ADVANCES
in Hydrologic Engineering
Spring 2008

Director's Comments

By Christopher N. Dunn, P.E.

Welcome to the latest edition of the HEC Newsletter. Many activities have occurred since our last newsletter, and, while we would like to describe them all, the newsletter would just be too long.

I recently completed my second year as the Director of HEC and it seems like the pace of work keeps accelerating. We continue to perform work for Corps Districts and Divisions but National activities and work with agencies outside the Corps has increased as well. Several members of HEC serve on National Teams and the interagency and international work has continued to climb. I'm not complaining as the work is varied and interesting and the funding has kept us fiscally healthy.

A few projects/programs are described in the following sections.

National Activities:

HEC continues to provide support to the Dam and Levee Safety Programs. We have members on the Policy and Procedures Teams and the Methodologies teams. Jason Needham has been working with the Consequences team to create damage and loss of life estimation techniques and then calculate damage and loss-of-life estimates for a number of possible dam and levee failure scenarios.

We Continue to write the Corps guidance on levee certification.

continued on page 2

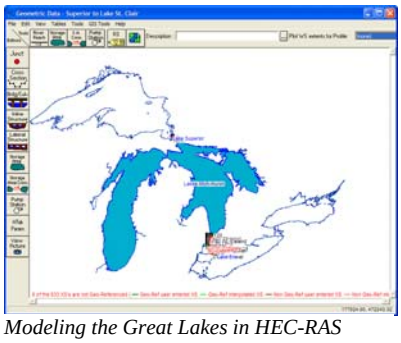
Modeling the Great Lakes in HEC-RAS

By Matthew McPherson, P.E., D WRE

The Detroit District worked with HEC to experiment with an unsteady flow HEC-RAS model for routing flows from Lake Superior to Lake St. Clair. The first phase of the work built on the District's existing partial RAS model of the St. Clair River. Work included extending the lower boundary condition through a branching delta region and into Lake St. Clair, and extending the upper boundary condition to Lake Michigan and Lake Huron, which was added as a storage area. Although the hydraulic computations in the river itself pose no special challenges to RAS, it was initially unclear how well RAS would perform regarding other aspects of typical Great Lakes routing analyses. Simulation results confirmed that RAS preserved continuity and encountered no numerical problems while managing a storage area in excess of 45,000 square miles.

The second phase of the work added Lake Superior and the St. Marys River, which included an inline structure representing the Compensating Works. The inline structure used the scripting capabilities of RAS 4.0 as a boundary condition, allowing it to call the Lake Superior regulation plan (Plan 1977A) and simulate the project's monthly operation. The complexity of Plan 1977A precluded direct implementation in the script language itself, but its availability as a portable FORTRAN module allowed it to be compiled and linked directly. The script interface simply shows Plan 1977A as one of the functions available to an inline structure.

The long simulation periods used for Great Lakes routing analyses



Modeling the Great Lakes in HEC-RAS

caused no problems for the unsteady flow numerical solution, solving eighty years of record at a three-hour computation interval in fourteen minutes. Problems arose, however, when trying to capture the full range of detail for those results. Flow and stage output hydrographs can quickly cause a DSS database file to become quite large (over 1 GB in size), making the file too unwieldy for practical use on a common desktop system. Fortunately, RAS allows modelers to specify an interval for

continued on page 6

In This Issue:

Director's Comments (continued)

Formerly, the levee certification guidance was to be an ETL but it is now being formalized as an EC. Because a few policy statements are included with the guidance, the ETL had to be converted to an EC. The EC reinforces a decade long policy on the use of risk analysis for levee certification. With this version of the EC, however, only the hydrology and hydraulics analysis must be performed with risk analysis. Other analyses such as geo-technical and structural can still employ deterministic approaches. In most cases, the EC describes how risk analysis may be used even for those disciplines that still employ deterministic approaches. In addition, the EC emphasizes the need for emergency plans and residual risk calculations for the inevitable overtopping scenario. The EC is receiving professional editing and then it will go through one more review before it is released. The current plan is to release the EC sometime this summer.

International Activities:

We have had an active international program over the last year. Listed below are a just a few of our international activities. A more complete article is provided in this newsletter. Recently, HEC has been involved in international assistance activities for Iraq, Afghanistan, India, Japan, Africa, and Korea. We are also working with Canada through the International Joint Commission and the Detroit District. The international activities range from hydrologic and hydraulic training to water resources modeling. We participated in a technical exchange with the Japanese Ministry of Land, Infrastructure, Transportation and Tourism and provided assistance on the Great Lakes modeling with the International Joint Commission. Please review the other article for a complete summary of our international work.

CWMS:

The Corps Water Management System (CWMS) continues to be updated at approximately annual intervals at the thirty plus USACE offices with water control management responsibilities. CWMS supports field-level decision making within the Corps water management mission. It embodies data acquisition, validation, transformation and management; forecasting, simulation and decision support analysis; and information dissemination. Improvements to the system continue via a field-prioritized betterments program. Version 2.0, with a release date of summer 2008, includes major revisions to the basic database structures, allowing water control users more direct access to their data and enabling them to make more effective use of the features inherent in the database at the center of CWMS. It also includes the incorporation of RiverWare from CADSWES in Boulder, Co, the latest versions of the modeling programs and numerous enhancements.

The Corps' Water Management Systems Users Representative Group, CURG, will be meeting in Davis July 8th and 9th. Then the CWMS Advisory Group will meet on the 10th. Over sixty representatives from the CURG and AG membership are expected to participate. These groups review the CWMS activities, make recommendations and set the direction for the program. They meet annually in person and by phone several times a year.

