Report to Subcommittee on Hydrology from the

Hydrology and Hydraulics GIS Applications Work Group

January 15, 2013

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Introduction: Purpose of the Work Group

The overarching purpose of the Work Group is to gather information and promote use of geographic information systems (GIS) in analysis of water resource problems. There are several ways in which this may be accomplished. A) Promote information exchange among federal agencies and outside organizations, B) promote learning opportunities among Work Group members, C) distribute information on GIS applications in hydrology and hydraulics to the federal agency community and to the general public, D) create a forum to express needs for new or enhanced GIS application in hydrology and hydraulics.

Disclaimer

Any use of trade, product, or corporation names in this report is for descriptive purposes only and does not imply endorsement by the U.S. Government. This list of GIS applications in hydrology and hydraulics cannot be construed to be a complete list of those applications available nor to be an approved list for projects completed by or for the U.S. Government.

Membership

Assistance from the following members was critical in accomplishing the tasks of the work group. Their assistance is greatly appreciated.

Jennifer Bountry, USDI, Bureau of Reclamation

C. Kirk Cover, Federal Energy Regulatory Commission

Bruce Feinberg (alternate member), USDI, Bureau of Reclamation

David Goodrich, USDA, Agricultural Research Service

John Hunter, US Army, Corps of Engineers

Di Long, Graduate Student, Texas A&M University

William Merkel (chair), USDA, Natural Resources Conservations Service

John Onderdonk, Federal Energy Regulatory Commission

Kernell Ries, USDI, US Geological Survey

Zhida Song-James, Association of State Flood Plain Managers

David Stewart, USDI, US Geological Survey

Nebiyu Tiruneh, Nuclear Regulatory Commission

Dan Wickwire, USDI, Bureau of Land Management

Background/History

Collection of digital geospatial data, whether it be from remote sensing or near-surface measurements (such as LIDAR), is increasing in both quantity and quality. Such data are increasingly being used by water resource and environmental professionals. Many analysts use the data for specific projects and specific purposes to reach some conclusions. Many of these analyses are one-time unique studies and not routinely repeated. However, there are needs for some GIS applications which are relatively easy to use repeatedly at many locations and at different times. For example, a GIS application for watershed analysis could be used by many individuals at different locations. These types of applications save time and make more efficient use of the vast amount of GIS data that has been collected. Applications are generally developed to use a specific geographic system. For example, employees of many federal agencies use GIS software developed by the Environmental Sciences Research Institute (ESRI). There are other GIS's used by federal agencies which are open source. Some applications are being developed for these systems.

The idea of setting up a work group to investigate GIS applications in hydrology and hydraulics was first presented to the Subcommittee on Hydrology in 2006. Favorable feedback was received and by summer 2007, a charge was written and approved. Members were requested from the federal agencies represented on the SOH to serve on the Work Group.

The charge to the Work Group was written very broadly and the Work Group members soon organized and set up some proposals and goals that could be accomplished. The Work Group members represented a variety of agencies/organizations, technical backgrounds, and technical interests. Several general discussions were held in teleconferences on the charge and responsibilities of the Work Group in order to focus and organize the Work Group.

To obtain consistent and detailed information on GIS application in hydrology and hydraulics, a questionnaire was developed to distribute to application developers and supporters. This questionnaire included contact information, description, data requirements, and associated software. In several teleconferences, the questionnaire was discussed as well as a potential list of applications. The focus was on public domain, non-proprietary, and open source GIS applications. Over about 1 year, the questionnaire was distributed and responses were received.

After the responses were received, the Work Group discussed how to make these available to the federal community and the general public. A web-based hydrologic model inventory has been maintained by Texas A&M University for several years. The possibility of adding the GIS applications to this inventory was investigated. Since some funding was requested by Texas A&M, a Cooperative Ecosystem Studies Unit (CESU) agreement was set up between the US Bureau of Reclamation and Texas A&M. The

Work Group members and Texas A&M developed the agreement document including an outline of procedure, deliverables, and schedule. This was successfully implemented.

Coordination with other committees with related interests was included in the Charge to the Work Group.   Two of the major ones focused on GIS data are the Subcommittee on Spatial Water Data (SSWSD) and the Federal Geospatial Data Committee (FGDC). There is a Hydrologic Modeling Work Group under the SOH which has somewhat overlapping scope with the GIS Applications in Hydrology and Hydraulics Work Group. Another organization with related interests is the Consortium of Universities for the Advancement of Hydrological Sciences, Inc. (CUAHSI).

A web site was set up and maintained with a link to the web page of the Subcommittee on Hydrology. The web page for the Work Group is: http://acwi.gov/hydrology/h2gisa/ . Membership, minutes of teleconferences, and the charge to the Work Group are posted.

Accomplishments

Teleconferences and e-mail are the main modes of communication for the Work Group. Sixteen teleconferences (some of which were Live Meetings) were held between September 2007 and July 2010. Minutes of these teleconferences are posted on the Work Group web site.

One of the primary tasks suggested by the work group members was to gather information on existing GIS applications in hydrology and hydraulics. Work group members searched for applications and contact information. A questionnaire was developed and distributed to model developers and supporters. Responses were received for those applications that were targeted (those responses are included in an appendix).

As some of the purposes of the Work Group were information exchange and training, four demonstrations of GIS applications were presented to the Work Group via Live Meeting. These were StreamStats (USGS), AGWA (USDA-ARS), Map Window (non-government open source), and CITY Green (American Forests).

Texas A&M maintains a web site inventory of hydrologic models with contact and technical information. A detailed questionnaire was organized and is periodically updated for the list of hydrologic models. The inventory of hydrologic models on the Texas A&M web site was actually reorganized based on suggestions of work group members. The inventory now includes the group of GIS application in hydrology and hydraulics.   The web page for the Texas A&M Hydrologic Modeling Inventory web site is: http://hydrologicmodels.tamu.edu/   The final report from Texas A&M agreement is included in an appendix.

Limited coordination was completed with committees of related interests. The Work Group received updates at each teleconference on the status of CUAHSI (from a Work Group member who was also a member of CUAHSI).

In an attempt to inform the professional engineering and GIS community of the purpose and accomplishments of the work group, two papers were presented at professional conferences. The first was at the American Water Resources Association (AWRA) Spring Specialty Conference GIS and Water Resources V in San Mateo, California, April 2008. The second was presented at the Federal Interagency Hydrologic Modeling Conference in Las Vegas, Nevada, June 2010. The papers are included in an appendix. There was much interest expressed by conference attendees concerning the activities of the Work Group.

Recommendations for future work

There is naturally much more the Work Group could accomplish. There is an increasingly significant opportunity in development and use of geospatial analysis tools in hydrology and hydraulics as well as in many other professions.

More coordination among agencies and committees is needed, especially CUAHSI and SSWD. More applications could be identified and placed in the hydrologic model inventory.

Training and outreach to professional community. More effort is needed to make federal water-related specialists aware of GIS applications available for use and provide training sources. Many GIS applications offer training and examples for download and self-study. Even though these materials are useful, the Work Group could provide on-line demonstrations (Live Meetings or webinars) to offer initial awareness training. More papers could be presented at professional conferences.

Possible improvements to GIS applications in hydrology and hydraulics could be recommended. The Work Group could participate in the development of ArcHydro River. ArcHydro River is a significantly large application being developed by ESRI and the University of Texas-Austin. The Work Group could review plans and comment on its various features in order to make it useful to a greater number of federal government agencies. Also, the Work Group could distribute status reports to the various agencies and facilitate and promote the use of ArcHydro River when completed.

The Work Group could identify geospatial technology needs for which there are limited or no public domain applications available. Once these are identified, GIS application developers could then determine if certain existing applications could be enhanced, or if completely new applications would need to be developed.

Appendix 1   Charge to Work Group (7-31-2007)

SUBCOMMITTEE ON HYDROLOGY (SOH)

CHARGE

FOR

HYDROLOGIC AND HYDRAULIC

GIS APPLICATIONS WORK GROUP (H2GISAWG)

The Hydrologic and Hydraulic GIS Applications Workgroup consists of application developers and users. The GIS data community is well developed and organized. On the other hand, application developers and users are not organized and do not have an efficient way to exchange and learn relevant technology, coordinate application development, and express needs. Use of GIS data and applications is growing at a steady rate. Numerous federal and non-federal employees would like to learn about both GIS data and its application in H&H. The Workgroup would communicate to the GIS user community the variety of data and applications that are available, how to access the data and applications, and how to receive training and support.

Background:

The Subcommittee on Hydrology (SOH) of the Advisory Committee on Water Information (ACWI) has the goal to provide cutting-edge information on new technological advances in hydrologic and related hydraulic analysis techniques to both federal and non-federal entities. One of the functions of the SOH is to "Develop procedures to improve the interpretation and

integration of data needed to describe surface-water resources and to understand the factors that affect the spatial and temporal distribution of these resources". With the amount of GIS data and applications of GIS data growing at a rapid rate, keeping up-to-date is difficult. Some GIS applications in H&H have been developed which use the most recent GIS data and provide high quality analysis of physical process simulation modeling.

The Workgroup has a very broad scope which includes data sources, data quality, GIS applications, and user support. Since the Workgroup is new, the actual working group members need to organize themselves and have input with respect to specific products that would be feasible to develop and distribute. Since the purpose is to benefit the organizations represented by the members, products of the highest priority could be identified. The Workgroup could start with information exchange concerning hydrologic and hydraulic GIS applications and data requirements. The primary product of the Workgroup will be a report (discussed in detail later). Another possible product is a list of web sites where GIS data and applications are available and a short description of the application and data requirements. Another possible product could be to assemble a list of hydrologic and hydraulic GIS applications and data needs of the federal and non-federal agencies.

The Workgroup will focus on 1) reporting availability, efficient access, and quality of GIS data for applications in H&H, 2) identifying and summarizing existing GIS applications in H&H, 3) promoting interagency development of GIS applications in H&H, and 4) facilitating training and user support on associated GIS applications.

The SOH will direct operation of the Workgroup. The SOH will provide general oversight and guidance to the Workgroup who will conduct the in-depth deliberations and information gathering associated with the overall task. The SOH will assist to draft the charge and recruit volunteers. The Workgroup will report schedule, plans, and progress at each SOH quarterly meeting.

Coordination of H&H GIS Applications Workgroup with Subcommittees :

The Workgroup is requested to coordinate closely with the Subcommittee on Spatial Water Data (SSWD). The common ground between the Workgroup and the SSWD is that applications use spatial water and related natural resources data and the applications depend on data quality, accessibility, scale, etc. However, hydrologic and hydraulic (H&H) GIS applications use more than spatial water data. Some of these are soil, land use, satellite imagery, etc. Coordination with other committees such as the Federal Geospatial Data Committee (FGDC) will also be needed. Communication between the data and application communities is of utmost importance because new applications are being developed which depend on knowing what spatial data are available and their quality. On the other hand, some potential future applications may require data which are not currently available or are of limited extent or quality. These needs must be communicated.

Products and Timeline for the Hydrologic and Hydraulic GIS Applications Workgroup:

The Hydrologic and Hydraulic GIS Applications Workgroup is asked to review existing public domain GIS applications in hydrology and hydraulics (H&H) maintained by federal agencies and others, with emphasis on national or large regional applications. If members of the workgroup know of other active hydrologic and hydraulic GIS applications underway that can illustrate factors important to its proposals, these locations can be contacted to provide summary information concerning the application.

Characteristics of applications that should be included in the Hydrologic and Hydraulic GIS Applications review include: (1) those that are maintained routinely, (2) those that include parameters of interest, with an identifiable level of quality assurance, (3) those that relate to surface water quantity analyses, (4) those that operate with generally available GIS data, and (5) emerging technology which would more widely used with minimal improvements. It is expected that the Workgroup will identify other characteristics of hydrologic and hydraulic GIS applications that are to be included in the GIS applications review.

The H&H GIS Applications Workgroup will prepare a report that contains the following:

1. List and summarize GIS applications (including data requirements) in H&H developed and supported by participating federal and other agencies.

2. Contacts for each application for those interested in obtaining them.

3. Plan for transferring the applications.

   A. Web site list.

   B. Training opportunities.

   C. Technical sessions at the 2010 Federal Interagency Hydrologic Modeling Conference to present papers, computer demonstrations, short courses, etc.

4. Recommendations for future improvement and/or development of hydrologic and hydraulic GIS applications which are needed by federal and other agencies.

The draft report on GIS applications in H&H is tentatively scheduled for submission to the SOH and SSWD in January 2009. At least two progress reports from the workgroup are needed to assure that this deadline can be met and to prepare for review by the SOH and SSWD. Because other activities are dependent on the work of the Hydrologic and Hydraulic GIS Applications Workgroup, the SOH and SSWD will want to track progress closely without causing the workgroup to spend too much time preparing reports rather than doing the work. One way to facilitate the needed information exchange will be to copy members of the SOH and SSWD on minutes of workgroup meetings and other correspondence. A first draft of the entire report will be submitted also to the ACWI.

Resources:

Federal agencies, state agencies, and others will supply appropriate individuals to conduct the work of the workgroup. It is expected that the workgroup will conduct its business via telephone, E-mail, and meetings in the Washington, DC metropolitan area.

In addition to the list of applications below, current applications of participating agencies will be reviewed and summarized.

EPA Basins

HEC Geo-HMS and HEC Geo-RAS

NRCS Geo-Hydro, GIS interface to the WinTR-20 Hydrologic Model (ESRI ArcView and ArcGIS versions).

ESRI ArcHydro tools

ARS Automated Geospatial Watershed Assessment Tool (AGWA)

Dates of Approval: Subcommittee on Hydrology (SOH)

July 26, 2007

S. Samuel Lin

Chair, The SOH

Appendix 2 List of models and responses to questionnaires (15 total)

AGWA - GIS Applications in H and H Questionnaire

March 31, 2009

The Subcommittee on Hydrology set up a workgroup to organize and publicize information on GIS applications in the fields of hydrology and hydraulics. This scope has been expanded to include related water quality, watershed management, and ecological sciences GIS applications. This work is intended to make information on GIS applications in hydrology and hydraulics more generally available. This questionnaire is designed to gather limited but key information about a particular GIS application in order for a potential user to decide if the application fits his/her computer system, data requirements, and physical system to be modeled.

These applications should be public domain and supported by user documentation. Availability on the web is not necessary if the application can be distributed on CD ROM or through e-mail requests. If a short abstract, fact sheet, or technical paper is available on the application, please attach a copy.

Name of Application, date, version number:

Automated Geospatial Watershed Assessment Tool (AGWA)

- **AGWA 2.0 for ArcGIS 9.x, latest update 12/31/2008**
- **AGWA 1.5 for ArcView 3.x, latest update 1/9/2009**

Contact (with e-mail, web site, and/or phone number):

Dr. David C. Goodrich

Email address: Dave.Goodrich@ars.usda.gov

Phone: (520)670-6381 ext. 144

Web site: http://www.tucson.ars.ag.gov/agwa and http://www.epa.gov/esd/land-sci/agwa/

Brief Description:

The Automated Geospatial Watershed Assessment (AGWA) tool is a Geographic Information Systems (GIS) interface jointly developed by the U.S. Department of Agriculture (USDA) Agricultural Research Service (ARS), the U.S. Environmental Protection Agency, and the University of Arizona to automate the parameterization and execution of the Soil and Water Assessment Tool (SWAT) and KINematic Runoff and EROSion (KINEROS2) hydrologic models. The application of these two models allows AGWA to conduct hydrologic modeling and watershed assessments at multiple temporal and spatial scales.

- **SWAT2000: a river basin scale model developed to quantify the impact of land management practices in large, complex watersheds.**
- **KINEROS2: A distributed-parameter, event-based rainfall-runoff-erosion model (this model is being coupled with OPUS to form a continuous model with nutrient and carbon cycling, common pesticides, and common cultivated and range management practices – anticipated release date – mid 2009)**

Platform/operating system:

Software

- **Windows 2000 and newer (Windows Vista is untested)**

Hardware:

- **Dictated by the GIS software platform (ArcGIS 9.x or ArcView 3.x)**

Web-based or desktop application:

Desktop application is ready for use and web-based application is at prototype/proof of concept stage.

