
**FIFTH WATER INFORMATION SUMMIT: REGIONAL PERSPECTIVES
ON WATER
INFORMATION MANAGEMENT SYSTEMS**

OCTOBER 23-25 WATER INFORMATION SUMMIT, FT. LAUDERDALE, FLORIDA, USA 2002

INFORMATION ACCESS INITIATIVES OF
THE WATER QUALITY INFORMATION CENTER
AT THE NATIONAL AGRICULTURAL LIBRARY

Joseph R. Makuch, Ph.D., Stuart R. Gagnon, M.S.L.S.*

INFORMATION ACCESS INITIATIVES OF
THE WATER QUALITY INFORMATION CENTER
AT THE NATIONAL AGRICULTURAL LIBRARY

Joseph R. Makuch, Ph.D., Stuart R. Gagnon, M.S.L.S.*

ABSTRACT: This paper describes several inter-related initiatives of the Water Quality Information Center at the National Agricultural Library designed to facilitate access to information on water and agriculture. These initiatives include managing a Web site focused on water resources and agriculture, providing timely information on environmental topics through the Enviro-News alert service; developing a database of online documents related to water and agriculture; and participating in a pilot project utilizing the Connexion system to catalog electronic resources and add records for them to the AGRICOLA database.

KEY TERMS: Water resources; information systems; libraries; Connexion; metadata; listservs; digital documents; Internet; agriculture

INTRODUCTION

The National Agricultural Library (NAL), part of the United States Department of Agriculture's Agricultural Research Service, ensures and enhances access to agricultural information. As the world's largest agricultural library, NAL is an important information source for people working on agricultural issues, including issues related to water and agriculture. To strengthen its capacity in the water resources area, NAL established the Water Quality Information Center in 1990. The center allows the library to provide special emphasis on meeting the needs of people seeking water-related information.

As the focal point of NAL's water quality efforts, the center collects, organizes and communicates the scientific findings, educational methodologies and public policy issues related to water resources and agriculture. Agricultural nonpoint-source pollution is the center's major focus.

*Respectively, Coordinator, Water Quality Information Center, National Agricultural Library, Agricultural Research Service, U.S. Department of Agriculture, 10301 Baltimore Ave., Beltsville, MD 20705-2531; NAL Cooperator Librarian, Science and Technology Services Team, University of Maryland Libraries, University of Maryland, College Park, MD 20742-7011.

Presented to the WaterWeb Consortium at the 5th Water Information Summit, October 23-25, 2002
www.WaterWeb.org

The center primarily serves water resources professionals—including scientists, policy makers, economists, engineers and many others—who are working on solutions to water quality problems associated with agriculture. These individuals are usually affiliated with federal and state governments, academic institutions and agricultural and environmental organizations. Members of the public with an interest in water issues are also served by the center.

To efficiently serve the needs of the many people seeking water information, the center strives to maximize the use of appropriate information technologies and develop integrated water information systems that allow users themselves to directly locate and access the information they need. In cases where members of the center's small staff are directly involved in providing information, they can often handle the transaction quite expeditiously by utilizing the information systems being built by the center. Often, these person-to-person interactions serve to point out to center staff the content, format and system inter-relationships required to efficiently and effectively meet the customers' needs. This information can then be used to modify systems to enhance their utility and improve management efficiencies.

Described below are four inter-related systems that the Water Quality Information Center is using to meet the needs of people looking for information on the various issues related to water and agriculture. The systems are the center's Web site; the Enviro-News alert service; a database of online documents covering water and agriculture; and the Connexion system, which facilitates creating records in AGRICOLA—NAL's database of agricultural literature.

In this paper, the word, *metadata*, is used. Metadata describes data that is created about (describing, administering, etc.) other data. A record in a library's online public access catalog (OPAC) is an example of metadata. It helps library users locate material with a specific title, author or on a specific subject. Work to provide better access to information managed by the Water Quality Information Center has led to several metadata-related initiatives associated with the center's information systems.

All of these various metadata applications follow a standard called Dublin Core which allows for greater compatibility between systems. See www.dublincore.org for more information about the Dublin Core Initiative.

WATER QUALITY INFORMATION CENTER WEB SITE

The Water Quality Information Center Web site (www.nal.usda.gov/wqic/) serves as the hub for the center's electronic information efforts. The Web site was established in 1994 in collaboration with the University of Maryland. It was originally on the university's server, but was moved to the NAL server in 1996. The Web site evolved from earlier efforts by the center to provide information electronically: From 1990-1995, the center operated the Water Information Network on NAL's Agricultural Library Forum, a dial-up computer bulletin board

system (Makuch and Schneider, 1993). This was followed by a Gopher system (1993-1997) offering water information (Makuch, 1995).

The central piece of the Water Quality Information Center Web site is the homepage, the top of which is shown in Figure 1. As appropriate, announcements and other timely messages are placed below the main menu buttons.

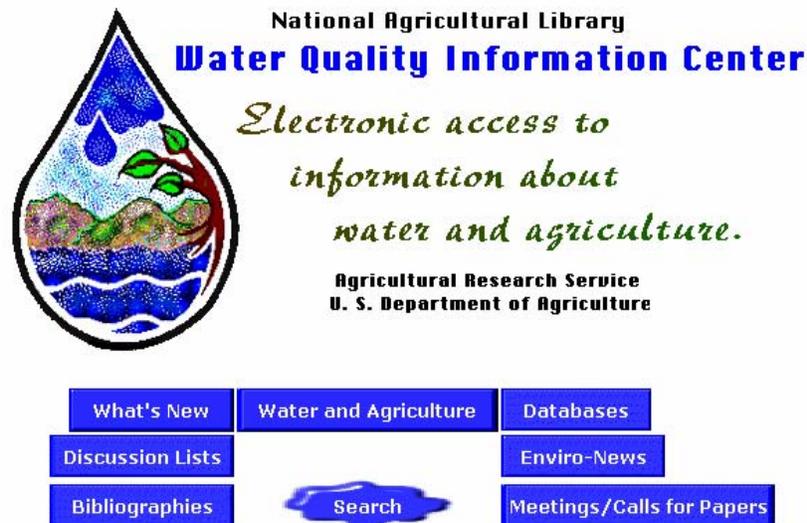


Figure 1. Top Portion of Water Quality Information Center Homepage.