A public release of the modeling component of CWMS, named HEC-RTS (Real-Time Simulation) is scheduled for release at the end of the calendar year, 2008. Information about CWMS and other HEC software is available on the HEC web site

HEC Software:

HEC continued to enhance many software products and introduce new products during the past year; please review our website to see the latest activities. Released since the last newsletter were:

- HEC-HMS, Hydrologic Modeling Systems, Version 3.2 includes several new features and improvements to Version 3.1. The companion GIS utility package (HEC-GeoHMS) also continues to be updated and is compatible with ArcGIS 9.x versions.
- HEC-RAS, River Analysis Systems, Version 4.0. Additional features include water quality temperature modeling, sediment transport, gate rules and modeling of the Katrina event. The companion GIS utility package (HEC-GeoRAS) also continues to be updated and is compatible with ArcGIS 9.x versions
- HEC-ResSim, Reservoir Simulation Model, Version 3.0. New features with this version include new and improved outlet capabilities, operation options, and data management and analysis features.
- HEC-RPT, Regime Prescription Tool, Version 1.1. Enhancements and bug fixes were made to Version 1.0 of the RPT. The RPT assists decision makers as they define competing flow recommendations. The tool allows visualization of large

continued on page 3

US Army Corps of Engineers
Hydrologic Engineering Center
http://www.hec.usace.army.mil

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Director: Christopher N. Dunn, P.E.
Water Resource Systems Chief: Michael K. Deering, P.E.

Director's Comments (continued)

amounts of flow data and helps define consolidated flow recommendations. The ultimate goal is to combine it with the ResSim software to enhance planning and real-time operational decision making.

This past year also saw improvements to HEC-FDA (Flood Damage Analysis). It is the primary flood damage and risk analysis software package. HEC-FIA (Flood Impact Analysis), is also close to being released. FY 2008 will see releases of HEC-EFM (Ecosystem Functions Model), and HEC-SSP, the Statistical Software Package that will replace the multiple DOS based statistical applications. A beta version of the new Watershed Analysis Tool, HEC-WAT, (which includes HMS, RAS, SSP, ResSim, EFM and FIA software) has also been released and is available. Beta testing continues and release of Version 1.0 of the WAT is expected late 2008.

HEC entered into an agreement with the Sonoma County Water Agency and initiated another agreement with the South Florida Water Management District. Both of these agreements will allow HEC to add specific enhancements to the HEC software that provides capabilities for these agencies.

Another collaborative activity includes ERDC-CHL and HEC drafting a proposal to integrate HEC-ResSim and CEQUAL-W2 for modeling water-quality constituents for the operations of one or more reservoirs. In addition, HEC and the USGS, in association with Delft Hydraulics, are working together to integrate HEC-RAS and the USGS MODFLOW software. These associations will continue into 2008 and beyond.

Summary:

As we enter late Spring of 2008, HEC's program is healthy. Our R&D program is very strong. We have a number of work units within the Flood and Coastal Storm Damage Reduction and the System-Wide Water Resources R&D programs. We serve along with ERDC on a number of R&D panels and work closely with many of our ERDC colleagues. We sent strong contingents to the ASCE Conference and the Corps' Planning CoP Conference in San Antonio. For FY 2009 we have propsed sixteen PROSPECT classes so please peruse our web site to see what is there and sign up for the classes you wish to take. Huntsville has started a survey of our classes (see article below). In addition, with the full complement of training courses this year, the many and varied reimbursable projects, and the frequently requested ITR's (Independent Technical Review), HEC expects to be busy for the foreseeable future. If we can help you in any way, please let us know.

Training Program

FY 2009 Proposed PROSPECT Training Program

By Michael Deering, P.E.

HEC has submitted our proposed FY 2009 PROSPECT training schedule to the Corps' Professional Development Support Center (PDSC). The PDSC, located in Huntsville, AL, has already started the survey which will help decide which classes will actually be taught. Only the classes that have enough subscriptions will be taught. For your review and use, HEC has provided the proposed FY 2009 class list (see page 4). If you are interested in one or more of the classes make sure you let the training program in your District/ Division know so that they can report your interest to the PDSC.

HEC is offering the traditional classes such as Water and the Watershed, CWMS Modeling for Real-Time Water Management, Risk Analysis for Flood Damage Reduction Projects, along with a few classes that have not been presented in awhile, Groundwater Hydrology and Interior Flooding Hydrology. To help ensure that all these classes will be taught, please sign up early if you are at all interested.

To register for our classes, please contact the appropriate part in your office or contact PDSC, http://pdsc.usace.army.mil. Registration is handled by Training and Operations (CEHR-P-RG).