Data Requirements:

- **Digital elevation model (DEM) for watershed delineation and discretization**
- **STATSGO, SSURGO, or FAO soils for parameterization**

- **Classified land cover for parameterization**
- **Multi-year daily precipitation for SWAT**
- **Event-based precipitation for KINEROS2**

Data format and compatibility:

All GIS data must be projected. DEM and land cover must be GRID-based. Soils data must be feature-based. Precipitation data must be in DBF format and follow the structure defined in the documentation and examples.

Will the application import and export data files?

Data may be imported/exported to/from different formats, but there are no application specific imports/exports.

Is the application flexible to couple with external programs and user created executables?

Yes

Are system and user documentation available?

Yes

Are example applications available?

Yes

Does the application require prior installation of ESRI software?

Yes

If so, which products?

AGWA2 for ArcGIS 9.x

- **ArcGIS 9.x**
- **Spatial Analyst Extension for ArcGIS 9.x**
- **3D Analyst for ArcGIS 9.x (optional - only required for Thiessen polygon weighting)**

AGWA 1.5 for ArcView 3.x

- **ArcView 3.x**
- **Spatial Analyst Extension for Arcview 3.x**

Is there a user group or hotline-type support?

Yes

http://www.tucson.ars.ag.gov/agwa

Click on 'Forum'

ESRI ArcHydro Tools - GIS Applications in H and H Questionnaire

June 13, 2012

Name of Application, date, version number: **ESRI ArcHydro Tools, versions 1.3 and 1.4**

Contact (with e-mail, web site, and/or phone number):
http://support.esri.com/en/downloads/datamodel/detail/15

Brief Description: ArcHydro Tools is a system for analyzing spatial terrain data and organizing the data into a datamodel. Some of the features of ArcHydro Tools are Terrain Preprocessing, Watershed Processing, Attribute Tools, and Network Tools. These features analyze the terrain data with respect to filling sinks, flow direction and flow accumulation, delineate watershed boundaries, calculate attributes of the watershed (such as slope), and delineate and analyze stream networks. A datamodel organizes the data such that it can be used for other applications.

Platform/operating system: **various versions of Windows**

Web-based or desk-top application ? **desktop**

Data Requirements: **digital elevation GIS data**

Data format and compatibility: **compatible with ESRI software**

Will the application import and export data files ? **yes**

Is the application flexible to couple with external programs and user created executables? **Yes**

Are system and user documentation available? **Yes**   Are example applications available? **Yes, in documentation**

Does the application require prior installation of ESRI software? **Yes**   If so, which products? **ArcGIS 9.2, 9.3, or 9.3.1 with spatial analyst extension**

Is there a user group or hotline-type support? **Yes**

E-Coastal - GIS Applications in H and H Questionnaire

March 21, 2008

Name of Application, date, version number:

eCoastal Program, May 2008

Contact (with e-mail, web site, and/or phone number):

Rose Dopsovic, rose.dopsovic@us.army.mil

http://eCoastal.usace.army.mil

251.680.4047

Brief Description:

The eCoastal program provides a foundation for a data management plan designed to function as an enterprise GIS. It was developed to concentrate on the specific needs of the coastal engineer. eCoastal is an architecture developed by the U.S. Army Corps of Engineers that addresses spatial data standards, geodatabase structure, and custom coastal GIS applications.

One focus of an enterprise GIS is to allow access to data from users inside or outside an organization.   Technology enables data to easily be accessible and distributable in a variety of formats. The eCoastal program offers support in understanding the available technologies, such as metadata clearinghouses or web mapping services, and provides additional guidance on system configuration to bring concepts to fruition. In the case of USACE organizations, eCoastal also provides system design and documentation that is compliant with all Army IT regulations.

In addition to the technology components, the eCoastal program is a compilation of lessons learned and recommendations for managing a variety of coastal related datasets in a geodatabase environment. eCoastal provides training to users on the default tools of ArcGIS and custom tools of the eCoastal toolbars to educate coastal engineers in data analysis procedures performed in a GIS environment.

Platform/operating system:

Desktop –

- ArcGIS 9.2
- Spatial and 3D Analyst extensions are needed for some desktop applications

Web –

- ArcIMS
- ArcGIS Server
- Google Earth

Web-based or desk-top application?

The eCoastal program frequently surveys the coastal engineering community to determine what other technologies, models, and/or applications exist that engineers are integrating into their data analysis procedures. There are a number of custom applications that have been developed over the years. Applications that require little configuration can be downloaded from the eCoastal website. Literature is provided for other, more complex, applications that require additional configuration, such as database design, lookup tables, or web services. All of the setup is documented in the engineer manual.

<u>Desktop</u>

- **Data Viewer Toolbar:** The Data Viewer tools have been created to assist GIS users in data analysis and access to the geodatabase through the ArcGIS ArcMap interface. The ArcGIS Desktop applications are developed using ArcObjects. When you use an application, such as ArcMap, most of the time you are simply looking at or working with ArcObjects. The graphical user interface in each custom eCoastal application is developed using the same objects, such that in each application you will find the interface contains toolbars, menus, commands, and tools that have the same look and feel. The eCoastal Toolbox is distributed as an install package for the ArcGIS environment. Created in a modular design, users can choose which tools to load in their toolbar. In general, the tools provide a simple interface to common GIS tasks; such as locating data stored in the geodatabase, building attribute queries or designing a map layout.
    - Data Picker
    - Zoom to Layer (per definition query)
    - Find by Attribute
    - Create Map Layout
    - Sort Layers
    - Move Layers Up
    - Move Layers Down
    - Delete Multiple Fields
    - Add XY Coordinates
    - Import Excel as Points
    - Export to Text File
    - Polygon Area
    - Graphics to Features
    - Generate Bounding Polygon
    - Compare Tools (Remove duplicate features)
    - Make PointZ Shape
    - Make PolylineZ Shape

- **Survey Tools:** LiDAR data is an integral part of data analysis in coastal engineering. The Survey Toolbar enables coastal engineers to simplify the formatting process of LiDAR datasets. All tools available on this toolbar require a license to 3D and Spatial Analysis. Below is a list of tools available on the toolbar.
  - o Profile Plot Generator
  - o 3D Viewer
  - o Depth Difference Calculator
  - o Random Point Generator
  - o Point to Surface Generator
  - o Beach Profile Importer
  - o Survey Loader/SAMS

- **Survey Analysis Management System (SAMS**): A primary use of hydrographic surveys supporting navigation operations and maintenance is to determine the quantity of material that has shoaled in a channel and is in need of dredging. These material quantity estimates are used for planning dredging operations and for computing payment volumes. One key aspect in this process is the issue of survey data management. This involves the handling, storing, formatting, and converting of raw ASCII data into useable GIS data layers where analytical methods and visualization techniques are ultimately employed for engineering purposes.

  The eCoastal Survey Analysis & Management System, hereinafter referred to as SAMS, is a system developed by the Mobile District Corps of Engineers that broadly functions as an enterprise GIS application designed to facilitate the collection, storage and retrieval of finished survey products from a GIS. eCoastal is a subset of the eGIS Enterprise concept being developed by the US Army Corps of Engineers that is a framework for developing GIS that manage the coastal environment.
  - o Locate Selected Navigation Project Extents
  - o Load Design Surface of Navigation Channel
  - o Load Design Template (3D polyline) of Navigation Channel
  - o View/Plot Survey Against Stationing
  - o Compute Channel Volume
  - o View Centerline Plot

- **SBAS-A:** The Regional Sediment Management GIS primarily establishes a regional sediment budget. A budget quantifies sediment erosion and accretion throughout the region. SBAS-A allows local (project-level) sediment budgets to be characterized regionally. Features of SBAS-A facilitate the creation and display of both local and regional sediment budgets. SBAS-A facilitates calculating and displaying local and regional sediment budgets including single and multiple inlets, estuaries, bays, and adjacent beaches.

Web

- ArcIMS page template

- RSM (Regional Sediment Management) Project Viewer
- Disposal/Dredge Area Viewer
- Ocean Disposal Area Manager

Data Requirements:

- Survey Tools: elevation data (grid, tin, XYZ point, profile data)
- Data to populate feeder databases: dredge/disposal events, project level information, etc.
- SBAS: sediment transport rates, dredge event records, disposal events records, survey data
- SAMS: 3D Navigation channel (SDS formatted), survey data

Data format and compatibility:

- An GIS formatted data

Will the application import and export data files ?

- Yes. A number of the applications convert a raw data input and format it properly for inclusion into an enterprise database.

Is the application flexible to couple with external programs and user created executables?

Most tools run within the ArcGIS environment, so any other extension can be coupled with the toolbars.

Also, the eCoastal program deploys instruction manuals to provide guidance to Districts on how to build the network architecture needed to broadcast Web Mapping Services. These open-source WMS can be consumed by a number of web and desktop applications.

Are system and user documentation available?   Are example applications available?

An engineer manual has been created to support the eCoastal program. The manual can be downloaded from the eCoastal website – http://eCoastal.usace.army.mil

Does the application require prior installation of ESRI software?   If so, which products?

Any of the custom desktop toolbars needs ESRI software.

Is there a user group or hotline-type support?

Users can submit a question or comment from the eCoastal website.

GIS Weasel - GIS Applications in H and H Questionnaire

March 21, 2008

Name of Application, date, version number: The GIS Weasel, 4/2008, v 1.0

Contact (with e-mail, web site, and/or phone number): mowshelp@usgs.gov, http://wwwbrr.cr.usgs.gov/weasel

Brief Description:

The GIS Weasel was designed to aid in the preparation of spatial information for input to lumped and distributed parameter hydrologic or other environmental models. The GIS Weasel provides geographic information system (GIS) tools to help create maps of geographic features relevant to a user's model and to generate parameters from those maps. The operation of the GIS Weasel does not require the user to be a GIS expert, only that the user have an understanding of the spatial information requirements of the environmental simulation model being used. The GIS Weasel software system uses a GIS-based graphical user interface (GUI), the C programming language, and external scripting languages. The software will run on any computing platform where ArcInfo Workstation (version 8.0.2 or later) and the GRID extension are accessible. The user controls the processing of the GIS Weasel by interacting with menus, maps, and tables. The purpose of this document is to describe the operation of the software. This document is not intended to describe the usage of this software in support of any particular environmental simulation model. Such guides are published separately.

Platform/operating system: Anywhere ArcInfo Workstation runs: Windows and a handful of Unix flavors.

Web-based or desk-top application ? Desktop

Data Requirements: raster elevation data

Data format and compatibility: ArcInfo Grid

Will the application import and export data files ? It will use ArcInfo Grids directly, but will not reformat input. It will export raster data via the ArcInfo GRIDASCII function. It also creates a wide variety of parameter output in ASCII files, as well as limited graphics.

Is the application flexible to couple with external programs and user created executables?

Are system and user documentation available?

Fact sheet: http://pubs.usgs.gov/fs/2008/3004/

Users manual: http://pubs.usgs.gov/tm/2007/06B04/

Are example applications available? Yes. Sample data provided with software package that goes with sample usage description in the users manual.

Does the application require prior installation of ESRI software?   Yes

If so, which products? ArcInfo Workstation with GRID module.

Is there a user group or hotline-type support? Yes, email support (mowshelp@usgs.gov).

HEC-GEO-HMS - GIS Applications in H and H Questionnaire

June 13, 2012

Name of Application, date, version number: HEC-GeoHMS, versions 5.0 and 10

Contact (with e-mail, web site, and/or phone number): www.hec.usace.army.mil/software/hec-geohms/index.html

Brief Description: The Geospatial Hydrologic Modeling Extension (HEC-GeoHMS) has been developed as a geospatial hydrology toolkit for engineers and hydrologists with limited GIS experience. HEC-GeoHMS uses ArcView and the Spatial Analyst extension to develop a number of hydrologic modeling inputs for the Hydrologic Engineering Center's Hydrologic Modeling System, HEC-HMS. ArcView GIS and its Spatial Analyst extension are available from the Environmental Systems Research Institute, Inc. (ESRI). Analyzing digital terrain data, HEC-GeoHMS transforms the drainage paths and watershed boundaries into a hydrologic data structure that represents the drainage network. The program allows users to visualize spatial information, document watershed characteristics, perform spatial analysis, and delineate subbasins and streams. Working with HEC-GeoHMS through its interfaces, menus, tools, buttons, and context-sensitive online help allows the user to expediently create hydrologic inputs for HEC-HMS.

Platform/operating system: **operates with various versions of Windows**

Web-based or desk-top application ? **desk top**

Data Requirements: **Digital elevation GIS data**

Data format and compatibility: **compatible with ESRI ArcGIS software**

Will the application import and export data files ? **yes**

Is the application flexible to couple with external programs and user created executables?

Are system and user documentation available? **Yes**   Are example applications available? **Yes**

Does the application require prior installation of ESRI software?   **Yes**   If so, which products?
Depending on version, ArcGIS 10.0 or ArcGIS 9.3 and ESRI Spatial analyst Extension

Is there a user group or hotline-type support? **E-mail support to report bugs.**

HEC-GeoRAS - GIS Applications in H and H Questionnaire

January 7, 2008

Name of Application:

HEC-GeoRAS

Source or Contact:

US Army Corps of Engineers, Hydrologic Engineering Center (HEC)

Downloads at http://www.hec.usace.army.mil/software/hec-ras/hec-georas.html

Features:

Creation of HEC-RAS import files using GIS techniques

Inundation area flood mapping

Creation of depth and velocity grids

Abstract:

HEC-GeoRAS is a set of procedures, tools, and utilities for processing geospatial data in ArcGIS using a graphical user interface (GUI). The interface allows the preparation of geometric data for import into HEC-RAS and processes simulation results exported from HEC-RAS. To create the

import file, the user must have an existing digital terrain model (DTM) of the river system in the ArcInfo TIN format. The user creates a series of line themes pertinent to developing geometric data for HEC-RAS. The themes created are the Stream Centerline, Flow Path Centerlines (optional), Main Channel Banks (optional), and Cross Section Cut Lines referred to as the RAS Themes.

Additional RAS Themes may be created/used to extract additional geometric data for import in HEC-RAS. These themes include Land Use, Levee Alignment, Ineffective Flow Areas, and Storage Areas.

Water surface profile data and velocity data exported from HEC-RAS simulations may be processed by HEC-GeoRAS for GIS analysis for floodplain mapping, flood damage computations, ecosystem restoration, and flood warning response and preparedness.

Supported Platforms and License Requirements:

HEC-GeoRAS 4.1.1 for ArcGIS 9.1

ArcGIS 9.1 (ArcView license) with the 3D Analyst and Spatial Analyst extensions are required

Only runs on Window 2000/NT/XP

HEC-GeoRAS 4.1 for ArcGIS 9

ArcGIS 9 (ArcView license) with the 3D Analyst and Spatial Analyst extensions are required.

Only runs on Window 2000/NT/XP

HEC-GeoRAS 4.0 for ArcGIS 8.3

ArcGIS 8.3 (ArcView license) with the 3D Analyst and Spatial Analyst extensions are required.

Only runs on Window 2000/NT/XP

HEC-GeoRAS 3.1.1 for ArcView 3.2

ArcView 3.2 with the 3D Analyst extension is required. Spatial Analyst is recommended.

Only runs on Window 2000/NT/XP

HEC-GeoRAS 1.0 for ArcInfo

ArcInfo with the TIN extension is required.

Uses ArcInfo 7.x which is compatible with Unix or Windows NT

Software Requirements:

All software other than ESRI Licensed software are typically contained in a downloadable installation file. Details are contained in downloadable Users Manual for each software version.

Data Requirements:

At this time HEC-GeoRAS requires a DTM in the form of a triangulated irregular network (TIN). The DTM must be a continuous surface that includes the bottom of the river channel and all of the floodplain to be modeled.   Because all cross-section data will be extracted from the DTM, only high resolution DTMs should be considered.

Documentation and Examples:

HEC-GeoRAS is fully documented with downloadable user manuals and example datasets.

User Support:

HEC website supports a "Known Issues" link.

