

STREAM NOTES

To Aid in Securing Favorable Conditions of Water Flows

Rocky Mountain Research Station

January 2007

ICWater: A New Software Tool for Protecting the Nation's Drinking Water

by Douglas F. Ryan

If a chemical, radioactive, or biological contaminant were accidentally or intentionally introduced into a surface source of drinking water, knowing the threat it posed to the public would be essential for first responders to mount an effective emergency response. ICWater (**I**ncident **C**ommand **T**ool for **P**rotecting **D**rinking **W**ater) is a new software tool available for incident commanders, water utility managers, and other resource managers responsible for protecting community drinking water sources during contamination emergencies. Preliminary versions of ICWater have already been used by water utilities and State HAZMAT (hazardous materials) response teams in Oregon and Washington, the National Oceanic and Atmospheric Administration (NOAA), and the Ohio Environmental Protection Agency.

ICWater was developed by the author and a team consisting of William B. Samuels, Rakesh Bahadur, Michael C. Monteith, David E. Amstutz, Jonathan M.

Pickus, and Katherine Parker at the Science Applications International Corporation (SAIC). The ICWater tool is now available for use across the Nation for responding to water-related emergencies, emergency preparedness planning and drills, and non-emergency uses needing information about water connectivity and quality within watersheds.

Key Elements of ICWater

ICWater is a computer-based tool that integrates multiple sources of information for incident commanders at the scene of a surface water contamination. ICWater links a time-of-travel spill model (RiverSpill) with the National Hydrography Database (NHD and NHDPlus) at a scale of 1:100,000 (Samuels and others, 2006). ICWater is available for all hydrologic units in the contiguous United States and coverage of Alaska and Hawaii is planned in the near future. The tool interfaces with the U.S. Geological Survey (USGS) real time stream gauging network to index average stream flow to flow velocity so that contaminant travel time and

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The PRIMARY AIM is to exchange technical ideas and transfer technology among scientists working with wildland stream systems.

CONTRIBUTIONS are voluntary and will be accepted at any time. They should be typewritten, single-spaced, and limited to two pages. Graphics and tables are encouraged.

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IN THIS ISSUE

- **Incident Command Tool for Protecting Drinking Water**
- **Lassen National Forest Watershed Improvement Program**
- **Geomorphology Observations of Lewis and Clark**

concentration can be estimated at locations downstream based on conditions at the time of the spill (fig. 1). Several other relevant geographic databases are also combined within the tool to provide critical information that incident commanders require, including the location and contact information for all public drinking water intakes, dams, hazardous material sites, pipelines, bridges, and locations of critical infrastructure such as hospitals, fire stations, and police stations. ICWater also contains a reference database that identifies the concentrations of over 300 potential contaminants which are a concern for human health if consumed in drinking water (fig. 2).

ICWater processes multiple information sources and quickly produces maps, graphs, tables, and reports that answer four questions that incident commanders identified as critical in a spill emergency (fig. 3):

- What path will a contaminant follow through surface water channels?

- Do drinking water intakes lie along that flow path? If so, how many people do they serve and who controls them?
- When will the contaminant reach the water intakes?
- Will the contaminant concentration at the water intakes be at a level that is of concern for human health?

ICWater can also navigate in the upstream direction, for use by investigators seeking the source or cause of a contaminant spill. In this mode, ICWater partitions the upstream watershed into zones based either on upstream distance or travel time. If travel time is chosen, stream flow can be indexed to real-time stream gauges, or flow can be specified by the user. The tool also permits likely origins of contaminants to be quickly identified by an investigator by overlaying maps of the upstream watershed with known potential sources of contaminants such as HAZMAT sites, sewer outfalls, pipelines, and bridges.