The Web site is comprised of the following major elements:

- Topic pages that provide annotated links to subject-specific information such as wetlands, water quality modeling, funding sources for water quality
- A database of freely available online documents covering water and agriculture (discussed below)
- Information about the Enviro-News alert service and access to its archives (discussed below)
- More than fifty bibliographies from the AGRICOLA database
- A listing of upcoming conferences and calls for papers related to water
- Access to a variety of databases related to water
- A listing of water-related Internet discussion lists
- What's new page
- Site searching capabilities through the NAL Web site's Inktomi search engine

Figure 2 shows the growth in monthly averages of page views for the site and average number of sessions (unique hosts accessing the site each day) per month. This growth is likely a function of the growth in the number of people with Internet connections, an increase in the number of pages on the site and the usefulness of the site.

As another indication of the site’s success in serving its audience, the Web site received a Blue Ribbon Award in 1997 from ASAE (the society for engineering in agricultural, food and biological systems) in its educational materials recognition program. And a search on “water quality information” using the Google search engine (on August 28, 2002), listed the Water Quality Information Center web site first on the results page. According to Google, “important, high-quality sites receive a higher PageRank” (Google, 2002). The site is also listed on the periodically updated *Best Environmental Directories* Web site (www.ulb.ac.be/ceese/meta/cdscom.html) maintained by the Centre for Economic and Social Studies on the Environment in Belgium and on the U. S. Environmental Protection Agency’s National Library Network *Core List for an Environmental Reference Collection* (www.epa.gov/natlibra/core/coretoc.htm).

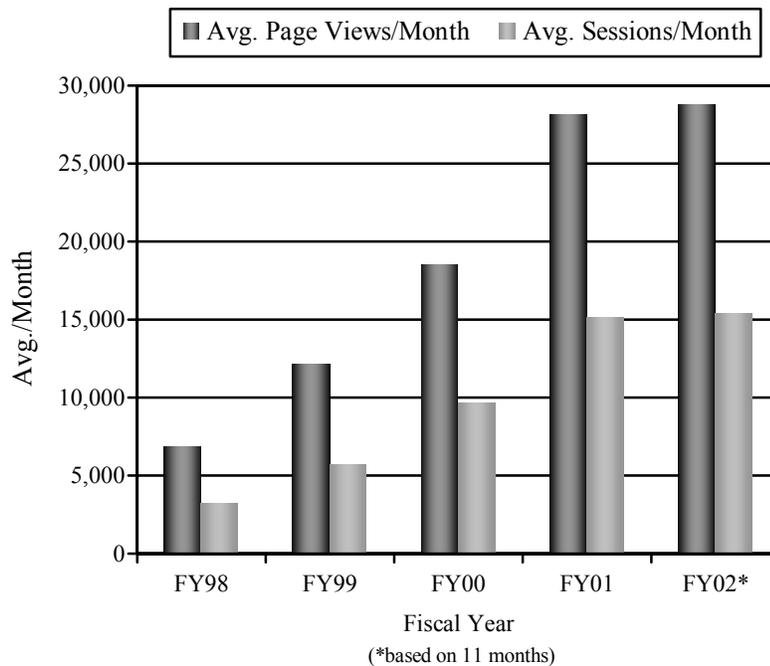


Figure 2. Monthly Averages of Page Views and Number of Sessions for Water Quality Information Center Web Site.

Enhancing the “search-ability” of a Web site sometimes means using techniques that are rarely seen by people reading the pages in their browsers. The Water Quality Information Center has included meta-tags, a form of metadata written into the source code of HTML documents, since the middle of 2000. Meta-tags reside within the header of the HTML and cannot be seen during normal Web page viewing. Figure 3 shows an example of meta-tags. Some search engines use meta-tags to enhance the relevance of their search results (Craven, 2001). Meta-tags currently being used are generated by an automated system developed by NAL that uses a Web form, called the NAL Metadata Template, for input. A description of the metadata elements used in the template can be found at www.nal.usda.gov/cataloging/TEMPLATE2.pdf.



```
<html>
<head>
<TITLE> "Manure Management" </TITLE>
<META content="Dublin Core Metadata Template (NAL Metadata)">
<META name=NAL.Title content="Manure Management">
<META name=DC.Title content="Manure Management">
<META name=NAL.Creator Scheme="PersonalName" content="Makuch, J. R.">
<META name=DC.Creator Scheme="PersonalName" content="Makuch, J. R.">
<META name=NAL.Creator.EMAIL content="jmakuch@nal.usda.gov">
<META name=DC.Creator.Address content="jmakuch@nal.usda.gov">
<META name=NAL.Subject.Keyword content="manure management">
<META name=DC.Subject.Keyword content="manure management">
<META name=NAL.Subject.Keyword content="nutrient mangaeement">
<META name=DC.Subject.Keyword content="nutrient mangaeement">
<META name=NAL.Subject.Keyword content="environmental protection">
<META name=DC.Subject.Keyword content="environmental protection">
<META name=NAL.Subject.NAL.Thesaurus content="animal manure management ">
<META name=DC.Subject.NAL.Thesaurus content="animal manure management ">
<META name=NAL.Subject.NAL.Thesaurus content="agricultural management ">
<META name=DC.Subject.NAL.Thesaurus content="agricultural management ">
<META name=NAL.Subject.NAL.Thesaurus content="waste management ">
<META name=DC.Subject.NAL.Thesaurus content="waste management ">
<META name=NAL.Subject.NAL.Thesaurus content="animal manures ">
<META name=DC.Subject.NAL.Thesaurus content="animal manures ">
<META name=NAL.Subject.NAL.Thesaurus content="manure handling ">
<META name=DC.Subject.NAL.Thesaurus content="manure handling ">
<META name=NAL.Subject.NAL.Thesaurus content="manure spreading ">
<META name=DC.Subject.NAL.Thesaurus content="manure spreading ">
<META name=NAL.Subject.NAL.Thesaurus content="manure storage ">
<META name=DC.Subject.NAL.Thesaurus content="manure storage ">
<META name=NAL.Description content="This WQIC resource provides links to inf
<META name=DC.Description content="This WQIC resource provides links to info
<META name=NAL.Publisher content="National Agricultural Library">
<META name=DC.Publisher content="National Agricultural Library">
<META name=NAL.Contributor content="Kinard, T. D." Scheme="PersonalName">
<META name=DC.Contributor content="Kinard, T. D." Scheme="PersonalName">
<META name=NAL.Date.Created content="1999-01-01" Scheme="ISO8601">
<META name=DC.Date.Created content="1999-01-01" Scheme="ISO8601">
```