Technical support for HEC-RAS users within the Corps of Engineers is provided through an annual subscription service.

Support cannot be provided to users outside the Corps of Engineers

Questions or problems regarding HEC-RAS should be directed to the development team at hec.ras@usace.army.mil.

StreamStats - GIS Applications in H and H Questionnaire

March 21, 2008

Name of Application, date, version number:

StreamStats   (http://streamstats.usgs.gov)

Contact (with e-mail, web site, and/or phone number):

Kernell Ries, kries@usgs.gov, 443-498-5617

Brief Description:

StreamStats is a Web application that provide users with information needed by engineers, land and water-resource managers, biologists, and many others to help guide decisions in their everyday work. StreamStats provides streamflow statistics, basin characteristics, and other information for USGS data-collection stations and for ungaged sites. Users can select data-collection station locations shown on a map interface and obtain previously published information for the stations. Users can also select any location along a stream and obtain the drainage-basin boundary, basin characteristics, and estimated streamflow statistics for the location. The estimates for ungaged sites are determined from USGS regional regression equations. A new version of StreamStats is nearing completion that will also provide the abilities to (1) navigate the stream network to locate streamgaging stations, dams, point discharges and other water-related features, (2) estimate flows at ungaged sites based on the flows at nearby streamgaging stations, and (3) allow other Web or desktop GIS applications to access StreamStats functionality remotely by use of Web services.

Platform/operating system:

Served through Windows-based computers, but use of Web site is not limited to Windows computers

Web-based or desk-top application ?

Web

Data Requirements:

None, except users need to be able to locate their sites of interest on a map.

Data format and compatibility:

No input files required

Will the application import and export data files ?

Tabular outputs are provided in html pages that can be saved in that format or as text, and tables on pages can be imported to Excel.

Is the application flexible to couple with external programs and user created executables?

Yes. A number of programs have already been coupled to StreamStats, such as an application for Kentucky that generates time series of average daily temperature and precipitation over user-defined drainage areas. Some StreamStats functionality is also available as Web services, allowing other applications to directly access this functionality.

Are system and user documentation available?   Are example applications available?

Documentation for the current version of the application is accessible through links from the StreamStats home page. Documentation for the new application is being prepared.

Does the application require prior installation of ESRI software?   If so, which products?

Users only need a Web browser, such as Internet Explorer, to use StreamStats.

Is there a user group or hotline-type support?

Contact information is provided through a link on the StreamStats home page.

NRCS Geo-Hydro (ArcGIS) - GIS Applications in H and H Questionnaire

NRCS Geo-Hydro ArcGIS Version

November 4, 2008

Name of Application, date, version number: NRCS Geo-Hydro, Dec 2008, Version 2.0.

Contact (with e-mail, web site, and/or phone number): William Merkel, william.merkel@wdc.usda.gov , 301-504-3956

Brief Description: NRCS Geo-Hydro is an ArcGIS GIS interface to the WinTR-20 hydrologic model. It operates with ESRI ArcGIS 9.1 and the Spatial Analyst extension. The interface is organized to complete the steps required to do a WinTR-20 hydrologic analysis. Using tools and menu selections, the user is guided step by step through the automated processes of defining the watershed boundary, dividing the watershed into sub-areas, developing cross sections, etc.

The end result is a WinTR-20 execution with peak discharges, hydrographs, etc. Basic familiarity with NRCS hydrologic procedures and ArcMap operations are helpful.

Platform/operating system: Windows XP

Web-based or desk-top application ? Desk-top application.

Data Requirements: Digital elevation, land use, soil, and stream location layers are required.

Data format and compatibility: Elevation, land use, and soil must be in ESRI grid format and stream locations as an ESRI shapefile. Layers must be in the same geographic projection. Data may be in English or SI units.

Will the application import and export data files ? Within the framework of ESRI ArcGIS, digital elevation, land use, soil, and stream location are imported to ArcGIS/ArcMap. During the steps of the application, various layers are created which may be exported. Layers may be operated on through standard ArcMap commands.

Is the application flexible to couple with external programs and user created executables? Within the framework of ESRI ArcObjects and VBA, the application may be modified and other models may be linked.

Are system and user documentation available? Yes.   Are example applications available? Yes. These are included with the download package. In addition, course material is available which include power point slides and example workshops.

Does the application require prior installation of ESRI software? Yes.   If so, which products? ArcGIS 9.1 and Spatial Analyst extension. Installation software for ArcHydro Tools, AP Framework, and XML parser are provided with the installation package.

Is there a user group or hotline-type support? Yes, call or e-mail developers.

NRCS Geo-Hydro (ArcView) - GIS Applications in H and H Questionnaire

November 4, 2008

Name of Application, date, version number: NRCS Geo-Hydro, May 2005, Version 1.0.

Contact (with e-mail, web site, and/or phone number): William Merkel, william.merkel@wdc.usda.gov , 301-504-3956 Web site:

http://go.usa.gov/KoZ

Brief Description: NRCS Geo-Hydro is an ArcView GIS interface to the WinTR-20 hydrologic model. It operates with ESRI ArcView 3.3 and the Spatial Analyst extension. The interface is organized to complete the steps required to do a WinTR-20 hydrologic analysis. Using tools and menu selections, the user is guided step by step through the automated processes of defining the watershed boundary, dividing the watershed into sub-areas, developing cross sections, etc. The end result is a WinTR-20 execution with peak discharges, hydrographs, etc. Basic familiarity with NRCS hydrologic procedures and ArcView operations are helpful.

Platform/operating system: Windows XP

Web-based or desk-top application ? Desk-top application.

Data Requirements: Digital elevation, land use, soil layers are required. Stream location layer is optional.

Data format and compatibility: Elevation, land use, and soil must be in ESRI grid format and stream locations as an ESRI shapefile. Layers must be in the same geographic projection.

Will the application import and export data files ? Within the framework of ESRI ArcView, digital elevation, land use, soil, and stream location are imported to ArcView. During the steps of the application, various layers are created which may be exported. Layers may be operated on through standard ArcView commands.

Is the application flexible to couple with external programs and user created executables? Within the framework of ESRI Avenue scripts, the application may be modified and other models may be linked.

Are system and user documentation available? Yes.   Are example applications available? Yes. These are included with the download package.

Does the application require prior installation of ESRI software? Yes.   If so, which products? ArcView 3.3 and Spatial Analyst extension.

Is there a user group or hotline-type support? Yes, call or e-mail developers.

EPA BASINS - GIS Applications in H and H Questionnaire

September 30, 2008

Name of Application, date, version number: BASINS version 4.0

Contact (with e-mail, web site, and/or phone number):
http://www.epa.gov/waterscience/BASINS/ , James N. Carleton, carleton.jim@epa.gov

Brief Description: BASINS is an extensible, open-source GIS-based (MapWindow) Decision Support System that integrates watershed models with ready access to data (flow,

meteorologic, water quality, and various GIS layers). BASINS includes tools for setting up surface water model runs, and processing and visualizing data and model output. See website for more information.

Platform/operating system: Windows 98 or above.

Web-based or desk-top application ? Desk-top with web based data through a Data Download Tool.

Data Requirements: Windows 98 or better.

Data format and compatibility: ESRI GIS standardized shapefile or GRID format among others.

Will the application import and export data files? Yes, both.

Is the application flexible to couple with external programs and user created executables? Yes

Are system and user documentation available? Yes, on website and online under the Help Menu.   Are example applications available? yes

Does the application require prior installation of ESRI software? No, Open source Mapwindow software (www.mapwindow.org) .   If so, which products?

Is there a user group or hotline-type support? There is a listserve called BASINSINFO that users can subscribe to.

HAZUS - GIS Applications in H and H Questionnaire

September 30, 2008

Name of Application, date, version number: HAZUS-MH, Nov. 2007, MR3 (1.3)

Contact (with e-mail, web site, and/or phone number): Eric Berman,
http://www.fema.gov/plan/prevent/hazus/index.shtm , eric.berman@dhs.gov, 202-646-3427

Brief Description:

HAZUS-MH is a loss estimation methodology that supports FEMA's mitigation efforts at all levels (federal, state and local) by assessing the risk & estimating potential loss from multiple natural hazards: earthquakes, floods, and hurricane winds. In HAZUS, current scientific & engineering knowledge is coupled with Geographic Information Systems technology to produce estimates of hazard-related damage. It takes into account impacts of a hazard event such as - Physical damage: damage to residential & commercial buildings, schools, critical facilities, and infrastructure; Economic loss: lost jobs, business interruptions, repair & reconstruction costs; and Social impacts: impacts to people, including requirements for shelters & medical aid. HAZUS fills a nationwide need for a risk assessment and loss estimation methodology (a modeling tool). It assists state & local governments with the development of their Disaster Mitigation Act 2000 Hazard Mitigation Plans. HAZUS was developed and is maintained by, National Institute of Building Sciences (NIBS), at their site and is distributed by FEMA upon request. HAZUS uses geospatial technology to map and display hazard data and the results of damage and economic loss estimates for buildings and infrastructure, and the impact on populations. Loss estimates produced by HAZUS are based on current scientific and engineering knowledge of the effects of hurricane winds, floods, and earthquakes. NIBS maintains committees of hurricane wind, flood and earthquake experts to provide technical oversight & guidance to HAZUS. Mitigation efforts offer the best and most cost-effective methods of addressing the impacts associated with disasters. The primary purpose of hazard mitigation planning is to help communities identify the most effective policies, actions, and tools to decrease risk and the potential for future losses.

Platform/operating system: Windows

Web-based or desk-top application ? Desk top

33

Data Requirements: All included for level 1

Data format and compatibility: ESRI

Will the application import and export data files ? Yes, we have the CDMS tool in HAZUS

Is the application flexible to couple with external programs and user created executables? Yes

Are system and user documentation available? Yes   Are example applications available? Yes

Does the application require prior installation of ESRI software? Yes

If so, which products? ArcView / ArcEditor with spatial analysis

Is there a user group or hotline-type support? Yes, both 800 number and users groups

Map Window - GIS Applications in H and H Questionnaire

September 30, 2008

Name of Application, date, version number: MapWindow, August 30, 2008, Version 4.6.

Contact (with e-mail, web site, and/or phone number): www.MapWindow.org

Brief Description: MapWindow is an open source GIS which is public domain. The code is open which allows for developing extensions and applications. It has tools which allow analysis of grid and vector GIS data. An extension named TauDEM is available which performs analysis of digital

elevation and stream vector data. Some of the analytical operations are burn streams, fill DEM, flow direction, flow accumulation, stream network analysis, watershed delineation, and more.

Platform/operating system: Windows XP or equivalent.

Web-based or desk-top application ? Desktop.

Data Requirements: The watershed delineation operation requires a DEM grid and optional stream vector layer. The general operation of MapWindow GIS accepts grid, vector, and image data layers.

Data format and compatibility: Data developed for use with ESRI software is compatible with MapWindow. Generic GIS data such as grid in ASCII grid format is compatible with MapWindow.

Will the application import and export data files ? MapWindow is a GIS which allows import of data for viewing and analysis. Data export ?

Is the application flexible to couple with external programs and user created executables?

Yes. The user may develop extensions within the MapWindow system and build layers and attribute tables acceptable to ESRI software.

Are system and user documentation available?   Yes from the web site.   Are example applications available? Example data and projects are available.

Does the application require prior installation of ESRI software? No.   If so, which products?

Is there a user group or hotline-type support? The web site has on-line help and bug reporting system.

SWAT - GIS Applications in H and H Questionnaire

September 30, 2008

Name of Application, date, version number:

Contact (with e-mail, web site, and/or phone number):

Dr. Jeffrey G. Arnold

Email address: Jeff.Arnold@ars.usda.gov

Web site: http://www.brc.tamus.edu/swat/

Brief Description:

SWAT is a river basin scale model developed to quantify the impact of land management practices in large, complex watersheds.

SWAT is a public domain model actively supported by the USDA Agricultural Research Service at the Grassland, Soil and Water Research Laboratory in Temple, Texas, USA.

Platform/operating system:

Hardware:

   * Personal computer using a Pentium IV processor or higher, which runs at 2 gigahertz or faster

   * 1 GB RAM minimum

   * 500 megabytes free memory on the hard drive for minimal installation and up to 1.25 gigabyte for a full installation (including sample datasets and US STATSGO data)

Web-based or desk-top application -

Currently desk-top application

Data Requirements:

Data format and compatibility:

Will the application import and export data files ?

Yes

Is the application flexible to couple with external programs and user created executables?

Yes

Are system and user documentation available?

Yes

Are example applications available?

Yes

Does the application require prior installation of ESRI software?

Yes

If so, which products?

Software (ArcSWAT 1.0 for ArcGIS 9.1 version):

- **Microsoft Windows XP, or Windows 2000 operating system with most recent kernel patch***
- **ArcGIS-ArcView 9.1 with service pack 2 (Build 766)**
- **ArcGIS Spatial Analyst 9.1 extension**
- **ArcGIS Developer Kit (usually found in C:\Program Files\ArcGIS\DeveloperKit\)**
- **ArcGIS DotNet support (usually found in C:\Program Files\ArcGIS\DotNet\)**
- **Microsoft .Net Framework 1.1**
- **[Adobe Acrobat Reader](#) version 7 or higher**

Is there a user group or hotline-type support?

Yes

http://www.brc.tamus.edu/swat/arcswat.html

Click on 'ArcSWAT Group'

NHD-PLUS - GIS Applications in H and H Questionnaire

Name of Application, date, version number:

NHDPlus Append Tool, 3/24/2008, V1.17

Contact (with e-mail, web site, and/or phone number):

Horizon Systems Corporation (under contract to EPA), NHDPlus@hscnet.com

http://www.horizon-systems.com/NHDPlus/, 703-471-0480

Brief Description:

Append combines individual NHDPlus workspaces to form larger NHDPlus workspaces. For example, Append may be used to combine NHDPlus HUC8 workspaces into a project workspace.

Platform/operating system:

Windows XP w/ Service Pack 2; Vista; Microsoft .Net 2.0 Framework (or above)

Web-based or desk-top application ?

Desk-top

Data Requirements:

NHDPlus HUC8 workspaces

Data format and compatibility:

ESRI Shapefiles, ESRI Grids, and Microsoft Access

Will the application import and export data files ?

Yes

Is the application flexible to couple with external programs and user created executables?

n/a

Are system and user documentation available?   Are example applications available?

Yes - http://www.horizon-systems.com/NHDPlus/tools.php

Does the application require prior installation of ESRI software?   If so, which products?

Yes - ArcGIS 9.2 (ArcInfo license level), Service Pack 4 or above; ArcGIS Spatial Analyst Extension

Is there a user group or hotline-type support?

Yes to both - NHDPlus@hscnet.com- 703-471-0480

Name of Application, date, version number:

NHDPlus AquaXpos, 4/29/2008, V1.003

Contact (with e-mail, web site, and/or phone number):

Horizon Systems Corporation (under contract to EPA), NHDPlus@hscnet.com

http://www.horizon-systems.com/NHDPlus/ , 703-471-0480

Brief Description:

AquaXpos conducts a geospatial analysis of the NHDPlus stream network to identify potential pesticide use impacts. Based on an initial area of concern and a method for estimating pesticide impact, AquaXpos analyzes the stream network to find places, downstream from potential pesticide use sites, where chemical impact's may exceed a specific level of concern..

Platform/operating system:

Windows XP w/ Service Pack 2; Vista; Microsoft .Net 2.0 Framework (or above)

Web-based or desk-top application ?

Desk-top

Data Requirements:

NHDPlus Dataset

NHDPlus Tools Application Data, Version 1

Data format and compatibility:

Microsoft Access

Will the application import and export data files ?

n/a

Is the application flexible to couple with external programs and user created executables?

n/a

Are system and user documentation available?   Are example applications available?

Yes - http://www.horizon-systems.com/NHDPlus/tools.php

Does the application require prior installation of ESRI software?   If so, which products?

No

Is there a user group or hotline-type support?