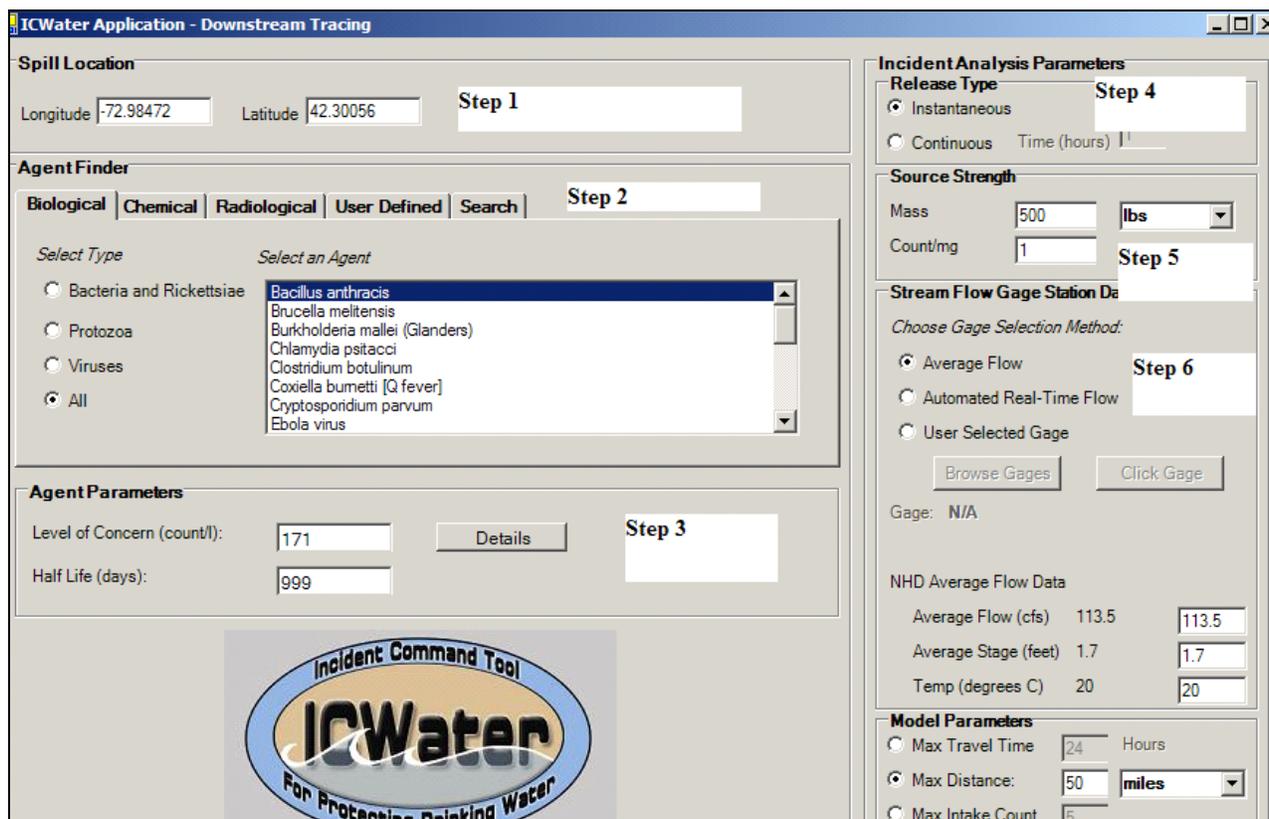


Figure 1. Input window in ICWater to determine the transport and concentration of contaminants downstream from the point of injection or spill.



Agent:	Aflatoxin
Treatment Options:	
Chlorine Resistance:	Probably tolerant [4]
Conventional Treatment:	
Water Threat:	Yes [5]
Other Information:	
Stable in Water:	Probably [5]
Infectious Dose/Recommended Guidelines:	
Drinking Water Concentration:	75 ug/l at water consumption of 2L/day NOAEL [5]
Half-Life (Days):	999
Comments:	
References	

Figure 2. An example of the contaminant agent reference database in ICWater that identifies over 300 potential biological, chemical, and radiological contaminants. Treatment options, physical and chemical properties, allowable concentrations in drinking water, a list of references, etc. are provided for each contaminant listed in the ICWater database.