Figure 3. Examples of Meta-tags on a Water Quality Information Center Web Page.

ENVIRO-NEWS

Enviro-News is an e-mail alert service that provides subscribers with timely access to news and announcements related to environmental issues. The Enviro-News Internet list was established in July 1996 as a way to funnel new and/or time-sensitive environmental information to ARS environmental researchers and administrators and NAL staff with an interest in environmental issues. Since the information covered by Enviro-News would be of interest to people beyond ARS and NAL, and since handling additional subscribers would not be particularly burdensome, Enviro-News was opened to anyone with an interest in the list's topics. However, it was recognized that problems with inappropriate postings might be more likely with a public list.

As an environmental information manager, the Water Quality Information Center was (and still is) receiving much useful information electronically covering environmental topics. This information comes to the center mainly via e-mail from environmentally-oriented Internet lists. Enviro-News was created so that these useful messages from a variety of sources could be easily forwarded through a single mechanism to a self-selected audience interested in timely environmental news. Enviro-News eliminates the need for center staff to decide on a message-by-message basis which information to forward to particular colleagues or clients. Information needs only be sent to the Enviro-News address and anyone subscribed to the list receives it.

The scope of Enviro-News goes beyond water and agriculture. Water issues are inter-related with other environmental and social issues. Since water resource professionals are increasingly embracing a holistic approach to understanding and solving water problems, they benefit from being informed on a wide array of environmental topics.

In July 2002, there were 427 Enviro-News Subscribers. The number of subscribers has remained stable in the 400-500 range during the past several years. As a rough guide to organizational affiliation of subscribers, Figure 4 shows distribution of domains in Enviro-News subscriber addresses.

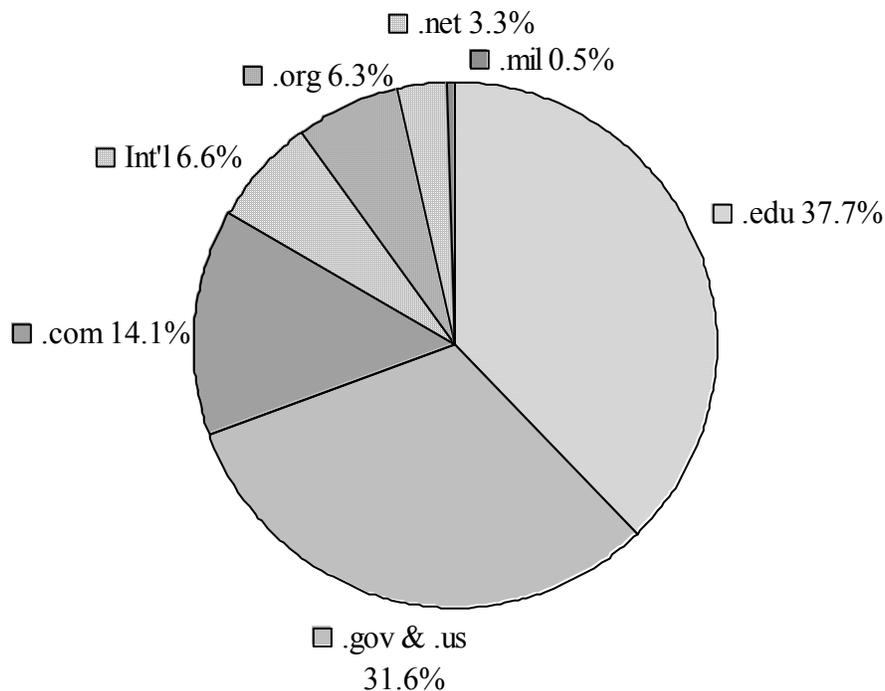


Figure 4. Internet Domains of Enviro-News Subscribers, July 2002 (N=427).

While any Enviro-News subscriber may post to the list, the majority of postings are from the Water Quality Information Center coordinator. The coordinator filters information from many lists and Web sites so only on-topic messages are posted. The coordinator also performs quality control and creates value-added messages: Links are checked and corrected if necessary.

Message formatting is improved where necessary. The coordinator also supplements forwarded messages with additional information as appropriate. As the primary list owner, the coordinator also assists subscribers and nonsubscribers in posting messages. Fortunately, messages posted to Enviro-News directly by subscribers have generally conformed to list guidelines.

Figure 5 shows the number of postings per month for a recent twelve-month period. The number of postings during this time averaged 39 per month.