Yes to both - NHDPlus@hscnet.com- 703-471-0480

Name of Application, date, version number:

NHDPlus BasinDelineator, 3/26/2008, V1.008

Contact (with e-mail, web site, and/or phone number):

Horizon Systems Corporation (under contract to EPA), NHDPlus@hscnet.com

http://www.horizon-systems.com/NHDPlus/ , 703-471-0480

Brief Description:

BasinDelineator delineates drainage basins for a user-defined set of basin pourpoints. The pourpoints must be located on the NHDPlus network which is defined as the subset of flowlines with known flow direction (i.e. NHDPlus.NHDFlowline.Flowdir = "With Digitized"). The input pourpoints are specified by a basin identifier, an NHD linear reachcode, and a measure along the reach. BasinDelineator returns a shapefile containing basin polygons.

Platform/operating system:

Windows XP w/ Service Pack 2; Vista; Microsoft .Net 2.0 Framework (or above)

Web-based or desk-top application ?

Desk-top

Data Requirements:

NHDPlus Dataset

NHDPlus Tools Application Data, Version 1

Data format and compatibility:

ESRI Shapefiles, ESRI Grids, and Microsoft Access

Will the application import and export data files ?

n/a

Is the application flexible to couple with external programs and user created executables?

n/a

Are system and user documentation available?   Are example applications available?

Yes - http://www.horizon-systems.com/NHDPlus/tools.php

Does the application require prior installation of ESRI software?   If so, which products?

Yes - ArcGIS 9.2 (ArcInfo license level), Service Pack 4 or above; ArcGIS Spatial Analyst Extension

Is there a user group or hotline-type support?

Yes to both - NHDPlus@hscnet.com- 703-471-0480

Name of Application, date, version number:

NHDPlus Catchment Attribute Allocation & Accumulation Tool, 3/26/2008, V1.009

Contact (with e-mail, web site, and/or phone number):

Horizon Systems Corporation (under contract to EPA), NHDPlus@hscnet.com

http://www.horizon-systems.com/NHDPlus/ , 703-471-0480

Brief Description:

CA3T has two functions, an attribute allocation function and an attribute accumulation function, which may be used separately or in combination. The CA3T allocation function takes a user-supplied grid format dataset of one or more landscape attributes and allocates the attributes to the NHDPlus catchments. The CA3T accumulation function builds, for each NHDPlus Flowline, the total upstream accumulated values for attributes that have been allocated to either NHDPlus catchments or NHDPlus flowlines.

Platform/operating system:

Windows XP w/ Service Pack 2 and Vista; Microsoft .Net 2.0 Framework (or above)

Web-based or desk-top application ?

Desk-top

Data Requirements:

NHDPlus Dataset

NHDPlus Tools Application Data, Version 1

Data format and compatibility:

ESRI Shapefiles, ESRI Grids, and Microsoft Access

Will the application import and export data files ?

n/a

Is the application flexible to couple with external programs and user created executables?

n/a

Are system and user documentation available?   Are example applications available?

Yes - http://www.horizon-systems.com/NHDPlus/tools.php

Does the application require prior installation of ESRI software?   If so, which products?

Yes - ArcGIS 9.2 (ArcInfo license level), Service Pack 4 or above; ArcGIS Spatial Analyst Extension

Is there a user group or hotline-type support?

Yes to both - NHDPlus@hscnet.com- 703-471-0480

Name of Application, date, version number:

NHDPlus VAA COM Object Navigator Tool, 4/7/2008, V1.03

Contact (with e-mail, web site, and/or phone number):

Horizon Systems Corporation (under contract to EPA), NHDPlus@hscnet.com

http://www.horizon-systems.com/NHDPlus/ , 703-471-0480

Brief Description:

The VAA COM Object Navigator uses the NHDPlus value added attributes to perform four types of navigations: upstream main stem, upstream with tributaries, downstream main stem, and downstream with divergences. Any of the four types of navigation may be stopped at a user-supplied distance from the starting point. This navigator may be used through ArcMap via a special ArcMap Toolbar or it may be called from user-written program code. The navigator will work on any

NHDGEOinSHP dataset that contains a fully populated NHDFlowlineVAA.dbf table (generally this means an NHDPlus dataset). When used via the ArcMap toolbar, results are returned to ArcMap as a new layer in the map called Navigation Results. This navigator is a COM object and may be call from user-written code that is developed in a COM-compliant programming language.

Platform/operating system:

Windows XP w/ Service Pack 2 and Vista; Microsoft .Net 2.0 Framework (or above)

Web-based or desk-top application ?

Desk-top

Data Requirements:

NHDPlus Dataset

Data format and compatibility:

ESRI Shapefiles and Microsoft Access

Will the application import and export data files ?

n/a

Is the application flexible to couple with external programs and user created executables?

Yes

Are system and user documentation available?   Are example applications available?

Yes - http://www.horizon-systems.com/NHDPlus/tools.php

Does the application require prior installation of ESRI software? If so, which products?

Yes - ArcGIS 9.2 (ArcInfo license level), Service Pack 4 or above

Is there a user group or hotline-type support?

Yes to both - NHDPlus@hscnet.com- 703-471-0480

Name of Application, date, version number:

NHDPlus Flow Table Navigator Tool, 2/12/2007, V1.00

Contact (with e-mail, web site, and/or phone number):

Horizon Systems Corporation (under contract to EPA), NHDPlus@hscnet.com

http://www.horizon-systems.com/NHDPlus/ , 703-471-0480

Brief Description:

The Flow Table Navigator uses the NHDFlow table to walk the network from one network feature to the next. The navigator performs four types of navigations: upstream main stem, upstream with tributaries, downstream main stem, downstream with divergences. It may be used through ArcMap via a special ArcMap Toolbar or it may be called from user-written program code. The navigator will work on any NHDGEOinSHP dataset, including NHDPlus, that contains a fully populated NHDFlow.dbf table. Results are returned to ArcMap as a selected set of the NHDFlowline layer. When used outside of ArcMap, results are returned in a text file residing in the highest level directory of the NHDPlus dataset.

Platform/operating system:

Windows XP w/ Service Pack 2; Vista

Web-based or desk-top application ?

Desk-top

Data Requirements:

NHDPlus Dataset

Data format and compatibility:

Microsoft Access

Will the application import and export data files ?

n/a

Is the application flexible to couple with external programs and user created executables?

Yes

Are system and user documentation available?   Are example applications available?

Yes - http://www.horizon-systems.com/NHDPlus/tools.php

Does the application require prior installation of ESRI software?   If so, which products?

No

Is there a user group or hotline-type support?

Yes to both - NHDPlus@hscnet.com- 703-471-0480

EPA-SWMM - GIS Applications in H and H Questionnaire

Name of Model:
Storm Water Management Model (SWMM) Version 5.0.022

Web site link: www.epa.gov/nrmrl/wswrd/wq/models/swmm

Model Type:
SWMM is a physically-based, distributed, unsteady, continuous urban stormwater runoff quantity and quality model.

Model Objective(s):
- **to design and size drainage system components, including detention facilities;**
- **to generate non-point source pollutant loadings for TMDL studies;**
- **to evaluate BMP and LID stormwater controls to meet sustainability goals;**
- **to alleviate combined and sanitary sewer overflows;**
- **to control flooding of urban areas and natural channel systems.**

Agency and Office:
U.S. Environmental Protection Agency, National Risk Management Research Laboratory, Cincinnati, Ohio.

Technical Contact and Address:
Lewis Rossman,
US EPA – NRMRL
26 W. M.L. King Drive
Cincinnati, OH 45268
Email: rossman.lewis@epa.gov

Model Structure or Mathematical Basis:
Hydrology:

Spatial Representation	User-defined subcatchment areas
Rainfall	User supplied
Interception/Evaporation	User supplied
Infiltration	Horton Curve Green-Ampt method SCS Curve
Overland Flow	Nonlinear reservoir model
Groundwater	Localized two-zone flux model
Snowmelt	Heat balance/degree day model

Hydraulics:

Drainage Elements	Nodes (Junction, Storage, Outfall) Links (Conduits, Pumps, Regulators)
Conduit Shapes	20 common shapes irregular open channels custom closed conduits
Flow Routing	Steady Flow Kinematic Wave (nonlinear form) Dynamic Wave (semi-implicit)

Water Quality:

Pollutant Buildup	Power, exponential or saturation function of time
Pollutant Washoff	Rate proportional to runoff and buildup or can use an EMC
BMP Removal	User-assigned percent reduction

| Non-Runoff Loads | User-defined, sanitary DWF, RDII inflow |

| Drainage System Routing | CSTR model |

| Drainage System Treatment | User-defined functions |

Model Parameters:

Subcatchments: % impervious, surface roughness, slope, flow path length.

Infiltration: Horton: max/min rates and decay constant; Green-Ampt: hydraulic conductivity and suction head; Curve Number: NRCS (SCS) Curve number; All: time for saturated soil to fully drain.

Conduits: Manning's roughness.

Water Quality: buildup/washoff function coefficients.

Spatial Scale Employed in the Model:

A study area can be divided into any number of individual subcatchments, each of which drains to a single point. Study areas can range in size from single lots up to hundreds of acres.

Temporal Scale Employed in the Model:

SWMM uses hourly or more frequent rainfall data as input and can be run for single events or in continuous fashion for any number of years.

Input Data Requirements:

Hydrology: Hourly or more frequent rainfall data; daily evaporation rates; subcatchment area, percent imperviousness, depression storage, and slope.

Hydraulics: Conduit shape, size, length, and slope; storage unit shape and size; weir/orifice type and dimensions; pump curve data.

Water Quality: Street sweeping frequency and effectiveness; BMP removal efficiency; treatment unit removal efficiency.

Computer Requirements:

Operating System: Windows 98/NT/ME/2000/XP/Vista/7;

Hardware Requirements: equivalent of an Intel 486 or higher CPU;

Memory Requirements: minimum of 256 MB RAM;

Disk Storage Requirements: minimum of 4 Mbytes.

Model Output:

SWMM produces time series output for the following variables:

Subcatchments: rainfall, runoff flow, pollutant washoff quality, snow depth, GW water table elevation, GW flow rate.

Drainage System Nodes: water depth, lateral inflow, flooding rate, pollutant concentration.

Drainage System Links: flow rate, flow depth, flow velocity, pollutant concentration.

Additional tables summarize such quantities as total rainfall, infiltration, evaporation, and runoff for each subcatchment; average and maximum water depth at each drainage system node; total and maximum flooding at each node; maximum flow, velocity and depth in each link.

Parameter Estimation / Model Calibration:

The SWMM Users and Reference Manuals provide guidelines and tables for estimating model parameters, most of which are physically-based. No formal calibration tools are included. However, SWMM's graphical user interface facilitates comparing computed values against measured values through its time series plotting feature.

Model Testing and Verification:

The latest version of SWMM, 5.0, has undergone quality assurance testing to verify its compatibility with earlier versions of the program (see Storm Water Management Model Quality Assurance Report, EPA/600/R-06/097, U.S. Environmental Protection Agency, Cincinnati, OH, September 2006). SWMM has been in constant use for over 30 years and has been field tested numerous times.

Model Sensitivity:

Runoff volumes are most sensitive to values assigned to percent imperviousness and infiltration parameters (e.g., hydraulic conductivity for Green-Ampt infiltration). Peak runoff rates are sensitive to flow path length and slope. The accuracy and stability of flow routing results are sensitive to the time step used. SWMM's dynamic wave routing method can use an internally computed variable time step to reduce the sensitivity to the user's initially assigned time step.

Model Reliability:

A properly calibrated SWMM model should be able to produce highly accurate runoff hydrographs and drainage system flow rates. Minimum reliability levels of ±10% for event volumes and ±20% for peak flows are routinely achievable. Water quality estimates are less reliable, and are highly dependent on the amount of measured data available for calibration.

Model Application / Case Studies:

There have been literally thousands of applications made with SWMM during its lifetime. Most of these are documented in consultant reports and are not available to the public. The 15-volume set of proceedings from the Annual Conferences on Stormwater and Urban Water Systems Modeling contain a number papers related to applications and case studies using SWMM (see http://www.computationalhydraulics.com).

Documentation:

Storm Water Management Model User's Manual, EPA/600/R-05/040, U.S. Environmental Protection Agency, Cincinnati, OH (Revised July 2009);

Storm Water Management Model Reference Manual, (in preparation);

Storm Water Management Model Applications Manual, EPA/600/R-09/077, U.S. Environmental Protection Agency, Cincinnati, OH (July 2009);

Other Comments:

SWMM 5.0 runs under a Windows graphical user interface. The interface allows users to draw a schematic representation of a catchment area and its drainage system elements against a backdrop map image of the study area, edit the properties of individual components by pointing and clicking on them, and view analysis results in several different formats, such as time series plots, hydraulic grade line profile plots, and tabular listings. A statistical analysis tool summarizes the results of long-term simulations with frequency plots and histograms.

Appendix 3 Final report from Texas A&M concerning hydrologic model inventory (4-7-2010)

Gathering and Dissemination of GIS-based Hydrology and Hydraulic Modeling Tools

Final Report

Vijay Singh[1, 2], Di Long[1]

1. Department of Biological & Agricultural Engineering, Texas A&M University

2. Department of Civil Engineering, Texas A&M University

College Station, Texas 77843-2117

The project was initiated in the context of increasing applications of Geographic Information System (GIS) and satellite remote sensing data techniques to the fields of hydrology and hydraulics. GIS is becoming the most common spatial platform to pre- and post-process information for water related modeling, and to share data and information. A variety of federal and non-federal entities are interested in developing tools and methods for taking advantage of GIS, particularly the non-proprietary, to address water-related problems. To that end, the objective of this project was to gather and disseminate GIS-based hydrology and hydraulic modeling tools, providing information on how to access the data and applications, and how to receive training and support.

Gathering and dissemination of the inventory of GIS-based applications were conducted primarily on the basis of an established web site at Texas A&M University (http://hydrologicmodels.tamu.edu/) and relevant questionnaires. The web site contains a list of questionnaires for a series of hydrologic and hydraulic models, which has been established between U.S. Bureau of Reclamation and Texas A&M University under the supervision of Professor Vijay P. Singh and is known to the hydrologic and hydraulic community. A cooperative ecosystem studies unit (CESU) agreement between the U.S. Bureau of Reclamation and Texas A&M University to post the completed questionnaires on a web site has been funded for $20,000. The project was undertaken from June 1, 2009 to May 31, 2010 and Di Long, a Ph.D. student from the Department of Biological & Agricultural Engineering at Texas A&M University worked on the project under the supervision of Professor Vijay P. Singh. The term of the agreement has been extended until August 2010 to allow for completion of the items requested in the plan of work.

After the project completion date, efforts will be made for Texas A&M University will continue to support the web site which includes major categories of hydrologic models. This includes updating questionnaires, adding/deleting models, etc. A summary of the project is now given.

1. Organization of Existing Hydrologic and Hydraulic Questionnaires

The watershed models are of different types, since they have been developed for different uses and purposes (Singh and Frevert, 2002). Nevertheless, many of them share some structural similarities because their underlying assumptions are similar, and some of the models are distinctly different. Singh (1995) classified models based on (1) process description, (2) time scale, (3) space scale, (4) techniques of solution, (5) land use, and (6) model use. ASCE (1996) reviewed and categorized flood analysis models into (1) event-based precipitation-runoff models, (2) continuous precipitation-runoff models, (3) steady flow routing models, (4) unsteady-flow flood routing models, (5) reservoir regulation models, and (6) flood frequency analysis models. Wurbs (1998) highlighted the availability and role of generalized computer modeling packages and outlined the institutional setting within which the models are disseminated throughout the water community. Generalized water resources models were classified into (1) watershed models, (2) river hydraulics models, (3) river and reservoir water quality models, (4) reservoir/river system operation models, (5) ground water models, (6) water distribution system hydraulic models, and (7) demand forecasting models. Todini (1988) classified hydrologic models according to the degree of priori knowledge that can be introduced at the model specification stage into four groups: (1) purely stochastic models, (2) lumped integral models, (3) distributed integral models, and (4) distributed differential models.