Other Possible ICWater Applications

ICWater has other potential uses by water resource managers because of its ability to perform rapid analyses of watershed connectivity at multiple scales anywhere in the country. For example, users in the U.S. Forest Service have already adapted the tool for several purposes. The Missoula Fire Lab used ICWater in the summer of 2006 for assessing what on-the-ground assets (including drinking water utilities and HAZMAT sites) were at risk from wildland fires as they were burning. They also used the tool for a wide-ranging planning assessment of what public drinking water systems were potentially vulnerable to disruption by wildland fire at the national scale. Forest Health Protection is using ICWater for planning a nationwide aquatic monitoring program for early-detection of waterborne propagules of Sudden Oak Death, a virulent tree pathogen. ICWater may also have potential non-emergency uses such as performing source water assessments.

Try experimenting with ICWater to see if the information it provides is useful in understanding and addressing issues related to drinking water and other resource values in a given watershed. One should find it useful for planning purposes as well as for responding to actual water-related emergencies.

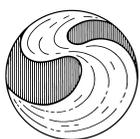
Development of ICWater

Developing ICWater drew upon the extensive expertise of the U.S. Forest Service in water research as well as models and data sources from other agencies. The U.S. Forest Service has a stake in protecting drinking water because over 3000 towns and cities draw their drinking water from within National Forests across the nation. The U.S. Forest Service also has an active corps of incident commanders who direct first responders on and off of National Forests during major wildland fires and other emergencies that require coordinated interagency action.

With U.S. Forest Service leadership, a cooperating group of agencies contributed financial and technical support to ICWater, including the Technical Support Working Group, United States Environmental Protection Agency, Federal Emergency Management Agency, USGS, and NOAA. Distribution and training for ICWater are being handled by the Defense Threat Reduction Agency (DTRA) under a memorandum of agreement with the U.S. Forest Service. ICWater is being incorporated as a module into DTRA's Consequences Assessment Tool Suite (CATS). ICWater will add a waterborne capability to CATS which already contains several other tools for assessing airborne plumes, earth motion and blast effects to provide incident commanders with critical information in the event of natural and technological emergencies such as earthquakes, hurricanes, and terror attacks. ICWater is being produced under government contract by Science Applications International Corporation (SAIC).

How to Obtain ICWater

ICWater is currently available as a stand-alone version installed from CD's. To run ICWater, users must have ArcGIS 9.x (a commercial GIS software available from Environmental Systems Research Institute, ESRI) installed on their computer because