Course descriptions are provided in the "Purple Book" at the PDSC site (http://pdsc.usace.army.mil/Purple_Book. asp). A short description along with course agendas is also provided on HEC's web site. To obtain enrollment information, please contact the Huntsville District. When doing so, please note the course number, name, data, and location, and contact:

CEHR-P-RG
USACE Professional Development Support Center (PDSC)
550 Sparkman Drive
Huntsville, AL 35817
Phone: (256) 895-7421
FAX: (256) 895-7465

continued on page 4

Training Program (continued)

Course Number	Course Title (all classes located in Davis, CA)	Dates
98	Reservoir System Analysis with HEC-ResSim	27-31 October 2008
164	Water and the Watershed	3-7 November 2008
369	Advanced Applications of HEC-HMS	17-21 November 2008
320	H&H for Dam Safety Studies	12-16 January 2009
176	Hydrologic Engineer Role in Planning	26-30 January 2009
155	CWMS Modeling for Real-Time Water Management	2-6 February 2009
219	Hydrologic Engineering Applications for GIS	23-27 February 2009
173	Interior Flooding Hydrology	9-13 March 2009
152	Water Data Management with HEC-DSSVue	23-27 March 2009
345	Nonstructural Measures for Flood Risk Management	30 Mar - 3 Apr 2009
161	Hydrologic Analysis for Ecosystem Restoration	6-10 April 2009
124	Groundwater Hydrology	20-24 April 2009
67	Advanced Steady Flow Analysis with HEC-RAS	4-8 May 2009
209	Risk Analysis for Flood Damage Reduction Projects	15-19 June 2009
58	Statistical Methods in Hydrology	13-17 July 2009
122	Sediment Transport Analysis with HEC-RAS	17-21 August 2009
N/A	Advanced Reservoir Modeling with HEC-ResSim	14-18 September 2009

HEC's FY 2009 Proposed PROSPECT Training Program

FY 2008 PROSPECT Training Program

By Michael Deering, P.E.

The PROSPECT training program for FY 2008 is almost finished. The last two classes for FY 2008 are Risk Analysis for Flood Damage Reduction Projects (16-20 June 2008) and Steady Flow with HEC-RAS (18-22 August 2008).

HEC will have provided nine classes this fiscal year; some basic and some advanced. The classes have ranged in topics from hydraulics and hydrology (Unsteady Flow Analysis with HEC-RAS) to hydrology (Hydrologic Modeling with HEC-HMS) to ecosystem restoration (Water and the Watershed) to statistical analysis (Flood Frequency Analysis). A new class was given this year, Nonstructural Measures for Flood Risk Management (previously titled Flood Warning Preparedness Program), in Omaha, Nebraska. The class was well received and has been included for the FY 2009 proposed schedule.

HEC Publications

HEC publications are now available electronically through the HEC web site (www.hec.usace.army.mil). FY 2008 has seen continuous addition of computer program documentation, and the addition of new publications: HEC-WAT, Watershed Analysis Tool, User's Manual (CPD-88); Truckee River at McCarran Ranch Ecosystem Functions Model Application (PR-61); and, Water Balance and Regulation Alternative Analysis for Kajakai Reservoir using HEC-ResSim – Phase I and II Final Report (PR-63).

All documents are in Adobe® format (7.0 and later) and are set for printing only. However, HEC is working on creating documents that will allow highlighting and searching in our publications. To download and view the documents, a user will need to the latest version of Adobe® Reader (8.1.2) from Adobe® (www.adobe.com). If you have any questions regarding HEC publications or this issue of the newsletter, please contact Ms. Penni Baker (email: penni.r.baker@usace.army.mil) of our office.

International Activities

HEC International Assistance

By Christopher N. Dunn, P.E.

Over the past few years, the Hydrologic Engineering Center (HEC) has responded to an increasing number of requests for overseas technical assistance. Recently, HEC has been involved in international assistance activities for Iraq, Afghanistan, India, Japan, Africa, and Korea. We are also working with Canada through the International Joint Commission and the Detroit District.

Middle East:

In Iraq, HEC entered into an MOA with the US Embassy Baghdad/Iraq to provide training to the Iraqi Ministry of Water Resources on the application of the Tigris-Euphrates Water Management Systems Model (WMSM). Under previous contracts with the US Agency for International Development, HEC developed and delivered the WMSM and documentation to the Ministry and Embassy. While we delivered the products we promised, the WMSM is still a very sophisticated model that needs further explanation and training if the Iraqis are going to use it for future planning purposes. Therefore, we entered into another MOA for additional training. The training for WMSM occurs in Amman, Jordan and is divided into three phases. For each of the three phases, we have sent three HEC employees to conduct the training.

Phase 3 will be held during the Spring of 2008. This phase will be a final workshop to reinforce what was taught, review the post-workshop assignments, and make sure they know how to apply and revise the WMSM. By the end of this workshop, the Iraqis should know enough to make proper use of the WMSM for current and future studies. This training is the culmination of all of our years of model development in Iraq. We will finally feel good that they can make use of what we created and that the Iraqis will have a tool that can make a difference in their lives now and in the future.

In another effort, two HEC employees taught a three-day session at the USGS Idaho Water Science Center in Boise (15-17 October 2007). They trained six engineers from the Iraq Ministry of Water Resources in the use of HEC-DSSVue for data management and provided consulting regarding their telemetry system and database designs. This training was also a continuation of work we organized during our earlier efforts in Iraq. Our Italian partners now lead the gage renovation effort, and expect to continue to engage HEC for technical support.

HEC Training Session at USGS

In Afghanistan, we prepared and delivered the final report "Water Balance and Regulation Alternative Analysis for Kajakai Reservoir Using HEC-ResSim" to AED. The report is now posted on our website as PR-63. It is the culmination of two years worth of modeling. To complete this study, we worked with the Portland District, CRREL, and AED.

Japan:

HEC hosted Mr. Makoto Kutsukake, Deputy Director of Water Administration Division, River Bureau, Ministry of Land, Infrastructure, Transportation and Tourism (MLIT) Japan from 10-18 January 2008. Mr. Kutsukake visited under the auspices of USACE/MLIT Memorandum of Understanding (MOU) regarding Management. We provided him with a Commander's type briefing, showed him CWMS, took him to the ground breaking ceremony for the Folsom Dam Spillway revisions, and discussed our risk and levee programs.