There are totally **97** hydrologic and hydraulic models being investigated for the web site model inventory. The first version questionnaire was sent to model developers in the year 1999, 2007 and 2008, respectively. Such questionnaire that is currently listed on our website is the latest one for the three surveys conducted. An attempt was made to group all these models into partially overlapping 7 categories by comprehensively and synthetically taking into account their physical bases, structure, techniques and purposes. There categories are: Precipitation-Runoff Models (54), Hydraulic Models (11), River and Watershed Management Models (9), GIS-based Models (17), Regional and Global Hydrology Models (2), Stochastic Models (2), and Parameter Analysis Model (2), respectively. The Precipitation-Runoff models were further categorized into 5 groups. There are Distributed Models (18), Lumped and Parametric Models (19), Environmental Models (12), Monthly Water Balance models (3), and Real Time Flow Forecasting Models (2). It is apparent that for disseminating information about the GIS-based hydrologic and hydraulic models, they were listed as a major independent category of models. Inevitably, a

single model could be placed in multiple categories. For example, the Soil and Water Assessment Tool (SWAT) is listed in both categories of the Precipitation-Runoff Model and GIS-based model.

2. Completion of a Questionnaire Survey on GIS-based Hydrologic and Hydraulic models

We received 17 responses to our questionnaire (the second version questionnaire is shown in Appendix I) about GIS-based hydrologic and hydraulic models. The questionnaire encompasses questions about: (1) Brief description; (2) Platform/operating system; (3) Web-based or desktop application; (4) Data requirement; (5) Data format and compatibility; (6) Will the application import and export data files? (7) Is the application flexible to couple with external programs and user created executables? (8) Are system and user documentation available? (9) Are example applications available? (10) Does the application require prior installation of ESRI software? (11) If so, which products? (12) Is there a user group or hotline-type support? The 12 questions can essentially describe basic information on the techniques and software of the GIS-based models for public users, providing the users with basic information regarding the selection and further investigation of a GIS-based model.

The GIS-based models involve Automated Geospatial Watershed Assessment Tool (AGWA), eCoastal Program, Basins, GIS Weasel, HAZUS-MH, HEC-GeoRAS, MapWindow, NHDPlus Append Tool, NHDPlus AquaXpos, NHDPlus BasinDelineator, NHDPlus Catchment Attribute Allocation & Accumulation Tool, NHDPlus VAA COM Object Navigator Tool, NHDPlus Flow Table Navigator Tool, NRCS Geo-Hydro ArcGIS, NRCS Geo-Hydro ArcView, StreamStats, and Soil and Water Assessment Tool (SWAT). A comprehensive comparison of such models is shown in Appendix III for providing the user with more meaningful information and reference and assisting in the selection and application of models in their research.

3. Completion of a New Questionnaire Survey for Hydrologic and Hydraulic Models on the Aspects of GIS and Remote Sensing Data and Techniques

We designed the third version questionnaire (shown in Appendix II) for further gathering information on the use of GIS and satellite data and techniques in a spectrum of hydrologic

modeling and applications and have updated such information on our web site. In addition to describing the computer system, operating system, programming language and software dependencies involved in the second version questionnaire, the third version questionnaire also attempts to describe a GIS-based model from a hydrologic or hydraulic perspective. The third version questionnaire contains items like model type, model objective, model structure or mathematical basis, model parameter, spatial scale employed in the model, temporal scale employed in the model, input data requirement, input data format, model output, output data format, parameter estimation or model calibration, model testing and verification, model sensitivity, model reliability and model application or case studies. This would provide the users with more detailed information on practical applications.

The questionnaire survey was carried out from December 21, 2009, onwards with disseminating to more than 30 institutes, organizations and developers. We have received 25 feedbacks and updated our web site. This questionnaire covers a broader range of hydrologic and hydraulic models as well as more detailed and wide descriptions about GIS applications in these models.

4. Investigation of Newly Developed Hydrologic and Hydraulic Models and Their Integrated Applications of GIS Techniques

We searched for newly developed GIS-based hydrologic and hydraulic as well as those models relevant to GIS applications through literature database like ISI Web of Knowledge, Scopus and Engineering Village and Google Scholar. We continue to disseminate the questionnaire to the developers and enrich the inventory database.

5. Collaboration of a Conference Paper with USBR and NRCS

We collaborated with the Hydrologic and Hydraulic GIS Applications Workgroup for a conference paper on 'Federal Interagency Hydrology and Hydraulics GIS Applications Workgroup' submitted to the Joint Federal Interagency Conferences 2010, Las Vegas, Nevada. The oral presentation was given by William Merkel from USDA/Natural Resources Conservation Service at Riviera hotel, Las Vegas on 28 June, 2010.

6. Suggestions and Recommendations

It is suggested that the model inventory be systematically updated every two or three years. Traditional and newly developed models are increasingly making use of GIS and satellite

data and relevant techniques for simulation. The newer use and integration of GIS techniques require a timely update of the inventory. Dissemination of the web site can be realized through the modelers' Email list and circulating amongst their colleagues and students. In addition, we may take opportunities to attend hydrologic modeling and water resources related conferences to let people know our web site. As a complement of the update of the inventory, we uploaded the latest version questionnaire on our web site. Model developers can download them to update information regarding their models at any time.

Appendix I

The Texas A&M University and U.S. Bureau of Reclamation Hydrologic Modeling Inventory (HMI) Questionnaire

December 19, 2009

This document is the Texas A&M University (TAMU)-U.S. Bureau of Reclamation (USBR) Hydrologic Modeling Inventory (HMI) Questionnaire. Your response to this questionnaire will provide the basis for the HMI on-line database accessed through the HMI Web page. Modelers can interactively obtain information about your model through this Web-enabled model inventory complete with search capabilities. The information you provide will hopefully foster wider interest in your model. A designated contact will be explicitly acknowledged and posted within the HMI Web page database.

Given more and more applications of GIS and remote sensing techniques to hydrologic modeling, water resources and watershed management, the Subcommittee on Hydrology has recently set up a workgroup to organize and publicize information on GIS applications in the fields of hydrology and hydraulics. This scope has been expanded to include related water quality, watershed management, and ecological sciences GIS applications. This work is intended to make information on GIS applications in hydrology and hydraulics more generally available. This questionnaire is also designed to gather limited but key information about a particular GIS application in order for a potential user to decide if the application fits his/her computer system, data requirements, and physical system to be modeled.

These applications should be public domain and supported by user documentation. Availability on the Web is not necessary if the application can be distributed on CD ROM or through e-mail requests. If a short abstract, fact sheet, or technical paper is available on the application, please attach a copy. Please respond this email before **22 January, 2010**.

Name of Model, Date, Version Number:

Contact (with e-mail, web site, and/or phone number):

Brief Description:

Model Type:

Model Objective(s):

Model Structure or Mathematical Basis:

Spatial Scale Employed in the Model:

Temporal Scale Employed in the Model:

Input Data Requirement:

Model Output:

Input Data Format:

Output Data Format:

Parameter Estimation/Model Calibration:

Model Testing and Verification:

Model Sensitivity:

Model Reliability:

Model Application/Case Studies:

Platform/Operating System:

Programming language and software:

Web-based or desk-top application?

Is the application flexible to couple with external programs and user created executables?

Are system and user documentation available? (Web site)

Are example applications available? (Web site)

Is there a user group or hotline-type support? (Website)

Other Comments:

Please return the questionnaire to Di Long at descartes66@tamu.edu or Dr. Vijay P. Singh, Texas A&M University, Office: (979)-845-7028, E-mail: vsingh@tamu.edu. **Address**: Scoates Hall 321, Texas A&M University, College Station, TX, 77843-2117

Appendix II

Guidelines for Responding to the Texas A&M University and U.S. Bureau of Reclamation Hydrologic Modeling Inventory (HMI) Questionnaire

Introduction to Model Questionnaire

This document provides guidelines for completion of the Texas A&M University (TAMU)-U.S. Bureau of Reclamation (USBR) Hydrologic Modeling Inventory (HMI) Questionnaire. Your response to this questionnaire will provide the basis for the HMI on-line database accessed through the HMI Web page. Modelers can interactively obtain information about your model through this Web-enabled model inventory complete with search capabilities. The information you provide will hopefully foster wider interest in your model. A designated contact will be explicitly acknowledged and posted within the HMI Web page database.

Please find attached a sample response form. You mail reply by E-mail, Fax, US Post. If you are not able to complete the questionnaire, please forward suitable documents that will permit completion of the questionnaire for your model. Models have recently been summarized in the literature by Wurbs (1998), Ahuja, et al (1995), and Barton (1993). The organization of the modeling questionnaire is based on characterization of past model developments by Singh (1995) and Singh & Frevert (2002a, b, 2006).

Please see our web page: http://hydrologicmodels.tamu.edu for more details about our approach to developing this inventory system.

Questionnaire Response Guidance:

The elements of the questionnaire will include the following topics to be filled out by the model developer/support group:

Name of Model, Date, Version Number:

Contact (with e-mail, web site, and/or phone number):

Brief Description:

Model Type:

Model Objective(s):

Model Structure or Mathematical Basis:

Spatial Scale Employed in the Model:

Temporal Scale Employed in the Model:

Input Data Requirement:

Model Output:

Input Data Format:

Output Data Format:

Parameter Estimation/Model Calibration:

Model Testing and Verification:

Model Sensitivity:

Model Reliability:

Model Application/Case Studies:

Platform/Operating System:

Programming language and software:

Is the model Web-based or desk-top application?

Is the application flexible to couple with external programs and user created executables?

Are system and user documentation available? (Web site)

Are example applications available? (Web site)

Is there a user group or hotline-type support? (Website)

Other Comments:

Name of Model, **Date, Version Number**

Format: Text title (Acronym)

> Limit to one phrase

For Example:

Flood Hydrograph Package (HEC-1)

The HEC Hydrologic Modeling System (HEC-HMS)

The GIS Weasel, 4/2008, v 1.0

Contact (with e-mail, web site, and/or phone number)

Provide the Agency and Office contacts information, including voice telephone, fax and e-mail and (optionally) web URL.

Model Type

This section states the type of model developed. For example, hydrologic models can be classified as event-based precipitation-runoff models, continuous precipitation runoff models, snowmelt runoff models, steady-flow flood routing models, unsteady-flow flood routing models, reservoir regulation models, flood frequency models, etc.

For Example:

The HEC-1 model is an event-based precipitation –runoff simulation model.

Model Objective(s)

Describe purpose of the model.

For Example:

The purpose of HEC-1 is the simulation of hydrologic processes for designing flood damage reduction projects.

Describe the following items:

1.   The type of the basins for which the model has been developed.
For example: The basins may be **rural**, **urban**, **agricultural**, **mountainous**, etc.

2.   The size of the basins for which the model applies.
For example: The basins may be **small**, **medium**, or **large**.

3.   The nature of simulation that the model undertakes.
For example: The simulation may be **event-based** or **continuous**.

4.   Components of the hydrologic cycle represented in model formulation.
For example: **Precipitation**, **infiltration**, **evaporation**, **interception**, **detention storage**, **overland flow**, **channel flow**.

5.   The underlying hypotheses (or the type of equations employed) that form the basis of the modeling approach to each component process, including:

Precipitation (Rain, snow, etc.)

Infiltration

Evaporation

Interception

Detention storage

Overland flow

Channel flow

Groundwater flow

Snow melt runoff

Mathematical formulation of the model components:

For example: **Lumped**, **Distributed**, **Deterministic**, or **Probabilistic**

For your assistance, the following list of terms is offered to assist you in providing the requested information about the model structure. This list is only illustrative and not intended to be exhaustive, please make any substitutions needed for your model:

Precipitation	**Infiltration**	**Evaporation**
Mean areal precipitation is estimated using the arithmetic mean, Theissen polygon, or isohyetal method.	The rate of infiltration is determined by the Green-Ampt, Horton, Phillip, or Smith equation.	Evapotranspiration is estimated using Penman, Penman-Monteith, Jensen-Hayes, Blaney-Criddle or Hargreve method.
Interception	**Detention storage**	**Overland flow**

The amount of interception is estimated as a fraction of the total precipitation amount or using an negative exponential equation.

The detention storage is estimated using either an exponential function or a power function or is taken as a constant of the precipitation amount.

The overland flow is determined using the kinematic wave theory or the linear reservoir theory.

Channel flow	**Groundwater flow**	**Snow melt runoff**
Flow routing in channels is computed by linear channel theory (e.g. Muskingum method, etc.), kinematic wave theory, diffusion wave theory, or dynamic wave theory.	The base flow is estimated using the linear reservoir theory or Boussinesq theory	Snow melt runoff routing is performed using empirical methods, linear reservoir theory or kinematic wave theory.

Spatial Scale Employed in the Model

This section describes the spatial representation used in the model. For example, the watershed can be treated as a single unit or as a network of sub-watersheds.

For Example:

In HEC-1 the watershed is decomposed into a network of homogeneous sub-watersheds, each having individualized parameters and processes.

Temporal Scale Employed in the Model

This section describes whether the model is an "event based" model or a daily, weekly, monthly, yearly model.

For Example:

The HEC-1 model is an event-based model, simulating the rainfall-runoff relationship for an individual rainfall event.

Input Data Requirements

This section describes the data required for application of the model (which follows from the model structure). The data may pertain to the following elements as needed by the model:

Watershed characteristics data (topographic map, drainage area, channel lengths, drainage areas of channels, slope, etc.)

Climate data (rainfall intensity in time, temperature [daily, max, min, etc.], humidity, vapor pressure, wind velocity, etc.)

Stream flow data (measured discharge in regular time steps)

Soils data (type, structure, texture, infiltration characteristics)

Land use data (cropping patterns, vegetation, percent imperviousness, etc.)

Model Output

This section describes the type of output the model produces.

For Example:

HEC-1 produces runoff water discharge output with user specified time intervals (minutes/hours).

Input Data format

This section describes the format of input for each category, Raster data? Vector data? Like DEM in ESRI GRID, TIFF/GeoTIFF, etc. Land use in ESRI GRID, Arcview Shapefile, ESRI Arcinfo Coverage, etc., Precipitation, temperatures, wind velocity in TXT, ASCII, etc.

Output Data format

This section provides the format of output data, like streamflows in ASCII, distribution of pollution load in ESRI GRID, etc.

Parameter Estimation / Model Calibration

This section describes the parameters to be estimated and the calibration algorithm used to pursue calibration.

For Example:

HEC-1 can have parameters estimated by the user or HEC-1 can be instructed to use an automated parameter search algorithm.

Model Testing & Verification

This section describes whether the model has been tested and verified extensively using split sampling data and split sampling watershed techniques, involving other watersheds than calibration watersheds. Are test data sets available to the user for modeling use training and model operation confirmation?

For Example:

HEC-1 has been extensively tested using data and watersheds other than those used in calibration / parameter estimation of HEC-1 as described in the user manual, as evidenced by the wide spread use of the model in the consulting community.

Model Sensitivity

This section describes the sensitivity of the model to its parameters and its components.

Has a sensitivity analysis been performed for the model and shared to the general user community?

For Example:

1) In HEC-1 the importance of evapotranspiration is considered inconsequential and is therefore not included in the model, for HEC-1 is an "event based" model and evapotranspiration is inconsequential during rainfall.

2) In HEC-1 the basin lag parameter is one of the most important parameters when using the unit hydrograph method for rain excess-runoff simulation.

Model Reliability

This section describes the confidence in the model results. Consider a) the repeatability of the model, b) accuracy of output as compared with real observations, and c) the Probability of obtaining consistently accurate model predictions.

For Example:

HEC-1 is widely accepted in the public and consulting community as a hydrograph simulation package and is considered to predict within XXX percent accuracy.

Model Application/Case Studies

This section describes where the model is/has been typically applied. How does the user community apply the model to real world problem settings?

For Example:

HEC-1 has been applied to design and planning of a wide range of civil works involving flood prediction, flood protection, urban drainage, dam safety and breach evaluation, flood damage reduction, among others.

Platform/Operating System

This section describes the type of computer / operating system, memory and disk storage for operating the model.

For Example:

HEC-1 is available on 486 PC running DOS (DOS under Win3.1, Win95, WinNT) XXXX Meg. Memory and YYYYY Meg. Disk space.

Anywhere ArcInfo Workstation runs: Windows and a handful of Unix flavors.