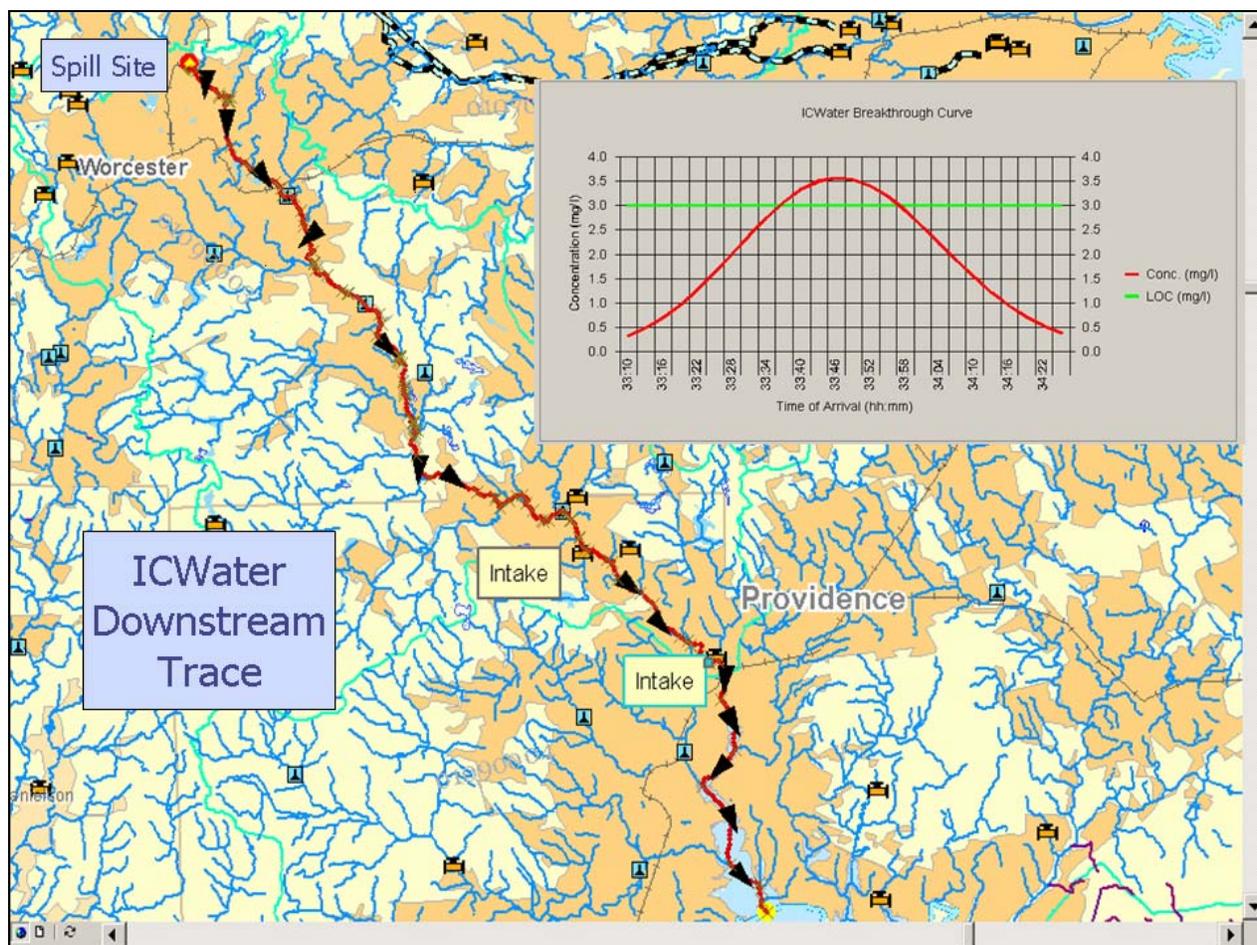


Figure 3. A map from ICWater displaying the location of a spill site, flow path of the contaminant, location of water intakes along the contaminant flow path, and other key infrastructure. The inset graph shows the concentration of the contaminant over time at a given water intake and the period of time the contaminant exceeds allowable concentrations for drinking water.

the stand-alone ICWater uses the ArcGIS 9.x platform. A web-enabled version of ICWater has been developed that would not require ArcGIS 9.x, but it is not currently available for general use.

To request copies of ICWater software on CD, government employees must register and follow the instructions posted on DTRA's AceCenter website (<https://acecenter.cntr.dtra.mil/registration/mainpage.cfm>). Non-government employees (academics, contractors, etc.) can also request the software at the AceCenter by following instructions specific to them at the site. To learn more about ICWater and how it works, please visit the following website at <http://eh2o.saic.com/icwater/>. For additional information, please

contact the author, Douglas Ryan, by email or phone.

References

Samuels, W.B., Bahadur, R., Monteith, M.C., Amstutz, D.E., Pickus, J.M., Parker, K., and Ryan, D. 2006. NHD, Riverspill, and the development of the Incident Command Tool for Drinking Water Protection. *Water Resources IMPACT*. 15-18.

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The Lassen National Forest Watershed Improvement Program

by Michael Furniss and Ken Roby

A rich-media online technology transfer product was recently developed and released by the Pacific Northwest and Pacific Southwest Research Stations, in cooperation with the Lassen National Forest, to describe the CALFED Bay-Delta watershed improvement program on the Lassen National Forest, California. The planning and restoration work was initiated to accelerate efforts by the Lassen National Forest to protect and improve habitat for some of the last naturally reproducing populations of steelhead and spring-run Chinook salmon in the Sacramento River system. The program includes work in five watersheds that are tributary to the Sacramento River: Antelope Creek, Battle Creek, Butte Creek, Deer Creek, and Mill Creek.