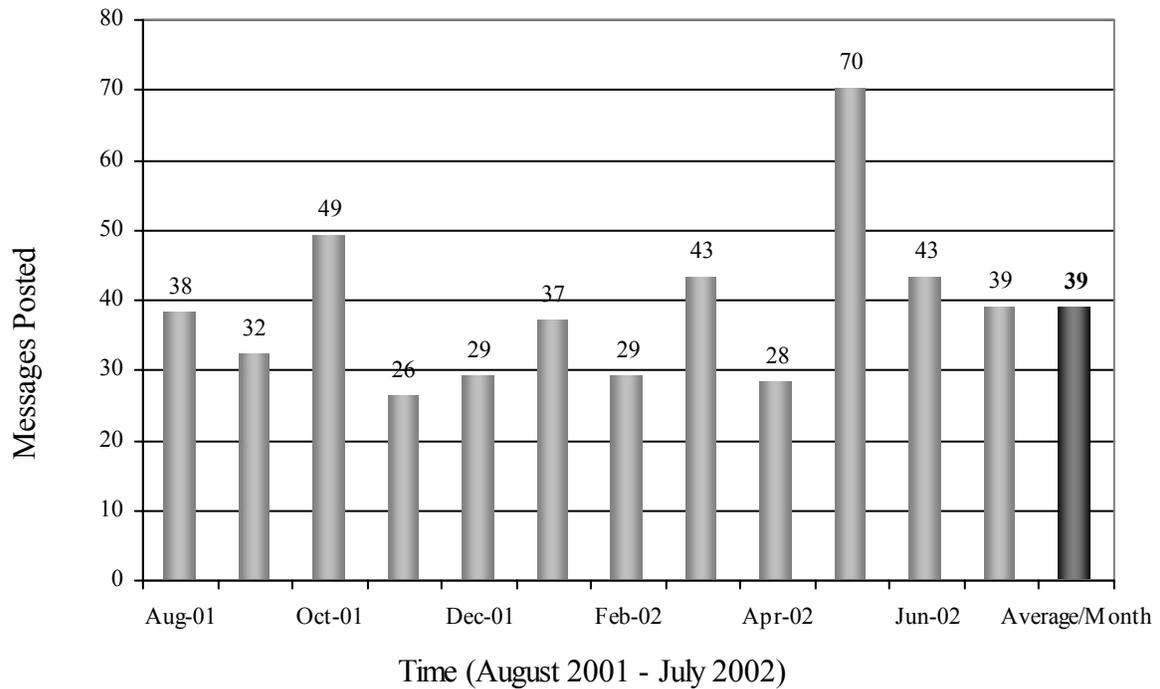


Figure 5. Number of Monthly Messages Posted to Enviro-News, August 2001-July 2002.

Postings typically cover:

- notices of upcoming conferences and calls for papers
- announcements of funding and employment opportunities
- links to online newspaper articles
- information about new World-Wide-Web resources
- press releases from environmental agencies and organizations

Enviro-News is not intended to be a discussion forum, nor a medium to pose questions or request information, nor for posting political or commercial announcements. Table 1 shows the titles of representative messages posted during July 2002. Access the list archive through the URL below to see additional postings.

Table 1. Titles, Size and Dates/Times of Selected Messages Posted to Enviro-News in July 2002.

<p>1. USGS Measures the Response of the Rodeo/Chediski Burn to the First Monsoon Rains (117 lines) Date: Fri, 26 Jul 2002 10:27:16 -0400</p> <p>2. Still Time to Register for StormCon, The Surface Water Quality Conference & Exposition (71 lines) Date: Thu, 25 Jul 2002 13:45:38 -0400</p> <p>3. EPA and World Summit on Sustainable Development (89 lines) Date: Thu, 25 Jul 2002 11:30:22 -0400</p> <p>4. EPA WILL HELP LOCAL GOVERNMENTS MEET ENVIRONMENTAL GOALS (114 lines) Date: Wed, 24 Jul 2002 16:45:44 -0400</p> <p>5. USDA PROVIDES WILDLIFE HABITAT RECOVERY HELP FOR LANDS DAMAGED BY DROUGHT AND FIRE (68 lines) Date: Wed, 24 Jul 2002 16:38:15 -0400</p> <p>6. New CAST Issue Paper: Animal Diet Modification to Decrease the Potential for Nitrogen and Phosphorus Pollution (117 lines) Date: Wed, 24 Jul 2002 15:51:26 -0400</p> <p>7. Position Vacancy: Education Associate or Specialist, Coachella Valley Water District (124 lines) Date: Wed, 24 Jul 2002 13:24:39 -0400</p> <p>8. INTERIOR SECRETARY NORTON PROPOSES BAN ON IMPORTATION OF SNAKEHEAD FISH (184 lines) Date: Wed, 24 Jul 2002 09:38:49 -0400</p> <p>9. ...Effluent Limitations Guidelines and Standards for Concentrated Animal Feeding Operations (1355 lines) Date: Tue, 23 Jul 2002 15:07:23 -0400</p>	<p>10. National Beach Guidance and Required Performance Criteria for Grants (163 lines) Date: Fri, 19 Jul 2002 14:02:07 -0400</p> <p>11. Glaciers Melting at Accelerated Pace -- A washingtonpost.com article (33 lines) Date: Thu, 18 Jul 2002 15:31:55 -0400</p> <p>12. 22 National Finalists Announced for International Junior Water Prize (137 lines) Date: Thu, 18 Jul 2002 12:04:33 +0200</p> <p>13. Agency Information Collection Activities: Proposed Collection; Comment Request; Clean Water Act Section 404 State-Assumed Programs (176 lines) Date: Tue, 16 Jul 2002 16:01:17 -0400</p> <p>14. U.S. and China to Fight Soil and Water Pollution (84 lines) Date: Mon, 15 Jul 2002 11:35:11 -0400</p> <p>15. Availability of Supplemental Allocation of Fiscal 2002 Operator Training Grants for Wastewater Security (75 lines) Date: Mon, 15 Jul 2002 10:27:24 -0400</p> <p>16. Call for Papers - SAGEEP 2003 (41 lines) Date: Wed, 3 Jul 2002 17:07:35 -0400</p> <p>17. New Issue of Electronic Green Journal (122 lines) Date: Wed, 3 Jul 2002 10:02:13 -0400</p> <p>18. New/Updated Congressional Research Service Reports Covering Water (28 lines) Date: Mon, 1 Jul 2002 12:08:03 -0400</p> <p>19. Water links on the UNESCO Water Portal N° 4 0 (128 lines) Date: Mon, 1 Jul 2002 09:42:20 -0400</p> <p>20. Comment Period Extended for Draft Water Quality Standards Strategy (66 lines) Date: Mon, 1 Jul 2002 09:28:53 -0400</p>
---	---

Enviro-News Software and Management

In March 2002, Enviro-News was migrated from the Majordomo software, which the library had been using, to Listserv software. Major enhancements due to this transition have been the availability of an online message archive and a Web-based interface for administration used by subscribers and the list owners. Interaction with the Majordomo software was solely via e-mail. Using e-mail to process commands is also possible with Listserv.

