The inventory is part of an organized effort to regulate wetlands as they pertain to highway project development. A wetland "bank" is a site where wetlands are restored, created, enhanced, or preserved for the purpose of providing compensatory mitigation in advance of authorized impacts to wetlands.
- Saucon Creek Highway Encroachment--This project is monitoring a wetland compensation site, a 450-foot reach of relocated tributary channel to Saucon Creek, and a newly created riparian buffer zone associated with a new roadway.
- Valley Creek Highway Encroachment--This project is monitoring a wetland compensation site, stabilization features in a reach of Valley Creek, and plantings in a riparian buffer adjacent to the creek.
- Endangered species of mussels--Monitored work of private consultants that were contracted by DOT to implement the USGS (BRD) protocol for assessing protected mussel communities at a bridge demolition and relocation project over the Allegheny River at East Brady, Pa.
- Relocation of Mussels--Allegheny River monitoring for endangered species populations following relocation at Kennerdell bridge project by BRD (Leetown Science Center) is continuing.

South Carolina

- Finalizing report on abutment scour.

Texas

- Texas District continues its multi-year research program with the Texas Department of Transportation and collaborative research with Texas Tech University, University of Houston, and Lamar University. The research program has projects involving the regional analysis of NRCS curve numbers, hydrographs (dimensionless and unit), and hyetographs and ancillary hydrologic components necessary for rural and urban small watershed drainage design. An extensive data base of 1,365 storms of pairwise streamflow and rainfall unit values has been aggregated for approximately 100 gaging stations from legacy USGS investigations and nearly 2,000 storm totals of streamflow and rainfall are available for investigation.
- TxDOT is also considering the establishment of a statewide small watershed data collection program.

Virginia

- Working on a small-basins study (basins less than 200 acres, most less than 10 acres). Six basins are instrumented for monitoring. Data will be used to evaluate the validity of the rational method.
- Maintain crest-stage gage network.

Vermont

- Network of 30 crest-stage gages.
- Updating regional flood-frequency equations and developing a “point and click” computer application that will use a GIS to automatically obtain the required basin characteristics for estimating flood frequency.

Wyoming

- Update of regional equations for estimating peak streamflows at ungaged sites.