Following an extensive resource inventory and watershed analysis, the Lassen National Forest, in collaboration with numerous stakeholders, developed and implemented an ambitious watershed improvement plan. Collaboration was

facilitated by the several watershed conservancies formed to provide stakeholder participation in management of the watersheds. Work of the watershed conservancies was instrumental in obtaining support from the CALFED Bay-Delta program. Objectives of the CALFED Bay-Delta program include improving ecosystem and watershed condition in the California Delta system.

Developing and implementing a watershed improvement plan is more detailed and complex than a brief set of video presentations can fully capture. The intent of these online, multimedia presentations is to share some of the primary drivers and program components of the Lassen National Forest watershed improvement plan.

Because anadromous fishes were the focal resource issue in the watersheds, background on their ecology is provided by **Howard Brown** of the National Marine Fisheries Service (NOAA Fisheries).

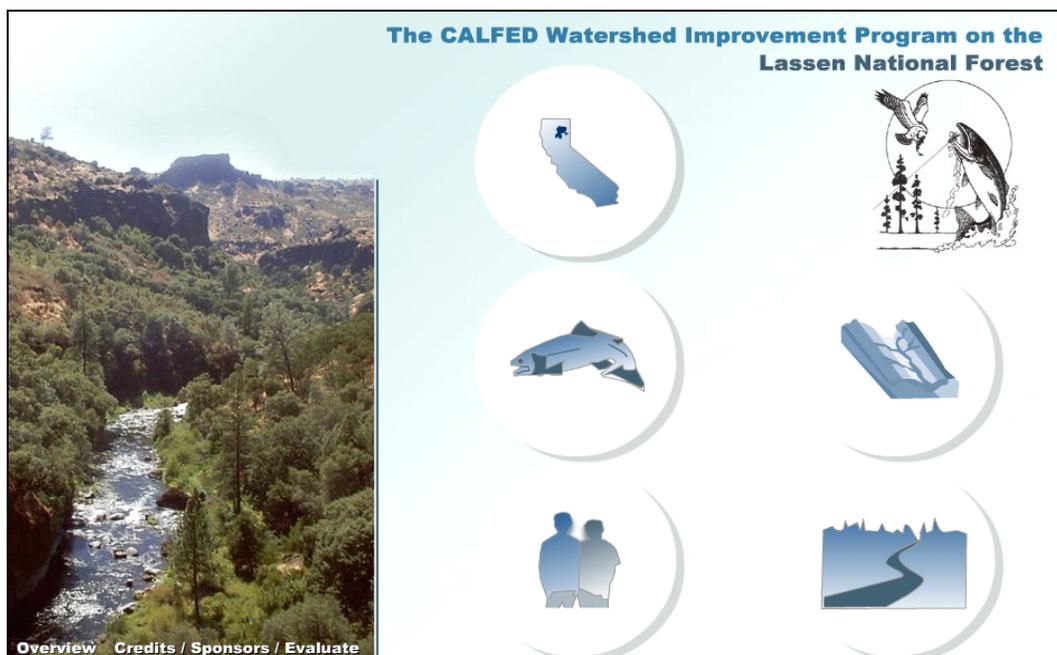


Figure 1. The home screen of the online presentations describing the CALFED watershed improvement program on the Lassen National Forest (<http://www.fs.fed.us/psw/topics/water/calfed/>). Clicking on the images provides an outline of various presentations.