People can now subscribe to Enviro-News using the Web. Once subscribed, they can change subscription options, such as electing to receive messages in a digest version (instead of singly) and unsubscribe from the list. The software also archives all messages. The messages can be viewed on the Web in monthly lists or a search of the entire archive can be done in various ways, such as by author or title.

Since February 1999, due to an incident involving another NAL list, all subscriptions to NAL lists, including Enviro-News, must be approved by the respective list owners. A potential Enviro-News subscriber uses a short Web form to provide name, organizational affiliation and areas of interest. This information is e-mailed to the list owner who then uses another Web form (or an e-mail command) to add the subscriber to Enviro-News. The list software also sends e-mail notification to the list owner when problems are encountered sending messages to specific subscriber addresses. The list owner must monitor this mailbox and delete chronic problem addresses. The list owner is also frequently asked to subscribe and unsubscribe people and post messages for others, even though the requesters could accomplish these tasks themselves.

The Web page for Enviro-News, with subscription information and access to the archives, is www.nal.usda.gov/wqic/EN/enviro.html. Informal feedback received from Enviro-News subscribers has been positive. Subscribers find the service extremely valuable.

DATABASE OF ONLINE DOCUMENTS RELATED TO WATER AND AGRICULTURE

The Water Quality Information Center has been providing people with Web access to a prototype database of freely available, online publications related to water and agriculture since May 2000. The history of the database's development and a description of an earlier version is provided by Makuch and Gagnon (2000). The database contains bibliographic records, including URLs, of the publications of interest. The publications themselves reside on the servers of the organizations that produced them. The database is a way to provide a single point of access to freely available online publications related to water and agriculture that are produced by many organizations.

Criteria for inclusion of a document in the database include

- relevancy to water and agricultural issues
- freely available online
- contains substantial (4+ pages or equivalent) content
- topic of broad (not simply local) interest
- published by a known entity
- continued availability likely

The database currently contains 1,244 records. This is about double the number that was in the database in September 2000. Records are being continuously added and enhanced as resources permit. During the summer of 2002, center staff devoted substantial time to adding keywords from the NAL Agricultural Thesaurus to records in the database. This should greatly improve search results.

There is both an internal and Web version of the database. The internal version (the “working” database) uses ProCite software and is where all additions, deletions and changes are made. The fields in the database have been set up to conform to the Dublin Core standards (Dublin Core Metadata Initiative, 2002) and meet the needs of the Water Quality Information Center and its clients. Background on the center’s use of the Dublin Core for this database can be found in Gagnon and Makuch (2001).

A sample record is shown in Figure 6. To make the database available on the Web, we save the records as an ASCII text file, put it on the NAL server and then run Perl scripts that convert the file to consecutively numbered HTML files. These HTML files represent individual records in the database and can be searched using the search engine (Inktomi) on the NAL Web site.