Programming Language and Software

This section provides what kind of programming language the software system uses and what kind of relevant software are required to drive the model

For Example:

The GIS Weasel software system uses a GIS-based graphical user interface (GUI), the C programming language, and external scripting languages. The software will run on any computing platform where ArcInfo Workstation (version 8.0.2 or later) and the GRID extension are accessible. The user controls the processing of the GIS Weasel by interacting with menus, maps, and tables

Other Comments

This section provides information and experiences that should be available for the reader of the modeling inventory not contained in previous categories in a limited free form text.

For Example:

HEC-1 has been employed in US, other developed countries, and developing countries. Third party instruction (public and private) for specific application of the model is readily available to the professional community.

Appendix III

A comprehensive comparison of a range of GIS-based hydrologic and hydraulic models under questionnaire surveys

Short Name	Full Name and Brief Description	Platform/operating system	Web-based or desktop application	Data Requirements	
AGWA	[1]Automated Geospatial Watershed Assessment Tool	Software: Windows 2000 and newer (Windows) Vista is untested; Hardware: Dictated by the GIS software platform (ArcGIS 9.x or ArcView 3.x)	Desktop application is ready for use and web-based application is at prototype/proof	Digital elevation model, STATSGO, SSURGO or FAO soils for parameterization, Classified land cover for parameterization, multi-year daily precipitation for SWAT, and event-based precipitation for KINEROS2	
	Data Format and Compatibility	**Will the application import and export data files?**	**Is the application flexible to couple with external programs and user created executables?**	**Are system and user documentation available?** **Are example applications available?**	
	All GIS data must be projected. DEM and land cover must be GRID-based. Soil data must be feature-based. Precipitation data must be in DBF format and follow the structure defined in the documentation and examples	Data may be imported/exported to/from different formats, but there are no application specific imports/exports	Yes	Yes	Yes

	Does the application require prior installation of ESRI software?	If so, which products?	Is there a user group or hotline-type support?	If so, which website
	Yes	AGWA2 for ArcGIS 9.x: ArcGIS 9.x, Spatial Analyst Extension for ArcGIS 9.x, 3D Analyst for ArcGIS 9.x (optional - only required for Thiessen polygon weighting); AGWA 1.5 for ArcView 3.x	Yes	http://www.tucson.ars.ag.gov/agwa
Short Name	**Full Name and Brief Description**	**Platform/operating system**	**Web-based or desktop application**	**Data Requirements**
eCoastal Program	[2]eCoastal Program	Desktop: ArcGIS 9.2 and Spatial and 3D Analyst extensions are needed for some desktop applications; Web: ArcIMS, Arc GIS Server and Google Earth	Desktop: Data Viewer Toolbar, Survey Tools, Survey Analysis Management System, and SBAS-A; Web: ArcIMS page template, RSM (Regional Sediment Management) Project Viewer, Disposal/Dredge Area Viewer and Ocean Disposal Area Manager	Survey Tools: elevation data (grid, tin, XYZ point, profile data); Data to populate feeder databases: dredge/disposal events, project level information, etc; SBAS: sediment transport rates, dredge event records, disposal events records, survey data; SAMS: 3D Navigation channel (SDS formatted), survey data

	Data Format and Compatibility	Will the application import and export data files?	Is the application flexible to couple with external programs and user created executables?	Are system and user documentation available? Are example applications available?	
	An GIS formatted data	A number of the applications convert a raw data input and format it properly for inclusion into an enterprise database.	Most tools run within the ArcGIS environment, so any other extension can be coupled with the toolbars.	An engineer manual has been created to support the eCoastal program.	Yes
	Does the application require prior installation of ESRI software?	If so, which products?	Is there a user group or hotline-type support?	If so, which website	
	Yes	Any of the custom desktop toolbars needs ESRI software.	Yes. Users can submit a question or comment from the eCoastal website	http://eCoastal.usace.army.mil	
Short Name	Full Name and Brief Description	Platform/operating system	Web-based or desktop application	Data Requirements	
BASINS	[3]Basins version 4.0	Windows 98 or above	Desk-top with web based data through a Data	Windows 98 or better	

			Download Tool	
	Data Format and Compatibility	**Will the application import and export data files?**	**Is the application flexible to couple with external programs and user created executables?**	**Are system and user documentation available?** **Are example applications available?**
	ESRI GIS standardized Shapefile or GRID format among others	Yes, both.	Yes	Yes, on website and online under the Help Menu	Yes
	Does the application require prior installation of ESRI software?	**If so, which products?**	**Is there a user group or hotline-type support?**	**If so, which website**
	No, Open source Mapwindow software (www.mapwindow.org)		There is a listserve called BASINSINFO that users can subscribe to	
Short Name	**Full Name and Brief Description**	**Platform/operating system**	**Web-based or desktop application**	**Data Requirements**
The GIS Weasel	[4]The GIS Weasel, 4/2008, v 1.0	Windows and a handful of Unix flavors	Desktop	Raster elevation data
	Data Format and Compatibility	**Will the application import and export data files?**	**Is the application flexible to couple with external programs and**	**Are system and user documentation available? Are example applications available?**

		user created executables?	
ArcInfo Grid	It will use ArcInfo Grids directly, but will not reformat input. It will export raster data via the ArcInfo GRIDASCII function. It also creates a wide variety of parameter output in ASCII files, as well as limited graphics.	No	Yes. Fact sheet: http://pubs.usgs.gov/fs/2008/3004/ Users manual: http://pubs.usgs.gov/tm/2007/06B04/ Sample data provided with software package that goes with sample usage description in the user's manual.
Does the application require prior installation of ESRI software?	**If so, which products?**	**Is there a user group or hotline-type support?**	**If so, which website**
Yes	ArcInfo Workstation with GRID module	Yes	email support (mowshelp@usgs.gov)

Short Name	Full Name and Brief Description	Platform/operating system	Web-based or desktop application	Data Requirements
HAZUS -MH	[5]HAZUS-MH, Nov. 2007, MR3 (1.3)	Windows	Desk top	All included for level 1
	Data Format and Compatibility	**Will the application import and export data files?**	**Is the application flexible to couple with external programs and user created**	**Are system and user documentation available?** **Are example applications available?**

			executables?	
	ESRI	Yes, we have the CDMS tool in HAZUS	Yes	Yes
	Does the application require prior installation of ESRI software?	**If so, which products?**	**Is there a user group or hotline-type support?**	**If so, which website**
	Yes	ArcView / ArcEditor with spatial analysis	Yes	both 800 number and users groups
Short Name	**Full Name and Brief Description**	**Platform/operating system**	**Web-based or desktop application**	**Data Requirements**
HEC -GeoRAS	[6]HEC-GeoRAS	HEC-GeoRAS 4.1.1 for ArcGIS 9.1; ArcGIS 9.1 (ArcView license) with the 3D Analyst and Spatial Analyst extensions are required Only runs on Window 2000/NT/XP; HEC-GeoRAS 4.1 for ArcGIS 9 ArcGIS 9 (ArcView license) with the 3D Analyst and Spatial	Desktop application	At this time HEC-GeoRAS requires a DTM in the form of a triangulated irregular network (TIN). The DTM must be a continuous surface that includes the bottom of the river channel and all of the floodplain to be modeled. Because all cross-section data will be extracted from the DTM, only high resolution DTMs should be considered.

		Analyst extensions are required. Only runs on Window 2000/NT/XP;		
		HEC-GeoRAS 4.0 for ArcGIS 8.3		
		ArcGIS 8.3 (ArcView license) with the 3D Analyst and Spatial Analyst extensions are required. Only runs on Window 2000/NT/XP;		
		HEC-GeoRAS 3.1.1 for ArcView 3.2 ArcView 3.2 with the 3D Analyst extension is required. Spatial Analyst is recommended. Only runs on Window 2000/NT/XP;		
		HEC-GeoRAS 1.0 for ArcInfo		
		ArcInfo with the TIN extension is required. Uses ArcInfo 7.x which is compatible with Unix or Windows NT;		
		All software other than ESRI Licensed software are typically contained in a downloadable installation file. Details are contained in downloadable		

		Users Manual for each software version.		
	Data Format and Compatibility	**Will the application import and export data files?**	**Is the application flexible to couple with external programs and user created executables?**	**Are system and user documentation available?** **Are example applications available?**
	ESRI	Yes	Yes	Yes
	Does the application require prior installation of ESRI software?	**If so, which products?**	**Is there a user group or hotline-type support?**	**If so, which website**
	Yes		HEC-GeoRAS is fully documented with downloadable user manuals and example datasets.	
Short Name	**Full Name and Brief Description**	**Platform/operating system**	**Web-based or desktop application**	**Data Requirements**
HEC -GeoHMS	[7]HEC-GeoHMS version 4.2.92, August, 2009 HEC-GeoHMS version 4.2.93, December, 2009	HEC-GeoHMS versions 4.2.92/4.2.93 have been extensively tested on the Windows XP operating system.	Desktop application	The main data source required by HEC-GeoHMS is a Digital Elevation Model (DEM) of the study area. HEC-GeoHMS uses the DEM for determining subbasin and stream delineations as well as for computing physical characteristics of the watershed. Other geospatial datasets, like land use and soil information, can be used by HEC-GeoHMS for estimating hydrologic parameters for

				an HEC-HMS model.
	Data Format and Compatibility	**Will the application import and export data files?**	**Is the application flexible to couple with external programs and user created executables?**	**Are system and user documentation available?** **Are example applications available?**
	ESRI	Yes	Yes	HEC-GeoHMS is fully documented with downloadable user manuals and example datasets. http://www.hec.usace.army.mil/software/hec-geohms/index.html
	Does the application require prior installation of ESRI software?	**If so, which products?**	**Is there a user group or hotline-type support?**	**If so, which website**
	Yes		The HEC-GeoHMS website supports a "Known Issues" link. Technical support for HEC-GeoHMS users within the Corps of Engineers is provided through an annual subscription service. Support cannot be provided to users outside the Corps of Engineers	
Short Name	**Full Name and Brief Description**	**Platform/operating system**	**Web-based or desktop application**	**Data Requirements**
HEC	[7]HEC-GeoHMS version 4.2.92, August, 2009	HEC-GeoHMS versions 4.2.92/4.2.93 have been	Desktop application	The main data source required by HEC-GeoHMS is a Digital Elevation Model (DEM) of the study area. HEC-

-GeoHMS	HEC-GeoHMS version 4.2.93, December, 2009	extensively tested on the Windows XP operating system.		GeoHMS uses the DEM for determining subbasin and stream delineations as well as for computing physical characteristics of the watershed. Other geospatial datasets, like land use and soil information, can be used by HEC-GeoHMS for estimating hydrologic parameters for an HEC-HMS model.
	Data Format and Compatibility	**Will the application import and export data files?**	**Is the application flexible to couple with external programs and user created executables?**	**Are system and user documentation available?** **Are example applications available?**
	ESRI	Yes	Yes	HEC-GeoHMS is fully documented with downloadable user manuals and example datasets. http://www.hec.usace.army.mil /software/hec-geohms/index.html
	Does the application require prior installation of ESRI software?	**If so, which products?**	**Is there a user group or hotline-type support?**	**If so, which website**
	HEC-GeoHMS is a public domain extension to ESRI's ArcGIS software (ArcView® license) and the Spatial Analyst extension.		The HEC-GeoHMS website supports a "Known Issues" link. Technical support for HEC-GeoHMS users within the Corps of Engineers is provided through an annual subscription service. Support cannot be provided to users outside the Corps of Engineers	

Short Name	Full Name and Brief Description	Platform/operating system	Web-based or desktop application	Data Requirements
	[8]MapWindow, August 30, 2008, Version 4.6	Windows XP or equivalent	Desktop application	The watershed delineation operation requires a DEM grid and optional stream vector layer. The general operation of MapWindow GIS accepts grid, vector, and image data layers.
	Data Format and Compatibility	**Will the application import and export data files?**	**Is the application flexible to couple with external programs and user created executables?**	**Are system and user documentation available?** **Are example applications available?**
Map **Window**	Data developed for use with ESRI software is compatible with MapWindow. Generic GIS data such as grid in ASCII grid format is compatible with MapWindow.	MapWindow is a GIS which allows import of data for viewing and analysis.	Yes, the user may develop extensions within the MapWindow system and build layers and attribute tables acceptable to ESRI software.	Yes, from the web site. Example data and projects are available. www.MapWindow.org
	Does the application require prior installation of ESRI software?	**If so, which products?**	**Is there a user group or hotline-type support?**	**If so, which website**
	No		The web site has on-line help and bug reporting system.	

Short Name	Full Name and Brief Description	Platform/operating system	Web-based or desktop application	Data Requirements
	[9]NHDPlus Append Tool, 3/24/2008, V1.17	Windows XP w/ Service Pack 2; Vista; Microsoft.Net 2.0 Framework (or above)	Desktop	NHDPlus HUC8 workspaces
	Data Format and Compatibility	**Will the application import and export data files?**	**Is the application flexible to couple with external programs and user created executables?**	**Are system and user documentation available?** **Are example applications available?**
NHDPlus Append Tool	ESRI Shapefiles, ESRI Grids, and Microsoft Access	Yes	No	Yes, http://www.horizon-systems.com/NHDPlus/tools.php
	Does the application require prior installation of ESRI software?	**If so, which products?**	**Is there a user group or hotline-type support?**	**If so, which website**
	Yes	ArcGIS 9.2 (ArcInfo license level), Service Pack 4 or above; ArcGIS Spatial Analyst Extension	Yes to both - NHDPlus@hscnet.com- 703-471-0480	
Short Name	**Full Name and Brief Description**	**Platform/operating system**	**Web-based or desktop**	**Data Requirements**

			application	
	[10]NHDPlus AquaXpos, 4/29/2008, V1.003	Windows XP w/ Service Pack 2; Vista; Microsoft .Net 2.0 Framework (or above)	Desk-top	NHDPlus Dataset NHDPlus Tools Application Data, Version 1
NHDPlus AquaXpos	**Data Format and Compatibility**	**Will the application import and export data files?**	**Is the application flexible to couple with external programs and user created executables?**	**Are system and user documentation available?** **Are example applications available?**
	Microsoft Access	No	No	Yes - http://www.horizon-systems.com/NHDPlus/tools.php
	Does the application require prior installation of ESRI software?	**If so, which products?**	**Is there a user group or hotline-type support?**	**If so, which website**
	No		Yes to both - NHDPlus@hscnet.com- 703-471-0480	
Short Name	**Full Name and Brief Description**	**Platform/operating system**	**Web-based or desktop application**	**Data Requirements**
NHDPlus Basin	[11]NHDPlus BasinDelineator, 3/26/2008, V1.008	Windows XP w/ Service Pack 2; Vista; Microsoft .Net 2.0 Framework (or above)	Desktop	NHDPlus HUC8 workspaces

Delineator	Data Format and Compatibility	Will the application import and export data files?	Is the application flexible to couple with external programs and user created executables?	Are system and user documentation available? Are example applications available?
	ESRI Shapefiles, ESRI Grids, and Microsoft Access	Yes	No	Yes - http://www.horizon-systems.com/NHDPlus/tools.php
	Does the application require prior installation of ESRI software?	**If so, which products?**	**Is there a user group or hotline-type support?**	**If so, which website**
	Yes	ArcGIS 9.2 (ArcInfo license level), Service Pack 4 or above; ArcGIS Spatial Analyst Extension	Yes to both - NHDPlus@hscnet.com- 703-471-0480	
Short Name	**Full Name and Brief Description**	**Platform/operating system**	**Web-based or desktop application**	**Data Requirements**
NHDPlus Catchment Attribute Allocation & Accumulation Tool	[12]NHDPlus Catchment Attribute Allocation & Accumulation Tool, 3/26/2008, V1.009	Windows XP w/ Service Pack 2 and Vista; Microsoft .Net 2.0 Framework (or above)	Desktop	NHDPlus Dataset NHDPlus Tools Application Data, Version 1
	Data Format and Compatibility	**Will the application import and export data files?**	**Is the application flexible to couple with external programs and user created**	**Are system and user documentation available?** **Are example applications available?**

			executables?	
	ESRI Shapefiles, ESRI Grids, and Microsoft Access	No	No	Yes - http://www.horizon-systems.com/NHDPlus/tools.php
	Does the application require prior installation of ESRI software?	**If so, which products?**	**Is there a user group or hotline-type support?**	**If so, which website**
	Yes	ArcGIS 9.2 (ArcInfo license level), Service Pack 4 or above; ArcGIS Spatial Analyst Extension	Yes to both - NHDPlus@hscnet.com- 703-471-0480	
Short Name	**Full Name and Brief Description**	**Platform/operating system**	**Web-based or desktop application**	**Data Requirements**
NHDPlus VAA COM Object Navigator Tool	[13]NHDPlus VAA COM Object Navigator Tool, 4/7/2008, V1.03	Windows XP w/ Service Pack 2 and Vista; Microsoft .Net 2.0 Framework (or above)	Desktop	NHDPlus Dataset
	Data Format and Compatibility	**Will the application import and export data files?**	**Is the application flexible to couple with external programs and user created executables?**	**Are system and user documentation available?** **Are example applications available?**