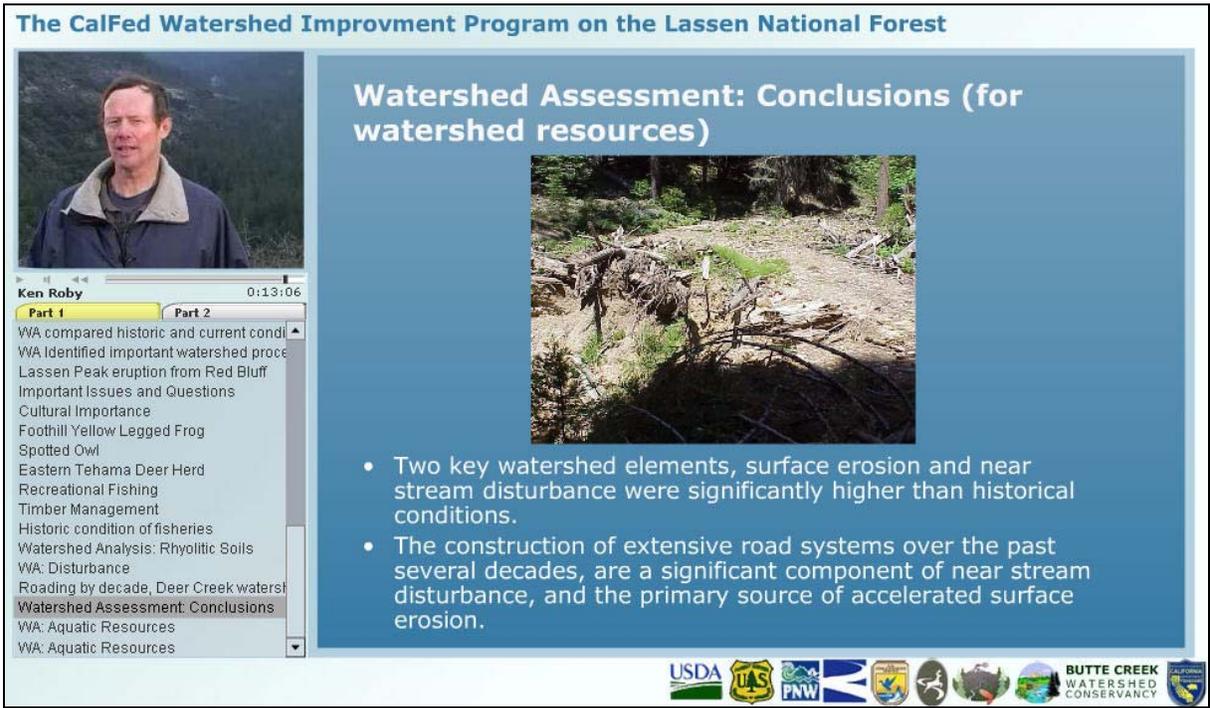


Figure 2. An example of one of the online presentations for the watershed improvement project on the Lassen National Forest. Shown is Ken Roby discussing the key findings from the watershed inventory and evaluation. At the bottom of the screen is a list of agencies and organizations that supported the watershed improvement program on the Lassen National Forest.

The mixed ownership within the watersheds creates a variety of management issues, challenges, and opportunities. The formation and continued work of watershed groups that can address issues across ownership are key to providing a forum for stakeholders, and a means to assess and develop solutions to problems at a watershed scale. **Holly Savage** of the Deer Creek Conservancy provides perspective from one of these organizations.

Ken Roby, fish biologist on the Lassen National Forest, provides information on the resource values in the watersheds and briefly outlines the watershed inventory and assessment work that was completed to develop the watershed improvement plan.

Because the watershed resource inventory and evaluation pointed to road related erosion as a primary concern in the upper watersheds, road work has been emphasized in implementation. **Mike Derrig**, hydrologist on the Lassen National Forest, explains the main components of this work.

Coye Robbins, wildlife biologist on the Lassen National Forest, provides a brief overview of the watershed improvement program and the different videos in this product.

In each presentation, a Table of Contents, a video window, and a slide window is displayed. Clicking on a Table of Contents entry allows the user to jump to any part of the presentation once it is loaded. The user can drag the slider bar below the video to move forward and backward in the presentation. Web links are provided on selected slides in the various presentations for those interested in obtaining additional information on a particular topic. Clicking on those links opens a new browser window. Additionally, web links for the various project sponsors are provided.

Mike Furniss, Pacific Northwest and Southwest Research Stations, and **Jeff Guntle**, Pacific Northwest Research Station produced the online presentations. The product may be viewed at <http://www.fs.fed.us/psw/topics/water/calFed/>.