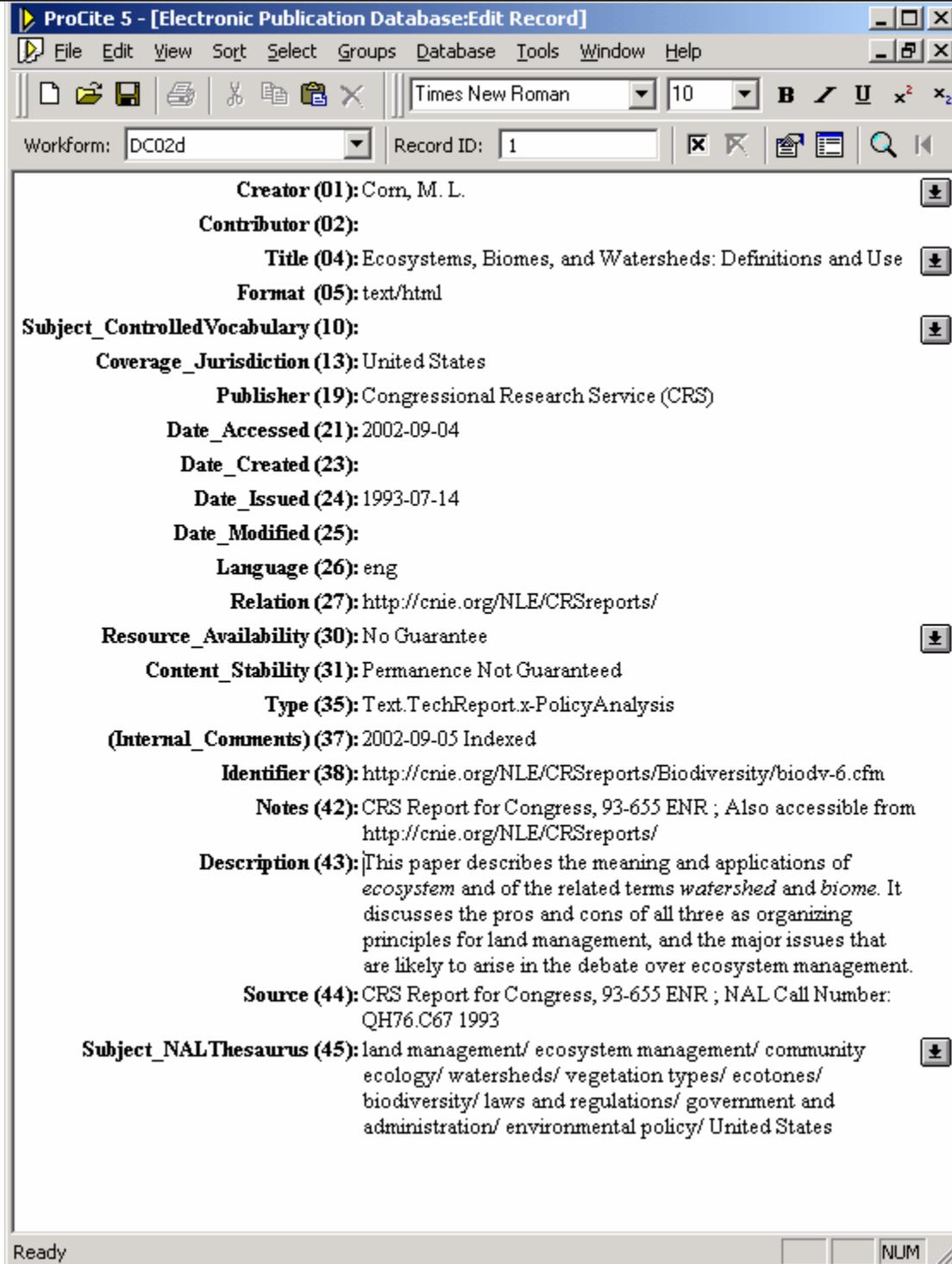


Figure 6. Example ProCite Record in Local Database.

The database search page (www.nal.usda.gov/wqic/wqdb/esearch.html) provides instructions on the various search options that are available. Figure 7 shows a sample record retrieved from the database with the URL providing a hyperlink to the actual document.

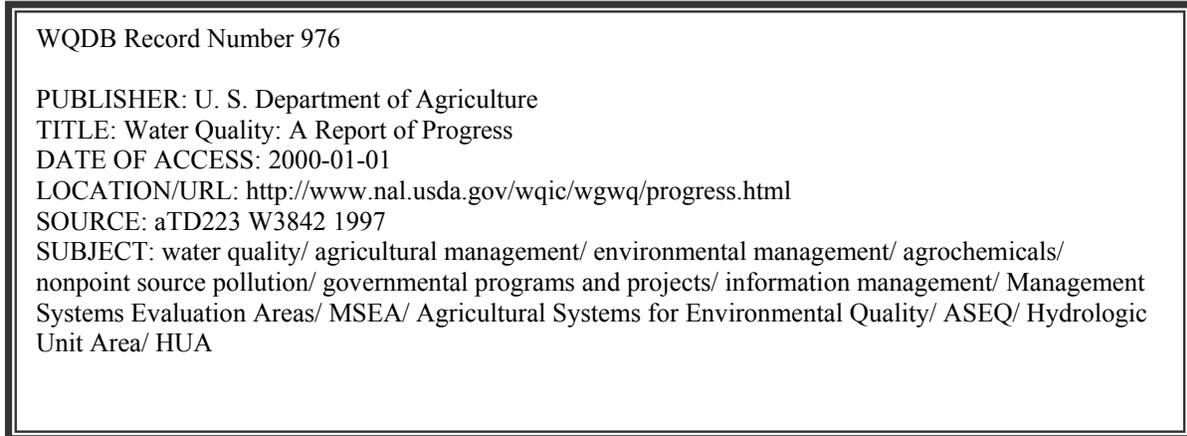


Figure 7. Example Record from Water Quality Information Center Online Database.

The database is one of the most utilized sections of the Water Quality Information Center Web site. For each month during the last year (August 2001-July 2002), the database search page has always been among the top ten Water Quality Information Center pages accessed. Plans are underway to improve the search interface and search capabilities by migrating to a MySQL database system. Since analyses of search term usage are possible using the Inktomi search engine, the Water Quality Information Center intends to utilize these capabilities. Several review articles are available on how people search the Web (Hsieh-Yee, 2001). The center is beginning to investigate how the Inktomi data can be analyzed and used to improve user's information retrieval.

CONNEXION

In the early 1970s, libraries adopted computer programs based upon card catalog systems to improve access to books on their shelves. Machine Readable Cataloging (MARC) is the standard framework used to describe books in libraries, also known as the library's *holdings*. A system of rules called Anglo-American Cataloging Rules (AACR2rev.) governs these descriptions, and has since card catalog days. These computer systems were created to help libraries share the work of describing and organizing published books and other traditional material. Now, with the availability of much more electronic information, these library systems have been enhanced to better describe, collect and provide better access to digital resources.

Connexion (www.oclc.org/connexion/) is the largest library-supported cataloging system for both traditional and electronic resources.

Connexion, developed and managed by OCLC (Online Computer Library Center), is essentially a system containing a very large database (over 40 million records) used by libraries for collecting, organizing and searching descriptive metadata, information much like searchable citations. Metadata describing electronic resources often link to full-text versions of those resources. Connexion helps a library process its material and improves user access to the electronic resources represented within the system. NAL participates in Connexion by submitting subject-related, evaluated resources to the shared database supported by over 40,000 libraries. Access by these libraries and their users increases the impact of resources identified by NAL librarians. Connexion becomes another storehouse of data that contains information and links to valuable material.

The Water Quality Information Center participated in an NAL Connexion (formerly known as the Cooperative Online Resource Catalog, or CORC) pilot project from June 2001 through August 2002. The impetus behind the project was a need to improve access to agriculture-related electronic resources. Connexion promotes participation from across the library, including from subject specialists who identify valuable, collectible resources during their research. NAL has been cataloging electronic resources since 1995. But with greater participation within a system that better manages electronic resources, significant increases in the number of electronic resources cataloged are expected with Connexion. Additionally, Connexion offers help with URL maintenance by identifying broken or re-directed links within the database.

Once created, Connexion records are added to the AGRICOLA database, NAL's online public access catalog and article abstract database. These records become searchable through this new source, just as they become available from the OCLC WorldCat database, an information product serving as the non-expert version of Connexion.