Under the Corps technical exchange agreement with Japan's Ministry of Land, Infrastructure, and Transport, Dr. Tom Evans, along with Mr. David Busse, (Technical Project Officer of the agreement) coordinated the 3rd Conference on Flood Control and Water Resources Management in New Orleans in January 2007. IWR participants also included Dr. Gerry Galloway, Dr. Jerry DelliPriscoli, and Mr. Darryl Davis. Topics discussed included Environmental Impacts of Water Management, Real-Time Control of Water Management Systems, Consensus Building, and Watershed Management. The Japanese delegation also visited USACE Headquarters and the Assistant Secretary of the Army for Civil Works before traveling to New Orleans for the Conference.

Under the auspices of the same agreement with Japan's MLIT, Dr. Tom Evans and I traveled to Japan (23-29 February 2008) to participate in the Corps and Japanese MLIT 4th Conference on Flood Control and Water Resources Management. Topics discussed were Climate Change, Risk Management, Natural Environment and Preservation, and River Information System. We made a presentation on the Corps Levee Program and another on the Corps Risk Analysis Program. Dr. Evans has been HEC's POC on this effort and provides continuity from conference to conference.

Africa:

In Africa, two HEC engineers provided three weeks of hydrologic, hydraulic, and groundwater training last summer in Kenya and Ethiopia.

continued on page 6

International Activities (continued)

HEC International Activities

continued from page 5

MLIT 4th Conference

They did this in concert with the Navy's NAVFAC (Naval Facilities) office in Port Hueneme, CA and with the Combined Joint Task Force - Horn of Africa (a coordinated group of DOD service organizations there for counter-terrorism and providing non-military services). We will be sending two engineers to Kenya this summer to provide additional hydrologic and hydraulic training. Again, we are working with the Navy's NAVFAC office and the Combined Joint Task Force – Horn of Africa.

HEC also hosted four Ethiopians and four NAVFAC engineers for two weeks, 21 January - 1 February 2008 where we provided detailed hydrologic and hydraulic training.

Canada:

HEC provided technical assistance regarding modeling tools to the IWR-led International Joint Commission Upper Great Lakes Study (UGLS). From September 2007 - April 2008 HEC provided substantial technical support to the modelers at Detroit District and Environment Canada charged with developing the UGLS "fencepost" alternatives for Lake Superior regulation. This support extends beyond the immediate study objectives and across much of the ongoing O&M mission shared by these offices. Although incidental to the main project, the deeper expertise and the closer international working relationships developed during this process are a significant "force multiplier" in the two governments.

South Korea:

HEC performed a levee evaluation and performance analysis for a levee along the Anseung River protecting Camp Humphreys in South Korea. In addition to the river flooding, interior drainage issues were addressed. Nonstructural measures such as flood warning and flood preparedness were recommended as well.

Future Activities:

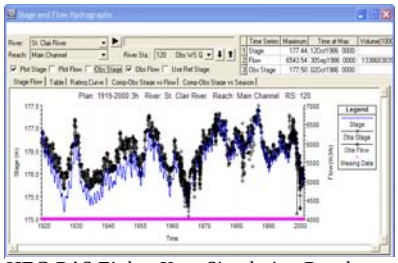
Activities for HEC are being planned for relations with India. HEC has agreed to partner with Riverside Technologies Inc. (RTI) consultants from Ft. Collins, CO on a proposal to perform a number of Water Resources planning and engineering activities for the Indian Government. We are waiting to hear if RTI, the prime contractor, made the short list.

Modeling the Great Lakes in HEC-RAS

continued from page 1

hydrograph output, and aggregating the results to daily values, which provides a way around problems with DSS file size. Memory requirements prevented use of the RAS post-processer for simulations longer than two to three years. Typical Great Lakes routing analyses have little need for the detailed hydraulic output from RAS, so use of the post-processor can be reserved for special periods requiring close examination.

With the basic functionality proven, the next steps are to include the Upper Niagara River, the Detroit River, and the Upper and Lower St. Mary's River. The ability to use HEC-RAS for short- or long-term Lake Superior regulation modeling combined with middle lakes routing computations allows new approaches and opportunities. The broad user base and abundant training options for HEC-RAS open such analyses up to a much wider community. Computing outflows based on physical parameters rather than regression equations simplifies analysis of the impact of hydraulic changes in the upper lake connecting channels on the levels and flows from Lake Superior to Niagara River. For example, instead of deriving new stage-fall-discharge relationships for each month in order to evaluate the hydraulic effect of different weed growth patterns since the Zebra Mussel was introduced in the system, HEC-RAS allows modelers to apply seasonal adjustments to roughness at each cross-section.



HEC-RAS Eighty-Year Simulation Results

Projects

Investigating Changes in Flood Damage Analysis Procedures

By David Watkins, PhD, Associate Professor, Michigan Technological University & Leo Beard Visiting Scholar

In accordance with the National Research Council's recommendations and the Corps' Actions for Change, investigations are under way to develop improved flood damage analysis procedures and the next generation of HEC's Flood Damage Analysis model (HEC-FDA). The new procedures and software are expected to provide significantly improved capabilities for flood risk management of complex, inter-dependent systems, as well as risk assessment for a wider range of social, economic, and environmental objectives than previously considered in HEC-FDA (e.g., project cost, agricultural damage, loss of life, habitat). Improved risk communication has also been identified as a critical goal of the new procedures and software tool.