	ESRI Shapefiles and Microsoft Access	No	No	Yes - http://www.horizon-systems.com/NHDPlus/tools.php
	Does the application require prior installation of ESRI software?	**If so, which products?**	**Is there a user group or hotline-type support?**	**If so, which website**
	Yes	Yes - ArcGIS 9.2 (ArcInfo license level), Service Pack 4 or above	Yes to both - NHDPlus@hscnet.com- 703-471-0480	
Short Name	**Full Name and Brief Description**	**Platform/operating system**	**Web-based or desktop application**	**Data Requirements**
NRCS Geo-Hydro	[14]NRCS Geo-Hydro, Dec 2008, Version 2.0.	Windows XP	Desk-top application.	Digital elevation, land use, soil, and stream location layers are required
	Data Format and Compatibility	**Will the application import and export data files?**	**Is the application flexible to couple with external programs and user created executables?**	**Are system and user documentation available?** **Are example applications available?**
	Elevation, land use, and soil must be in ESRI grid format and stream locations as an ESRI Shapefile. Layers must be in the same geographic projection. Data may be in English or SI units.	Within the framework of ESRI ArcGIS, digital elevation, land use, soil, and stream location are imported to ArcGIS/ArcMap. During the steps of the application, various layers are created which may be exported. Layers may be operated on	Within the framework of ESRI ArcObjects and VBA, the application may be modified and other models may be linked.	Yes - Yes. These are included with the download package. In addition, course material is available which include power point slides and example workshops.

		through standard ArcMap commands.		
	Does the application require prior installation of ESRI software?	**If so, which products?**	**Is there a user group or hotline-type support?**	**If so, which website**
	Yes	ArcGIS 9.1 and Spatial Analyst extension. Installation software for ArcHydro Tools, AP Framework, and XML parser are provided with the installation package.		Yes, call or e-mail developers.
Short Name	**Full Name and Brief Description**	**Platform/operating system**	**Web-based or desktop application**	**Data Requirements**
NRCS Geo-Hydro	[15]NRCS Geo-Hydro, May 2005, Version 1.0.	Windows XP	Desk-top application	Digital elevation, land use, soil layers are required. Stream location layer is optional.
	Data Format and Compatibility	**Will the application import and export data files?**	**Is the application flexible to couple with external programs and user created executables?**	**Are system and user documentation available?** **Are example applications available?**
	Elevation, land use, and soil must be in ESRI grid format and stream	Within the framework of ESRI	Within the framework of ESRI Avenue scripts, the	Yes-Yes. These are included with the download package.

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	locations as an ESRI shapefile. Layers must be in the same geographic projection.	ArcView, digital elevation, land use, soil, and stream location are imported to ArcView. During the steps of the application, various layers are created which may be exported. Layers may be operated on through standard ArcView commands.	application may be modified and other models may be linked.	
	Does the application require prior installation of ESRI software?	**If so, which products?**	**Is there a user group or hotline-type support?**	**If so, which website**
	Yes	ArcView 3.3 and Spatial Analyst extension.		Yes, call or e-mail developers.
Short Name	**Full Name and Brief Description**	**Platform/operating system**	**Web-based or desktop application**	**Data Requirements**
StreamStats	[16]StreamStats	Served through Windows-based computers, but use of Web site is not limited to Windows computers	Web-based application	None, except users need to be able to locate their sites of interest on a map.
	Data Format and Compatibility	**Will the application import and export data files?**	**Is the application flexible to couple with external programs and user created**	**Are system and user documentation available?** **Are example applications available?**

			executables?	
	No input files required		Yes. A number of programs have already been coupled to StreamStats, such as an application for Kentucky that generates time series of average daily temperature and precipitation over user-defined drainage areas. Some StreamStats functionality is also available as Web services, allowing other applications to directly access this functionality.	Documentation for the current version of the application is accessible through links from the StreamStats home page. Documentation for the new application is being prepared.
		Tabular outputs are provided in html pages that can be saved in that format or as text, and tables on pages can be imported to Excel.		
	Does the application require prior installation of ESRI software?	**If so, which products?**	**Is there a user group or hotline-type support?**	**If so, which website**
	Users only need a Web browser, such as Internet Explorer, to use StreamStats.		Contact information is provided through a link on the StreamStats home page.	
Short Name	**Full Name and Brief Description**	**Platform/operating system**	**Web-based or desktop**	**Data Requirements**

SWAT	[17]Sool and Water Assessment Tool	Hardware: Personal computer using a Pentium IV processor or higher, which runs at 2 gigahertz or faster: 1 GB RAM minimum, 500 megabytes free memory on the hard drive for minimal installation and up to 1.25 gigabyte for a full installation (including sample datasets and US STATSGO data)	Desktop-based application	
			application	
	Data Format and Compatibility	**Will the application import and export data files?**	**Is the application flexible to couple with external programs and user created executables?**	**Are system and user documentation available?** **Are example applications available?**
		Yes	Yes	Yes
	Does the application require prior installation of ESRI software?	**If so, which products?**	**Is there a user group or hotline-type support?**	**If so, which website**

Software (ArcSWAT 1.0 for ArcGIS 9.1 version): Microsoft Windows XP, or Windows 2000 operating system with most recent kernel patch, ArcGIS-ArcView 9.1 with service pack 2 (Build 766) ArcGIS Spatial Analyst 9.1 extension, ArcGIS Developer Kit (usually found in C:\Program Files\ArcGIS\DeveloperKit\), ArcGIS DotNet support (usually found in C:\Program Files\ArcGIS\DotNet\), Microsoft .Net Framework 1.1, Adobe Acrobat Reader version 7 or higher	Yes. http://www.brc.tamus.edu/swat/arcswat.html Click on 'ArcSWAT Group'

1. A GIS interface to automate the parameterization and execution of the Soil and Water Assessment Tool (SWAT) and KINematic Runoff and EROSion (KINEROS2) hydrologic models. The application of these two models allows AGWA to conduct hydrologic modeling and watershed assessments at multiple temporal and spatial scales;

2. The eCoastal program provides a foundation for a data management plan designed to function as an enterprise GIS. It was developed to concentrate on the specific needs of the coastal engineer. eCoastal is an architecture developed by the U.S. Army Corps of Engineers that addresses spatial data standards, geodatabase structure, and custom coastal GIS applications. One focus of an enterprise GIS is to allow access to data from users inside or outside an organization. Technology enables data to easily be accessible and distributable in a variety of formats. The eCoastal program offers support in understanding the available technologies, such as metadata clearinghouses or web mapping services, and provides additional guidance on system configuration to bring concepts to fruition. In the case of USACE organizations, eCoastal also provides system design and documentation that is compliant with all Army IT regulations. In addition to the technology components, the eCoastal program is a compilation of lessons learned and recommendations for managing a variety of coastal related datasets in a geodatabase environment. eCoastal provides training to users on the default tools of ArcGIS and custom tools of the eCoastal toolbars to educate coastal engineers in data analysis procedures performed

3. BASINS is an extensible, open-source GIS-based (MapWindow) Decision Support System that integrates watershed models with ready access to data (flow, meteorological, water quality, and various GIS layers). BASINS includes tools for setting up surface water model runs, and processing and visualizing data and model output. See website for more information.

4. The GIS Weasel was designed to aid in the preparation of spatial information for input to lumped and distributed parameter hydrologic or other environmental models. The GIS Weasel provides geographic information system (GIS) tools to help create maps of geographic features relevant to a user's model and to generate parameters from those maps. The operation of the GIS Weasel does not require the user to be a GIS expert, only that the user has an understanding of the spatial information requirements of the environmental simulation model being used. The GIS Weasel software system uses a GIS-based graphical user interface (GUI), the C programming language, and external scripting languages. The software will run on any computing platform where ArcInfo Workstation (version 8.0.2 or later) and the GRID extension are accessible. The user controls the processing of the GIS Weasel by interacting with menus, maps, and tables. The purpose of this document is to describe the operation of the software. This document is not intended to describe the usage of this software in support of any particular environmental simulation model. Such guides are published separately.

5. HAZUS-MH is a loss estimation methodology that supports FEMA's mitigation efforts at all levels (federal, state and local) by assessing the risk & estimating potential loss from multiple natural hazards: earthquakes, floods, and hurricane winds. In HAZUS, current scientific & engineering knowledge is coupled with Geographic Information Systems technology to produce estimates of hazard-related damage. It takes into account impacts of a hazard event such as - Physical damage: damage to residential & commercial buildings, schools, critical facilities, and infrastructure; Economic loss: lost jobs, business interruptions, repair & reconstruction costs; and Social impacts: impacts to people, including requirements for shelters & medical aid. HAZUS fills a nationwide need for a risk assessment and loss estimation methodology (a modeling tool). It assists state & local governments with the development of their Disaster Mitigation Act 2000 Hazard Mitigation Plans. HAZUS was developed and is maintained by, National

Institute of Building Sciences (NIBS), at their site and is distributed by FEMA upon request. HAZUS uses geospatial technology to map and display hazard data and the results of damage and economic loss estimates for buildings and infrastructure, and the impact on populations. Loss estimates produced by HAZUS are based on current scientific and engineering knowledge of the effects of hurricane winds, floods, and earthquakes. NIBS maintains committees of hurricane wind, flood and earthquake experts to provide technical oversight & guidance to HAZUS. Mitigation efforts offer the best and most cost-effective methods of addressing the impacts associated with disasters. The primary purpose of hazard mitigation planning is to help communities identify the most effective policies, actions, and tools to decrease risk and the potential for future losses.

6. HEC-GeoRAS is a set of procedures, tools, and utilities for processing geospatial data in ArcGIS using a graphical user interface (GUI). The interface allows the preparation of geometric data for import into HEC-RAS and processes simulation results exported from HEC-RAS. To create the import file, the user must have an existing digital terrain model (DTM) of the river system in the ArcInfo TIN format. The user creates a series of line themes pertinent to developing geometric data for HEC-RAS. The themes created are the Stream Centerline, Flow Path Centerlines (optional), Main Channel Banks (optional), and Cross Section Cut Lines referred to as the RAS Themes. Additional RAS Themes may be created/used to extract additional geometric data for import in HEC-RAS. These themes include Land Use, Levee Alignment, Ineffective Flow Areas, and Storage Areas. Water surface profile data and velocity data exported from HEC-RAS simulations may be processed by HEC-GeoRAS for GIS analysis for floodplain mapping, flood damage computations, ecosystem restoration, and flood warning response and preparedness.

7. The Hydrologic Engineering Center's Geospatial Hydrologic Modeling Extension, HECGeoHMS, is a public domain extension to ESRI's ArcGIS software (ArcView® license) and the Spatial Analyst extension. HEC-GeoHMS is a geospatial hydrology toolkit for engineers and hydrologists. The user can visualize spatial information, document watershed characteristics, perform spatial analysis, delineate subbasins and streams, construct inputs to hydrologic models, and assist with report preparation. Through the use of HEC-GeoHMS a user can easily and efficiently create hydrologic inputs that can be used directly with the Hydrologic Engineering Center's Hydrologic Modeling System, HEC-HMS software.

8. MapWindow is an open source GIS which is public domain. The code is open which allows for developing extensions and applications. It has tools which allow analysis of grid and vector GIS data. An extension named TauDEM is available which performs analysis of digital elevation and stream vector data. Some of the analytical operations are burn streams, fill DEM, flow direction, flow accumulation, stream network analysis, watershed delineation, and more.

9. Append combines individual NHDPlus workspaces to form larger NHDPlus workspaces. For example, Append may be used to combine NHDPlus HUC8 workspaces into a project workspace.

10. AquaXpos conducts a geospatial analysis of the NHDPlus stream network to identify potential pesticide use impacts. Based on an initial area of concern and a method for estimating pesticide impact, AquaXpos analyzes the stream network to find places, downstream from potential pesticide use sites, where chemical impact's may exceed a specific level of concern.

11. BasinDelineator delineates drainage basins for a user-defined set of basin pourpoints. The pourpoints must be located on the NHDPlus network which is defined as the subset of flowlines with known flow direction (i.e. NHDPlus.NHDFlowline.Flowdir = "With Digitized"). The input pourpoints are specified by a basin identifier, an NHD linear reachcode, and a measure along the reach. BasinDelineator returns a Shapefile containing basin polygons.

12. CA3T has two functions, an attribute allocation function and an attribute accumulation function, which may be used separately or in combination. The CA3T allocation function takes a user-supplied grid format dataset of one or more landscape attributes and allocates the attributes to the NHDPlus

catchments. The CA3T accumulation function builds, for each NHDPlus Flowline, the total upstream accumulated values for attributes that have been allocated to either NHDPlus catchments or NHDPlus flowlines.

13. The VAA COM Object Navigator uses the NHDPlus value added attributes to perform four types of navigations: upstream main stem, upstream with tributaries, downstream main stem, and downstream with divergences. Any of the four types of navigation may be stopped at a user-supplied distance from the starting point. This navigator may be used through ArcMap via a special ArcMap Toolbar or it may be called from user-written program code. The navigator will work on any NHDGEOinSHP dataset that contains a fully populated NHDFlowlineVAA.dbf table (generally this means an NHDPlus dataset). When used via the ArcMap toolbar, results are returned to ArcMap as a new layer in the map called Navigation Results. This navigator is a COM object and may be call from user-written code that is developed in a COM-compliant programming language.

14. NRCS Geo-Hydro is an ArcGIS GIS interface to the WinTR-20 hydrologic model. It operates with ESRI ArcGIS 9.1 and the Spatial Analyst extension. The interface is organized to complete the steps required to do a WinTR-20 hydrologic analysis. Using tools and menu selections, the user is guided step by step through the automated processes of defining the watershed boundary, dividing the watershed into sub-areas, developing cross sections, etc. The end result is a WinTR-20 execution with peak discharges, hydrographs, etc. Basic familiarity with NRCS hydrologic procedures and ArcMap operations are helpful.

15. NRCS Geo-Hydro is an ArcView GIS interface to the WinTR-20 hydrologic model. It operates with ESRI ArcView 3.3 and the Spatial Analyst extension. The interface is organized to complete the steps required to do a WinTR-20 hydrologic analysis. Using tools and menu selections, the user is guided step by step through the automated processes of defining the watershed boundary, dividing the watershed into sub-areas, developing cross sections, etc.

The end result is a WinTR-20 execution with peak discharges, hydrographs, etc. Basic familiarity with NRCS hydrologic procedures and ArcView operations are helpful.

16. StreamStats is a Web application that provides users with information needed by engineers, land and water-resource managers, biologists, and many others to help guide decisions in their everyday work. StreamStats provides streamflow statistics, basin characteristics, and other information for USGS data-collection stations and for ungauged sites. Users can select data-collection station locations shown on a map interface and obtain previously published information for the stations. Users can also select any location along a stream and obtain the drainage-basin boundary, basin characteristics, and estimated streamflow statistics for the location. The estimates for ungauged sites are determined from USGS regional regression equations. A new version of StreamStats is nearing completion that will also provide the abilities to (1) navigate the stream network to locate streamgaging stations, dams, point discharges and other water-related features, (2) estimate flows at ungauged sites based on the flows at nearby streamgaging stations, and (3) allow other Web or desktop GIS applications to access StreamStats functionality remotely by use of Web services.