Since August 2001, the center has submitted more than four hundred items to the NAL Cataloging Branch through the Connexion pilot project. Example subjects include

- best management practices
- efficient water use
- environmental and agricultural policy
- hypoxia
- TMDLs
- watershed management

The major source of documents added to Connexion is the center's database of online documents covering water and agriculture. Throughout the process, every effort is made to ensure the value and permanence of resources for which records are submitted. A more complete description of the NAL pilot project can be found in Gagnon, Makuch and Davids (2002).

Connexion also provides a Web-based tool to build subject-specific bibliographies, or pathfinders, that can help users find database resources. The process of pathfinder-building uses simple forms and does not require any HTML experience. Since resources have been selected and evaluated prior to addition to Connexion, the quality of these cataloged electronic resources is high. Creators of pathfinders are free to include references to resources not in the Connexion database and in any format. During the pilot project, sample pathfinders were created using identified resources within the database. (See Figure 8.)

As resources permit, the center will continue to add records for online documents related to water and agriculture to AGRICOLA through the Connexion system.

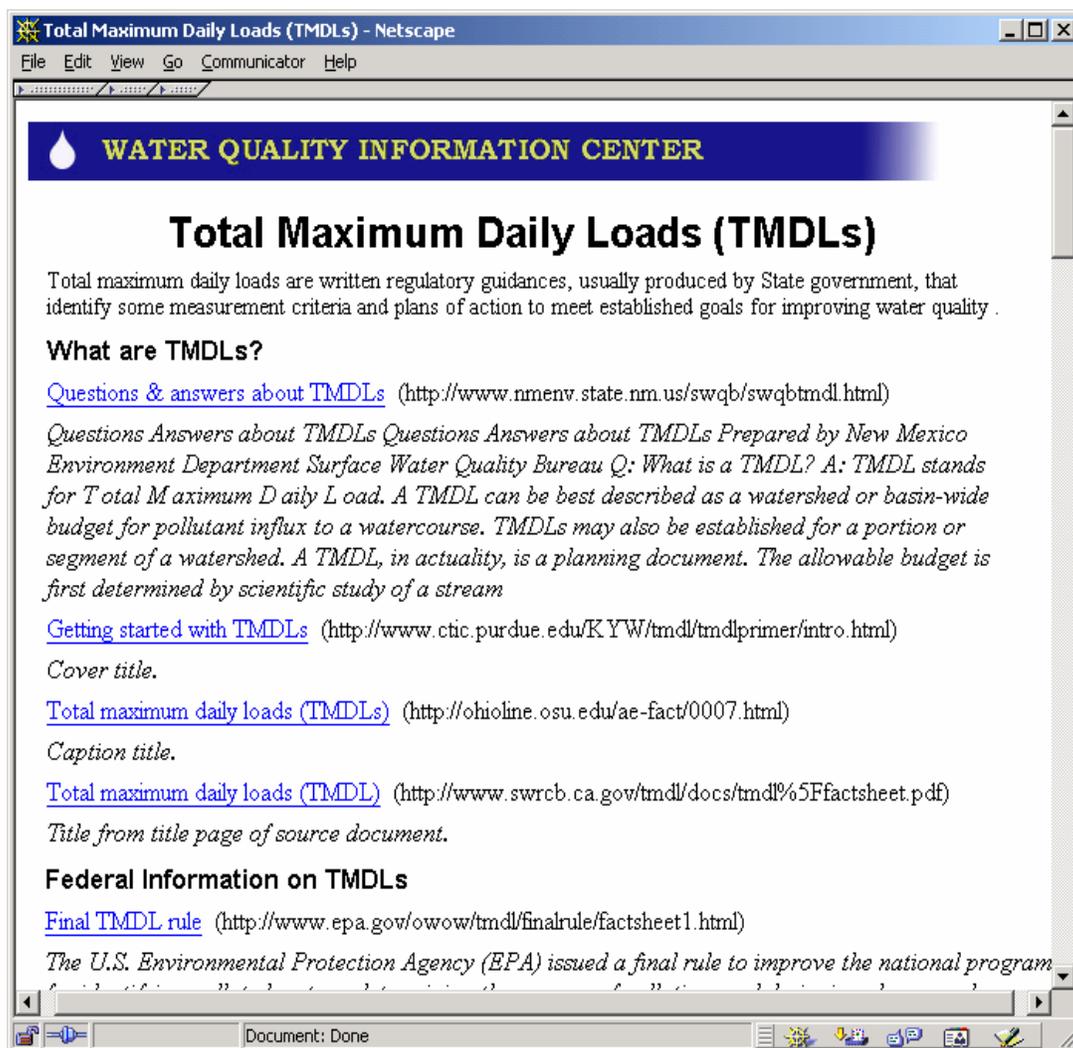


Figure 8. Top Portion of Web Page for a Pathfinder on TMDLs.

SUMMARY

The four systems discussed above are inter-related to each other and other systems internal and external to the Water Quality Information Center. Figure 9 illustrates these connections and inter-relationships. The goal of the center's information systems is to integrate multiple information sources covering water and agriculture for the purpose of providing users with various ways to efficiently locate and access desired information and to streamline workflow in the center. Interactions with users help determine the types of information the systems should provide. As in the past, the center's information systems will evolve to take advantage of technological advances and be structured to easily interface with complementary systems.