Accomplishing these goals will likely require new approaches to problem formulation and analysis. For instance, the new tool may include event-based sampling, to allow for consideration of system inter-dependencies, and the ability to do scenario analysis, which could facilitate risk communication. It may also include life-cycle considerations to account for the fact that damaged areas do not always rebuild completely every year following a flood event. The feasibility of using tightly coupled hydrologic-hydraulic-impact analysis models is also being investigated, as are improved sampling procedures to accommodate inter-site correlation and to improve computational efficiency.

A workshop was held in January 2008 to discuss research items for the new version of the flood damage analysis tool. Following the recommendations of the workshop participants, work is now being carried out to prepare a design document for a prototype flood risk analysis tool in the domain of leveed riverine systems. A prototype analysis tool for interior impact areas with multiple flood sources is being developed to accompany this document. Leveed riverine systems were identified as the preferred problem domain for prototype development in order to leverage the knowledge and experience gained in recent Corps planning studies, although it is recognized that flexibility should be maintained in order to incorporate other flood defense systems (non-structural and structural) into the analysis. The intent of the current effort is to provide guidance for the next stage of effort - the implementation of a prototype model and application to a case study, currently proposed to be an analysis of flood risk in the Lower Sacramento River Basin, California. To allow for further delineation of model design features, it is proposed that the next steps be a user-community workshop in Summer 2008, followed by the development of a proof-of-concept model.

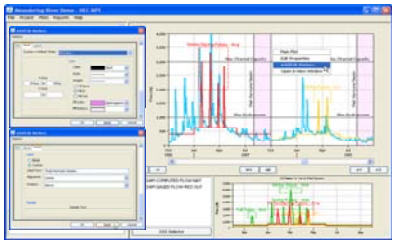
HEC Software

There have been several releases of HEC software, which are detailed in the Director's Comments (see page 2) of this newsletter. Releases include:

- HEC-HMS, Version 3.2
- HEC-RAS, Version 4.0
- HEC-ResSim, Version 3.0
- HEC-RPT, Version 1.1
- HEC-SSP, Beta Release
- HEC-WAT, Beta release

HEC software is available electronically through the HEC web site (www.hec.usace.army.mil). Although our software is developed to meet the needs of the U.S. Army Corps of Engineers' planning and engineering communities, we do make our software available to the public whenever appropriate. HEC software that we make available for download on our web site may be used by individuals outside of the Corps of Engineers without charge, subject to the Terms and Conditions for use of HEC Software. Note that HEC cannot provide direct user assistance or support for its software to non-Corps users.

If you have any questions regarding HEC software or this issue of the newsletter, please contact Ms. Penni Baker (email: penni.r.baker@usace.army.mil) of our office.



HEC-RPT, Regime Prescription Tool

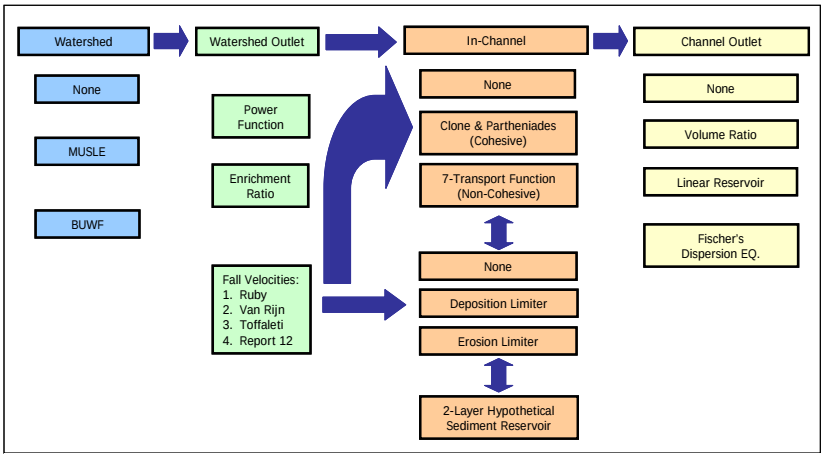
HEC Software (continued)

Soil Erosion and Sediment Yield Modeling with HEC-HMS

By Jay Pak, PhD, P.E.

The effects of surface erosion and stream sediment loading in watersheds has become increasingly important in water quality best management practices (BMPs), watershed management, and natural resources conservation planning. Many water resources studies must now consider the erosion related effects of watershed activities. Surface erosion models describe the detachment, deposition and transport of soil particles by the erosive forces of raindrops and surface flow of water from their point of origin to the watershed outlet. The current version of the Hydrologic Modeling System (HEC-HMS) contains no capacity to simulate surface erosion processes; however, the need of erosion and sediment yield modeling exists throughout the Corps of Engineers, especially as the Corps moves towards watershed level investigations, including Total Maximum Daily Load (TMDL) studies. Therefore, the Hydrologic Engineering Center (HEC) has developed new and existing tested soil erosion and sediment yield methods to include in HEC-HMS. The goal is to develop tools within HEC-HMS that provide output necessary for making informed decision about managing soil erosion within the watershed.