17. Management practices in large, complex watersheds. SWAT is a public domain model actively supported by the USDA Agricultural Research Service at the Grassland, Soil and Water Research Laboratory in Temple, Texas, USA.

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Appendix 4 Professional conference papers

**Presented at the American Water Resources Association (AWRA) Spring Specialty Conference GIS and
Water Resources V in San Mateo, California, April 2008**

FEDERAL INTERAGENCY HYDROLOGY AND HYDRAULICS GIS APPLICATIONS WORKGROUP

William Merkel and David Wells *

ABSTRACT: The Hydrologic and Hydraulic GIS Applications Workgroup was authorized in 2007 by the Federal
Subcommittee on Hydrology (a subcommittee of the Advisory Committee on Water Information, ACWI). The
Workgroup consists of application developers and users. The GIS data community is well developed and organized
and the use of GIS data and applications is growing steadily. However, application developers and users do not
have an efficient way to exchange and learn relevant technology, coordinate application development, and express
needs. Numerous federal and non-federal employees would also like to learn about both GIS data and its
application in hydrology and hydraulics (H&H). The Workgroup will communicate to the GIS user community the
variety of data and applications that are available, how to access the data and applications, and how to receive
training and support. The Workgroup will focus on 1) reporting availability, efficient access, and quality of public
domain GIS data for applications, 2) identifying and summarizing existing public domain GIS applications, 3)
promoting interagency development of GIS applications, and 4) facilitating training and user support on associated
GIS applications in relation to hydrology and hydraulics. To benefit the GIS user community, a report summarizing
information on these GIS applications will be compiled. Goals, guiding principles, and progress on the activities of

the Workgroup are included in the paper. Detailed information on the new Workgroup can be accessed from the web site: http://acwi.gov/hydrology/h2gisa/ . Information on activities will be posted periodically.

KEY TERMS: GIS applications, hydrologic models, web links

INTRODUCTION

The Hydrologic and Hydraulic GIS Applications Workgroup consists of application developers and users. Growing use of GIS data and applications is resulting in the increasing need for federal and non-federal employees to learn about both GIS data and its application in hydrology and hydraulics. The Workgroup would communicate to the GIS user community the variety of data and applications that are available, how to access the data and applications, and how to receive training and support. The focus is on applications which are in the public domain (accessible to the largest number of people at the least cost). The workgroup was established in July 2007 and currently has ten members representing a spectrum of federal agencies.

The Workgroup has a very broad scope which includes data sources, data quality, and GIS applications. Since the Workgroup is relatively new, planning is currently underway and possible products are being discussed. Information exchange concerning GIS applications and GIS data are important items. This will be accomplished through teleconferences held every 1-2 months. The first priority of the Workgroup is to gather and publicize information on GIS applications in hydrology and hydraulics. This step is described in the next section of the paper.

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* Respectively, Hydraulic Engineer, USDA/Natural Resources Conservation Service, 5601 Sunnyside Avenue, Mail Stop 5420, Beltsville, MD 20705-5420, Phone: (301)-504-3956, Fax: (301)-504-2295,

E-Mail: william.merkel@wdc.usda.gov , Hydrologist, US Environmental Protection Agency, Washington, DC, E-Mail: Wells.David@epa.gov .

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INFORMATION TO BE COMPILED ON EACH APPLICATION

A questionnaire was designed to gather limited but key information about a particular GIS application in order for a potential user to decide if the application fits his/her computer system, data requirements, and

physical system to be modeled. Some of the information to be compiled includes a brief description, data requirements, operating system, and software dependencies (for example, is the application dependent on other software such as Environmental Systems Research Institute, ESRI, products). After information is gathered on a variety of GIS application in hydrology and hydraulics, a report will be written and a web site will be set up so individuals can access the information concerning each application.

EXAMPLES OF GIS APPLICATIONS WHICH WILL BE INCLUDED IN THE WEB LIST

The following six high-profile GIS applications in hydrology/hydraulics/water quality/watershed assessment are examples of software applications which will be included in the web list. Pertinent information on these applications will be included so a potential user can decide if a particular application is suitable for his/her purposes.

HEC GeoHMS, U.S. Army Corps of Engineers (USACE, 2007). Geo-HMS is a GIS graphical user interface to the Corps of Engineers Hydrologic Modeling System (HMS) model. Geo-HMS is designed to operate with ESRI ArcView and the Spatial analyst extension. Using digital elevation, land use and soil layers, a number of inputs to the HMS flood event model are generated.

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outlet interactively on a map of the state. Basin characteristics (such as drainage area) and peak discharges for a series of return periods are calculated. No GIS software or data need to be installed on the user's computer.

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SUMMARY AND CONCLUSIONS

The purpose of the Workgroup is to gather and disseminate information on GIS data and applications related to hydrology and hydraulics. The focus is primarily on data and applications of federal agencies which are in the public domain. These are of great interest to the general GIS user community because of easy access, acceptance, good documentation, and in some cases, user support. Progress is being made towards accomplishing these goals and setting a course for future developments. Progress will be posted on the Workgroup web site.

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DISCLAIMER

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FEDERAL INTERAGENCY HYDROLOGY AND HYDRAULICS GIS APPLICATIONS WORKGROUP

William Merkel, Hydraulic Engineer, USDA/Natural Resources Conservation Service, 5601 Sunnyside Avenue, Mail Stop 5420, Beltsville, MD 20705-5420, Phone: (301)-504-3956, Fax: (301)-504-2295,

E-Mail: william.merkel@wdc.usda.gov , Jennifer Bountry, Hydraulic Engineer, US Bureau of Reclamation, Denver, CO, Dr. Vijay P. Singh, Professor, Texas A&M University, College Station, TX, Di Long, Graduate Student, Texas A&M University, College Station, TX.

Abstract: The GIS data community is well developed and organized and the use of GIS data and applications by water resource modelers is growing steadily. However, hydraulic and hydrologic model developers and users do not have an efficient way to exchange and learn relevant technology, including coordinating application development within GIS environments and expressing needs for new tools specific to water resource applications. Numerous federal and non-federal employees would also like to learn about both GIS data and its application in hydrology and hydraulics. To meet this need, the Hydrologic and Hydraulic GIS Applications Workgroup was authorized by the Federal Subcommittee on Hydrology (a subcommittee of the Advisory Committee on Water Information, ACWI). The Workgroup consists of application developers and users working in the field of water resources. The Workgroup is charged with communicating to the GIS and water resources modeling community the variety of data and applications that are available, how to access the data and applications, and how to receive training and support.

The Workgroup is directing its efforts to 1) reporting availability and efficient access of GIS-based applications in a web environment, 2) identifying and summarizing existing GIS-based applications, and 3) promoting interagency development and use of GIS applications in relation to hydrology and hydraulics. Toward these ends, the Workgroup has set up a web site through Texas A&M University to summarize information on these GIS applications. Goals, guiding principles, and progress on the activities of the Workgroup are included in the paper.

Detailed information on the Workgroup can be accessed from the web site: http://acwi.gov/hydrology/h2gisa/ . Information on activities is posted periodically.

INTRODUCTION

The Hydrologic and Hydraulic GIS Applications Workgroup consists of application developers and users. Growing use of GIS data and applications is resulting in the increasing need for federal and non-federal employees to learn about both GIS data and its application in hydrology and hydraulics. The Workgroup communicates to the GIS user community the variety of data and applications that are available, how to access the data and applications, and how to receive training and support. The focus is on applications which are in the public domain (accessible to the largest number of people at the least cost). The workgroup was established in July 2007 and currently has ten members representing a spectrum of federal agencies.

The Workgroup has a very broad scope which includes data sources and GIS applications. Information exchange concerning GIS applications and GIS data are important items. The Workgroup holds teleconferences every 1-2 months. The first priority of the Workgroup has been to gather and publicize information on GIS applications in hydrology and hydraulics. This step is described in the next section of the paper.

INFORMATION TO BE COMPILED ON EACH APPLICATION

A questionnaire was designed to gather limited but key information about particular GIS applications in order for a potential user to decide if the application fits his/her computer system, data requirements, and

physical system to be modeled. Some of the information that has been compiled includes a brief description, data requirements, operating system, and software dependencies (for example, is the application dependent on other software such as Environmental Systems Research Institute, ESRI, products). Twelve applications are currently in the list. More are being sought.

A more detailed questionnaire is desirable for further investigation of GIS-based models. In addition to describing the computer system, data requirements, operating system and software dependencies of the GIS-based models, the new questionnaire is also attempting to describe a GIS-based model from a hydrologic or hydraulic perspective. This would provide the user with more detailed information on practical applications. These items are shown as follows:

Model Type: this sections states the types of model developed. For example, hydrological models can generally be classified as event-based precipitation-runoff models, continuous precipitation runoff models, snowmelt runoff models, steady-flow flood routing models, unsteady-flow flood routing models, reservoir regulation models, flood frequency models, watershed/water resources management models, etc. These categories are basically defined on the basis of the nature of a hydrological model, its physical mechanism and in part application purposes. There is no doubt that some models bear a series of application purposes, such as simulations of water quantity, water quality, and sedimentation. In this case, a category termed general purposes

would be listed. On the other hand, with a rapid development of digital images and data (from scanner, digital video, digital camera, sensors mounted on balloon, aircrafts, space shuttles, satellites) and relevant GIS database, newly developed hydrologic models are increasingly assimilating these data sources based on a GIS platform. Describing a model in a hydrologic manner would however provide the user with an essential scope about its physical mechanism and application purposes.

Model Objective (s): describe purpose of the model, like the simulation of hydrologic processes for designing flood damage reduction projects.

Model Structure or Mathematical Basis: describe the type of the basins for which the model has been developed. For example, the basins may be rural, urban, agricultural, mountainous, etc; describe the size of the basins for which the model applies. For example, the basins may be small ($<10^3$ km^2), medium (10^3-10^4 km^2), or large ($>10^4$ km^2); the nature of simulation that the model undertakes. For example, the simulation may be event-based or continuous; components of the hydrological cycle represented in model formulation, for example, precipitation, infiltration, evaporation, interception, detention storage, overland flow, channel flow. Mathematical formulation of the model components, for example, lumped, distributed, deterministic, and probabilistic.

Model Parameters: this section describes the number of parameters involved in each model component process and then of the model.

Spatial Scale: this section describes the spatial representation used in the model. For example the watershed can be treated as a single unit or as a network of sub-watersheds.

Temporal Scale: this section describes whether the model is an 'event based' model or a daily, weekly, monthly, yearly model.

Input Data Requirements: this section describes the data required for application of the model. The data may pertain to the following elements as needed by the model, like watershed characteristics data (topographic map, drainage area, channel lengths, drainage areas of channels, slope, etc.), climatic data (rainfall intensity in time, temperature, humidity, vapor pressure, wind velocity, etc.), stream flow data (measured discharge in regular time steps), soil data (type, structure, texture, infiltration characteristics) and land use data (cropping patterns, vegetation, percent imperviousness, etc.).

Model Output: this section describes the type of output of the model procedures.

Model Testing & Verification: this section describes whether the model has been tested and verified extensively using split sampling data and split sampling watershed techniques, involving other watersheds than calibration watersheds. Are test data sets available to the user for modeling use training and model operation confirmation?

Model Sensitivity: this section describes the sensitivity of the model to its parameters and its components. Has a sensitivity analysis been performed for the model and shared to the general user community?

Model Reliability: this section describes the confidence in the model results. Consider a) the repeatability of the model, b) accuracy of output as compared with real observations, and c) the Probability of obtaining consistently accurate model predictions.

Model Application/Case Studies: this section describes where the model is / has been typically applied. How does the user community apply the model to real world problem settings?

EXAMPLES OF GIS APPLICATIONS WHICH ARE INCLUDED IN THE WEB LIST

The following seven high-profile GIS applications in hydrology/hydraulics/water quality/watershed assessment are examples of software applications included in the web list. Pertinent information on these applications is included so a potential user can decide if a particular application is suitable for his/her purposes.

HEC GeoHMS, U.S. Army Corps of Engineers (USACE, 2007). Geo-HMS is a GIS graphical user interface to the Corps of Engineers Hydrologic Modeling System (HMS) model. Geo-HMS is designed to operate with ESRI ArcView and the Spatial analyst extension. Using digital elevation, land use and soil layers, a number of inputs to the HMS flood event model are generated.

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hydrology, erosion, and sedimentation.   SWAT is a continuous simulation model which analyzes hydrology, erosion/sedimentation, nutrients, and pesticides.   Both models allow for distributed processing of a discretized watershed. AGWA utilizes generally available digital datasets of elevation, soil, land use, rainfall, and others.

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Soil Water Assessment Tool, (SWAT), USDA Agricultural Research Service (ARS), (Arnold, 1998). SWAT is a river basin scale model developed to quantify the impact of land management practices in large, complex watersheds. Application of the model (ArcSWAT 1.0 for ArcGIS 9.1 version) requires prior installation of ESRI software package including ArcGIS-ArcView 9.1 with service pack 2 (Build 766), ArcGIS Spatial Analysis 9.1 extension, ArcGIS Developer Kit (usually found in C:\Program Files\ArcGIS\DeveloperKit\), and ArcGIS DotNet support (usually found in C:\Program Files\ArcGIS\DotNet\). The required GIS grid data layers are digital elevation models, soil map, and land use map.

More recently developed GIS-based hydrologic models with their latest versions and their performance and development could be obtained from the user group or hotline-type support, or from online academic database, such as ISI Web of Knowledge, and Engineering Village. The questionnaires will be disseminating to the developer at a certain period. If they are not well aware of the sensitivity and reliability of the models, the Workgroup would search for relevant information and summarize it. Development of the original models will also be traced for providing the hydrologic community with latest information.

GIS APPLICATIONS WEB SITE

The web site where the list of GIS applications resides is associated with the list of hydrologic models maintained at Texas A&M University. The web site is http://hydrologicmodels.tamu.edu

Welcome to the Hydrologic Modeling Inventory Website. This is a collaborative effort between Texas A&M University and the Bureau of Reclamation to provide basic information on a variety of hydrologic models to practitioners in the academic, governmental and private sectors.

The effort was started in 1999 as a collaborative effort between Louisiana State University and the Bureau of Reclamation. Developers of well known models were contacted by Dr. Vijay P. Singh, Dr. Donald K. Frevert and several other Bureau of Reclamation staff members. Each developer was asked to fill out a questionnaire providing basic information including the capabilities of their model, input requirements, output information, assumptions, hardware requirements and contact information. The questionnaires were originally posted on a Bureau of Reclamation website, but in 2007 the website was moved to the Texas A&M domain to facilitate support and maintenance. Developers have been contacted in subsequent years to update the information on their respective models and new models continue to be added as appropriate.

Visitors to the website will click on the link at the bottom of this page and will be directed to a page with a listing of model links which, in turn, will direct the visitor to the summary sheet for each model. More detailed information on specific models can be obtained by contacting the developers and the e-mail, phone or mailing addresses indicated.

From the introductory page, go to the list of hydrologic models. The models are grouped in categories, one of which is GIS applications.

Geographic Information System (GIS)-based models

- Automated Geospatial Watershed Assessment Tool
- eCoastal Program
- BASINS version 4.0
- GIS Weasel
- HAZUS-MH
- HEC-GeoRAS
- MapWindow
- NHDPlus Append Tool
- NRCS Geo-Hydro_ArcGIS
- NRCS Geo-Hydro_ArcView
- StreamStats
- Soil and Water Assessment Tool (SWAT)

By clicking on one of the applications, the questionnaire with pertinent information is available. This includes a link to the developer's web site.

SUMMARY AND CONCLUSIONS

     The purpose of the Workgroup is to gather and disseminate information on GIS data and applications related to hydrology and hydraulics. The focus is primarily on data and applications of federal agencies which are in the public domain. These are of great interest to the general GIS user community because of easy access, acceptance, good documentation, and in some cases, user support. Progress is being made towards accomplishing these goals and setting a course for future developments. Progress is posted on the Workgroup web site.

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