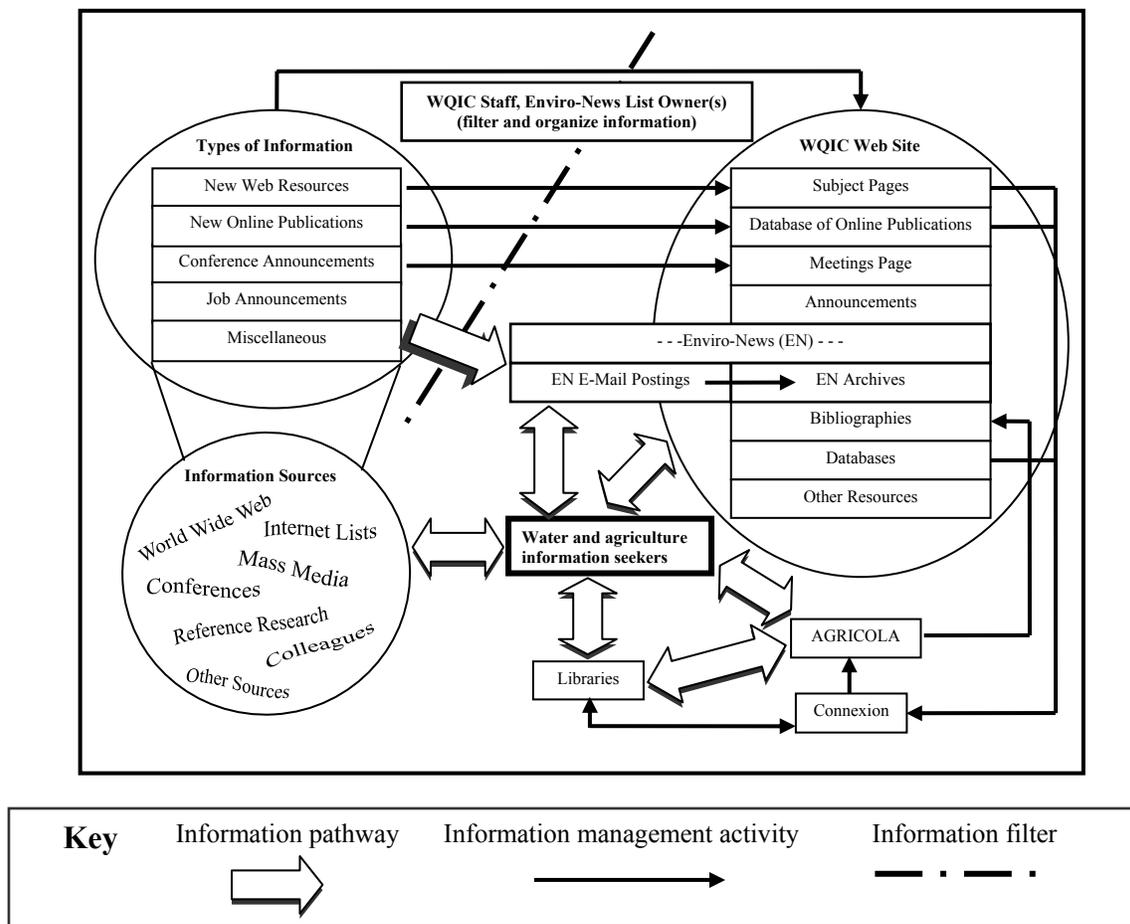


Figure 9. Inter-relationships of Information Systems Used by the Water Quality Information Center to Meet Needs of People Seeking Information on Water and Agriculture (2002).

REFERENCES

- Craven, T.C. 2001. Description Meta Tags in Pages Returned on Different Search Engines. *Canadian Journal of Information and Library Science*, v. 26 no. 1, pp. 1-17.
- Dublin Core Metadata Initiative. 2002. Dublin Core Metadata Initiative (DCMI) [Online]. Available: <http://www.dublincore.org/> [2002, September 16].
- Gagnon, S.R. and Makuch, J.R. 2001. Lessons Learned Associating and Developing Specialized Terminology Schema for a Web Database at the National Agricultural Library. Collected Presentations—2001, pp. 64-71. Papers Presented at the 16th Annual Meeting, Computers in Libraries, March 14-16, 2001, Washington, D.C. Westport, Connecticut: Meckler.
- Gagnon, S.R., Makuch, J.R. and Davids, S.L. 2002. Testing the CORC System as a Tool for Managing Agricultural Information. ASAE Meeting Paper No. 02-3094. Proceedings of the 2002 ASAE Annual International Meeting and the CIGR Congress in Chicago, Illinois. St. Joseph, Michigan: ASAE.
- Google. 2002. Google Searches More Sites More Quickly, Delivering the Most Relevant Results [Online]. Available: <http://www.google.com/technology/index.html> [2002, August 28].
- Hsieh-Yee, I. 2001. Research on Web Search Behavior. *Library and Information Science Research*, v. 23, no. 2, pp. 167-185.
- Makuch, J. R. 1995. Internet Access to Information on Water Quality and Agriculture. *Electronic Green Journal*, 2(2) [Online]. Available: <http://egj.lib.uidaho.edu/egj04/makuch01.html> [2002, September 16].
- Makuch, J. R. and Gagnon, S. R., 2000. The National Agricultural Library's Database of Online Documents Covering Water and Agriculture. Proceedings of the Third Water Information Summit, Supporting Sustainable Water Resources --- Management Through Information Distribution, in Miami, Florida. Palm Beach Gardens, Florida: WaterWeb Consortium.
- Makuch, J. R. and Hamilton, E. P. 1999. Improving Access to Water and Agriculture Publications on the World Wide Web [Online]. Symposium on Water Resources and the World Wide Web. December 5-9, 1999, Seattle, Washington. American Water Resources Association: Middleburg, Virginia. Available: <http://www.awra.org/proceedings/www99/w09/index.htm> [2002, September 16].
- Makuch, J. R. and Schneider, K. R. 1993. The Water Information Network (WIN): What's on It for You? In Heatwole, C. D., (Ed.), *Application of Advanced Information Technologies: Effective Management of Natural Resources*, pp. 84-88. Proceedings of the 18-19 June 1993 Conference, Spokane, Washington. St. Joseph, Michigan: American Society of Agricultural Engineers.

Disclaimer: The use of trade, firm, or corporation names in this paper is for the information and convenience of the reader. Such use does not constitute an official endorsement or approval by the United States Department of Agriculture, Agricultural Research Service, National Agricultural Library of any product or service to the exclusion of others that may be suitable.

Submitted September 30, 2002.