The subbasin element is one of seven hydrologic elements that compose a basin model network in an HEC-HMS model. The subbasin element is used to represent a drainage basin where precipitation falls, infiltration occurs, and surface runoff may result. Outflow from the subbasin element is calculated by subtracting precipitation losses due to interception by the canopy, storage on the land surface and infiltration into the soil from the total precipitation. Once losses have been computed, the excess precipitation is treated as surface runoff and transformed to stream flow at the subbasin outlet, and baseflow is added. Initially, two surface erosion methods will be included in the subbasin element: the Modified Universal Soil Loss Equation (MUSLE) and the build-up and wash-off methods. The MUSLE method simulates the sediment yield processes from a pervious land segment and the build-up and wash-off method simulates sediment yield processes from an impervious land segment. Future work will eventually include adding additional erosion methods suitable for both pervious and impervious areas, allowing the engineer to select the best method for a specific watershed study. Before sediment from the land surface is available to the reach element, a sediment enrichment ratio is introduced to determine the relationship between particle size of watershed sediment and fluvial suspended sediments. The enrichment ratio presents a mechanism to translate the sediment distribution from the land surface throughout the basin to a sediment distribution representative to that found at the basin outlet.



Sediment Transport Module Processes (HEC-HMS)

The reach element is another of the seven hydrologic elements that compose a basin model network in an HEC-HMS model. The reach element is used to convey stream flow downstream in the basin model. Inflow into the reach element can come from one or many upstream hydrologic elements. Outflow from the reach is calculated by accounting for translation and attenuation of the inflow hydrograph. Multiple methods for modeling sediment transport and erosion/deposition within the channel will be added to the reach element. Several sediment transport equations can be used to route sediment through the stream network in HEC-HMS. The sediment continuity equation was used in conjunction with a sorting algorithm to solve for the actual volume of deposition or erosion.

The new features will make it possible to use HEC-HMS to estimate background and anthropogenic nonpoint source sediment loads that can be used in the TMDL studies for watersheds containing significant nonpoint sources of pollution. An effort was made to ensure that sediment output from HEC-HMS could be easily used as boundary conditions in HEC-RAS for more detailed river mechanics modeling. These new sediment capabilities of HEC-HMS focus on runoff volume, and sediment loading to streams, rivers and lakes. HEC-HMS will be able to model the amount of sediment from pervious and impervious areas

continued on page 9

HEC Software (continued)

Soil Erosion and Sediment Yield Modeling with HEC-HMS

continued from page 8

in a watershed and route it to the stream. In addition, HEC-HMS utilizes hydraulic parameters calculated based on the fixed channel geometry and one of seven transport capacity equations to solve the sediment continuity equation in the stream for sediment processes. Future versions of the program will include a convenient user interface to specify the necessary data for a sediment analysis and a wide range of available outputs for analyzing results.

The capabilities described in this article are currently being tested in-house. The target for official release is sometime during the second quarter of FY 2009.

HEC-SSP

By D. Jeff Harris

HEC-SSP is an integrated system of software, designed for interactive use in a multi-tasking environment. The system is comprised of a graphical user interface (GUI), separate statistical analysis components, data storage and management capabilities, mapping, graphics and reporting facilities. The HEC-SSP software system was developed following software guidelines established at HEC, these guidelines will produce more consistent results when using HEC software in water resources studies. Also, the guidelines facilitate a common graphical user interface and look-n-feel for HEC software in the PC environment.

The goal of HEC-SSP development is to ultimately combine all of the statistical analyses capabilities of HEC-FFA, STATS, REGFRQ and MLRP. New features and additional capabilities will be added in future releases.

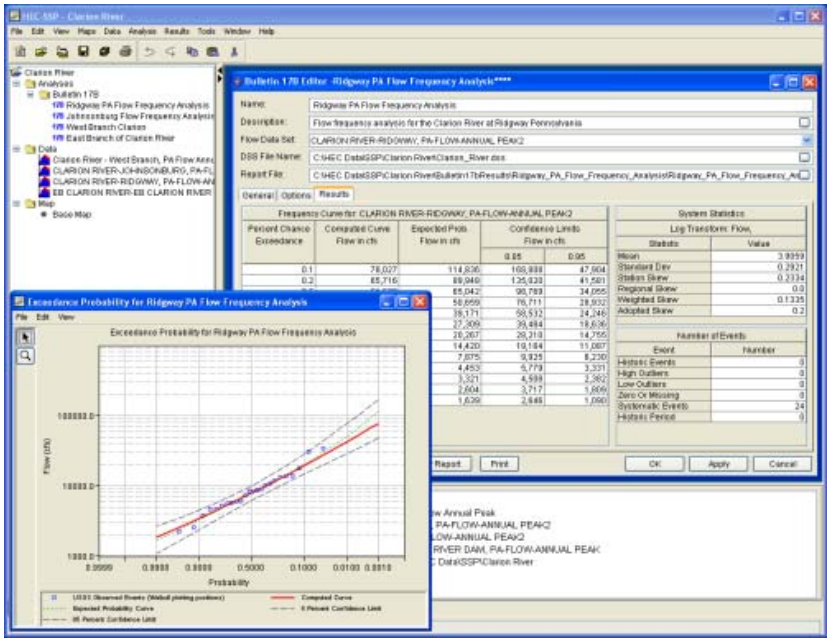
HEC-SSP is designed to perform statistical analyses of hydrologic data. The main focus in the design of the interface was to make it intuitive, while still maintaining a high level of efficiency for the user. The interface provides for the following functions:

- File management
- Data entry, importing, and editing
- Statistical analyses
- Tabulation and graphical displays of results
- Reporting facilities
- On-line help

In its current publically available Beta version, HEC-SSP performs peak flow frequency analysis. The underlying basis for all current and future analyses of unregulated, homogeneous annual peak flows is based on guidance recommended by Bulletin 17B "Guidelines for Determining Flood Flow Frequency (1982)," by the Interagency Advisory Committee on Water Data. HEC-SSP provides options to address all recommendations within Bulletin 17B. HEC-SSP follows the 17B recommendation of using the Log-Pearson Type III distribution and the method of moments to determine the statistical parameters of the station data. Methods are included in HEC-SSP to address: Broken Record; Incomplete Record; Zero Flood Years; Low and High Outliers; Historical Events.