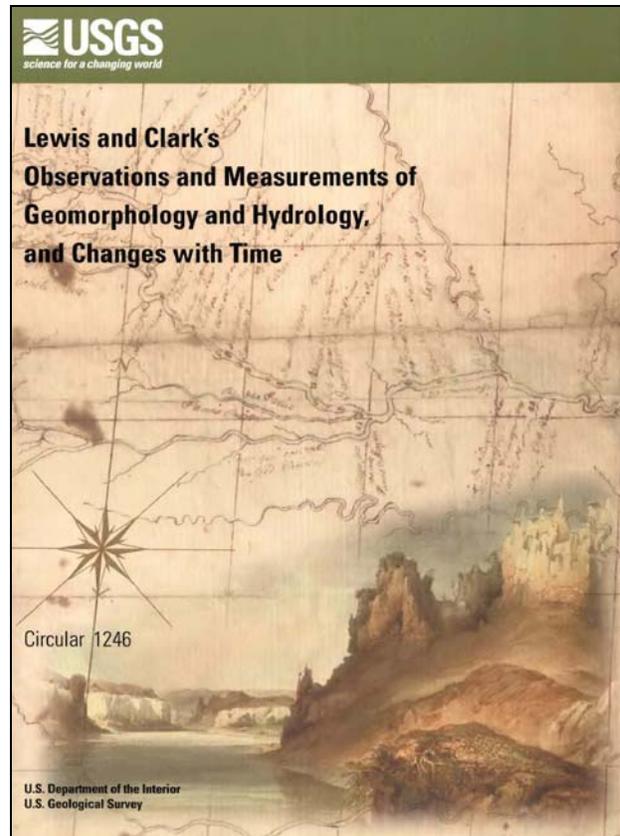
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Lewis and Clark's Observations and Measurements of Geomorphology and Hydrology, and Changes with Time

Lewis and Clark's Observations and Measurements of Geomorphology and Hydrology, and Changes with Time is a recent U.S. Geological Survey Circular written by John A. Moody, Robert H. Meade, and David R. Jones that synthesizes the geomorphic and hydrologic measurements and observations of Meriwether Lewis and William Clark on their epic Corps of Discovery expedition along the Missouri River and its tributaries, through the northern Rocky Mountains, and along the Columbia River and its tributaries. This publication integrates relevant narrative descriptions and sketches made by Lewis and Clark of channel characteristics, landforms, and fluvial processes along their journey. This publication also summarizes measurements of water level, water temperature, flow velocity, channel width, and channel length that Lewis and Clark made on numerous streams. The authors have not only synthesized the stream observations and measurements made by these explorers, they place them in context of our modern understanding of fluvial processes. More interestingly, the authors have compiled stream measurements collected by others at later dates to assess the accuracy of Lewis and Clark's observations and measurements and how land-use changes over the past 200 years have altered channel characteristics and fluvial processes observed by Lewis and Clark. The latter is especially telling as the Missouri River and Columbia River of today have no resemblance of the dynamic rivers observed and documented by Lewis and Clark. More importantly, the observations of channel characteristics and fluvial processes made by Lewis and Clark over 200 years ago provides a historical framework and understanding for those attempting to restore channel conditions and fluvial processes in the western United States.

Hydrologists, geomorphologists, and ecologists studying streams will find this publication interesting from a historical context, but also a reminder of the importance to clearly document



observations, measurements, and interpretations during a study. As stated by the authors, “the legacy of the keen observations in all scientific fields left by Lewis and Clark needs to be continued today, and into the future, to discover the complex but important interconnected relationships in riverine ecosystems.”

Lewis and Clark's Observations and Measurements of Geomorphology and Hydrology, and Changes with Time is published by the U.S. Geological Survey as Circular 1276. It can be viewed online at <http://pubs.er.usgs.gov/usgspubs/cir/cir1246> using a DjVu plugin. The citation for the publication is: Moody, J.A., Meade, R.H., and Jones, D.R. 2003. Lewis and Clark's observations and measurements of geomorphology and hydrology, and changes with time. U.S. Geological Survey Circular 1246. 110 p.



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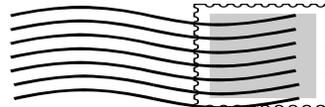
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January 2007

IN THIS ISSUE

- Incident Command
Tool for Protecting
Drinking Water
- Lassen National Forest
Watershed
Improvement Program
- Geomorphology
Observations of
Lewis and Clark

STREAM NOTES



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