HEC-SSP Version 1.0 is expected to be released in summer FY 2008. It will include additional capabilities beyond the 17B analyses. The General Frequency analysis capabilities will allow the user to perform both analytical and graphical frequency analyses. When performing a General Frequency Analysis, the user has the option to: choose if log transform is used and if so set the distribution to Log Normal or Log-Pearson Type III; set confidence limits; select time window for the analysis; select plotting position method; use historic data and set outlier thresholds; turn off expected probability computation; set skew to station, weighted or regional.

Another tool that will be available in Version 1.0 is Volume-Duration



HEC-SSP, Statistical Software Package

continued on page 10

HEC Software (continued)

HEC-SSP

continued from page 9

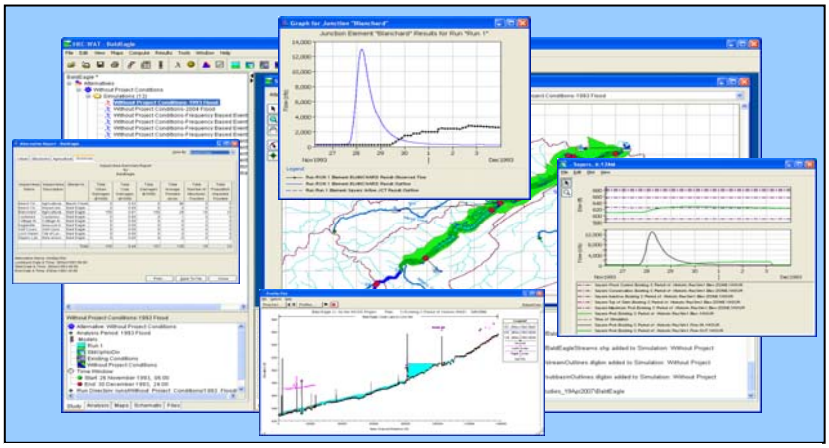
Frequency Analysis. The Volume-Duration Frequency analysis is important to many aspects of the engineering and environmental communities. For an engineering analysis of a reservoir, it may be necessary to generate synthetic inflow hydrographs based on a volume-duration frequency analysis of the gaged daily flows. Within the environmental community, many times it is necessary to compute 7Q10 value. The Volume-Duration Frequency module in HEC-SSP can satisfy both of these needs. In a volume-duration analysis, the analysis is computed using mean daily flows. The user can perform form either an analytical or graphical analysis. When performing a Volume-Duration Analysis, the user has the option to: choose if log transform is used and if so set the distribution to Log Normal or Log Pearson III; set the analysis to use maximum or minimum values; select water or calendar year; set time window and season of data to be analyzed; select plotting position method; select desired flow durations; select specific exceedance intervals for computation of values to be shown in results; turn off expected probability computation; set skew to station, weighted or regional.

Once results of any analysis are available, the user can view the resulting values at each selected exceedance interval, a plot of the data and a report of the computations. A new post compute tool for both General Frequency and Volume-Duration Analyses allows the user to enter statistics and recomputed the curve based on the input statistics. If you are interested in more information on HEC-SSP please contact Jeff Harris (david.j.harris@usace.army.mil) or Gary Brunner (gary.w.brunner@usace.army.mil) at HEC.

HEC-WAT Beta Release Version 1.0

By Penni R. Baker

The Watershed Analysis Tool (HEC-WAT) is new software that has been developed by the Hydrologic Engineering Center (HEC). The development process began in earnest during FY 2004 and the Beta Version of the WAT was released in the second quarter of FY 2008. The WAT was developed to help the Corps (USACE) and its study partners conduct watershed and water resources management studies. HEC-WAT modeling teams will benefit because they will develop their models in a closely coordinated manner, track progress of other models, and automatically retrieve results from previous model runs thus assuring more efficient and coordinated results. The management team will benefit by using a common interface to track project status through each modeling component and displaying results during public and project status meetings.



HEC-WAT, Watershed Analysis Tool

The Beta release is available to Corps users from our web site www.hec.usace.army.mil/software/hec-wat. For non-Corps users please contact Penni Baker to receive download information. This is the first release of the software and is available for your use, review, and comment. HEC has tested the HEC-WAT, but it is a new piece of software with new concepts. HEC would like suggestions, comments, and reports on bugs regarding the WAT, and these should be sent to hec.wat@usace.army.mil. Specifically, we would like comments and suggestions on the usability of HEC-WAT, and also, would like suggestions on what kind of output other than the individual model output, the user would like to see from the HEC-WAT. For the Beta version most of the supporting software has been included for testing of the HEC-WAT concepts, however this software should not be considered final products. Once the Beta release has been tested, and updates have been made to the WAT, the release of Version 1.0 is scheduled for the end of FY 2008. For further information regarding HEC-WAT contact Christopher Dunn (christopher.n.dunn@usace.army.mil) or Penni Baker (penni.r.baker@usace.army.mil) at 530 756-1104.

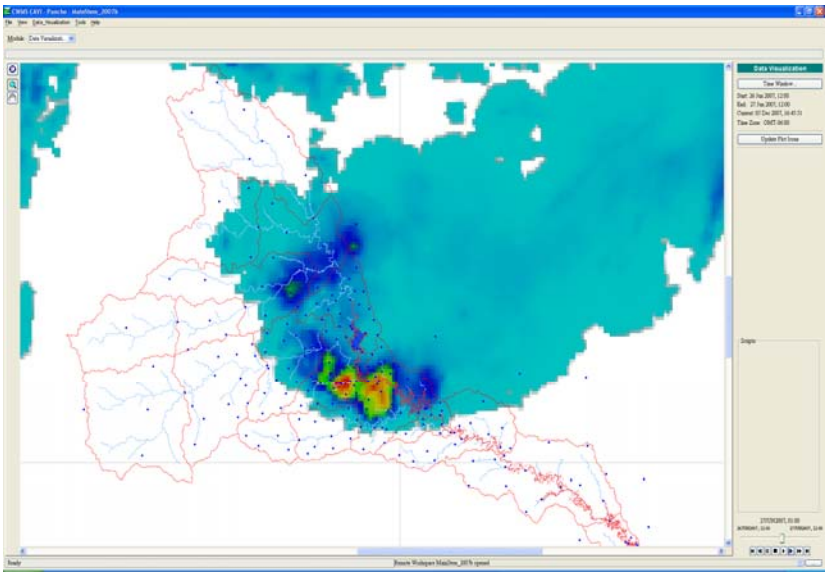
HEC Software (continued)

CWMS - LCRA Usage During 2007 Floods in Texas

By William Charley, P.E.

The Lower Colorado River Authority (LCRA) River Operations Center successfully used the Corps Water Management System (CWMS) to forecast flows and operate LCRA reservoirs for the major 2007 event in the Colorado River in Texas. The June 2007 events had rainfall amounts of seventeen to nineteen inches over a six-hour period upstream of LCRA reservoirs, and have been classified as exceeding the 500-year event.

Texas Flooding Along the Colorado River



CWMS, Data Visualization Module - Precipitation Grids

CWMS is a comprehensive data acquisition and hydrologic modeling system for short-term decision support of water control operations in real time. It encompasses data collection, validation and transformation, data storage, visualization, real time model simulation for decision-making support, and data dissemination. Forecasting to support operational decision making can include the following models. Rainfall-runoff modeling with HEC-HMS based on gaged precipitation, Quantitative Precipitation Forecasts (QPF) and other future precipitation scenarios provides forecasts of river flows into and downstream of reservoirs. Simulation of reservoir operations, utilizing either the HEC-ResSim or CADSWES RiverWare program, uses these flow scenarios to provide operational decision information for the engineer. The river hydraulics program, HEC-RAS, computes river stages and water surface profiles for these scenarios. An inundation boundary and depth map of water in the flood plain can be calculated from the HEC-RAS results using ArcInfo®. The economic impacts of the different flows are computed by HEC-FIA. The user-configurable sequence of modeling software allows engineers to evaluate operational decisions for reservoirs and other control structures, and view and compare hydraulic and economic impacts for various "what if" scenarios.

On Wednesday, June 27, 2007, in the Hill Country above Austin Texas, observed rainfall significantly exceeded forecasted amounts. At 12:30 a.m., more than two inches of rainfall fell in a short time period, and was reported as a "rain bomb". Marble Falls received sixteen inches of rain in six hours, an approximately 500-year event. The rainfall caused heavy runoff from the already saturated soils, which quickly filled streams and lakes already swollen from previous rains. The storm wreaked havoc in the Marble Falls community, flooding homes, sweeping cars away, destroying property and endangering lives. The high flows quickly filled reservoirs, forcing emergency flood operations in the early morning hours. Gates were opened at upstream reservoirs to relieve pressure on the system and move water into Lake Travis with its flood storage pool. Lake Travis rose to 701.52 feet msl, twenty feet into its flood pool and its fifth highest elevation.

LCRA used CWMS to forecast simulations every few hours. For scenarios of no future rainfall, the forecasted reservoir elevations were close to the measured elevations. This accuracy allowed engineers to determine that only four floodgates were needed to be opened for Mansfield Dam. CWMS also forecasted the peak of the flood well before it happened. Smaller rain storms continued for a period of weeks causing additional flooding, and CWMS was used successfully through these storms to calculate lake levels, operation of reservoir gates along with a hydro-generation schedule.

Mansfield Dam

continued on page 12

HEC Software (continued)

CWMS - LCRA Usage During 2007 Floods in Texas

continued from page 11

Overall, the comparison between forecasted results and observed were within 0.2 ft for a twelve-hour forecast and 0.6 ft for a twenty four-hour forecast for lake level projections on Lake Travis. The June 2007 event was comparable to the 1997 event to which the models were calibrated. This is a limited number of rainfall events upon which to evaluate the performance of CWMS forecasts. The LCRA will keep looking at forecast performance to see how longer term forecasts (greater than twelve-hour) can be improved. The accuracy of forecasts using CWMS and NWS MPE (multi-sensor precipitation, which is a combination of radar and rain gage data) estimate provided reservoir operators the necessary information to operate the LCRA reservoir system successfully and prevent downstream flooding.

LCRA Operations Central