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# River Voices

# The Power of Maps

By Melinda Laituri

Maps are powerful tools for communication. This power is enhanced by new technologies, which are changing the very nature of maps. Increasingly, maps can be viewed as dynamic entities that can be queried interactively. The wide availability of new software programs allows greater accessibility to map-making by a broad range of people.

## History of Map-making

Maps utilize representation and symbols to convey aspects of the real world. New and different types of maps have been created in response to new ideas about the world or due to technical advances. For example, Erastosthenes, a Greek astronomer, used geometry to calculate the circumference of the earth, introducing new methods to determine shapes and surfaces. The Age of Exploration ushered in a period of map-making, creating maps that were both artistic products and general reference maps for identifying places. The Enlightenment and the Scientific Revolution produced maps that classified and defined space, introducing thematic and choropleth (i.e., population density) maps that depict patterns of distribution. New methods and theories, such as cartographic modeling and ecological perspectives, influence the types of maps we make. Increasingly, maps are treated as dynamic entities which utilize real-time data to create models to weight the importance of environmental phenomena, to assess land suitability and to address sustainability strategies.

## Technology and Maps

Advances in technology have had a profound influence on the types of maps we construct and the uses we have for such products. Map design, data selection and collection, the production and reproduction of maps, are all influenced by technology. Early maps were constructed using a variety of mediums—brushes, quills, stylus on papyrus, silk and parchment. Magnetic technology allowed for the development of the compass, which navigators and surveyors found particularly useful for measuring angles and determining directions. Mechanical technology, in the form of engraving machines and engine-driven presses, allowed for increased map production and accessibility of maps to a wider audience. Lens grinding processes have increased map accuracy by enhancing human vision through telescopic sighting instruments and magnifying lenses. Advances in laser technology have improved data storage and retrieval through the use of CD-ROMs. Photography has influenced data collection, map compilation, production and reproduction. Enlargement and reduction techniques were greatly modified and simplified through both photography and lithography.

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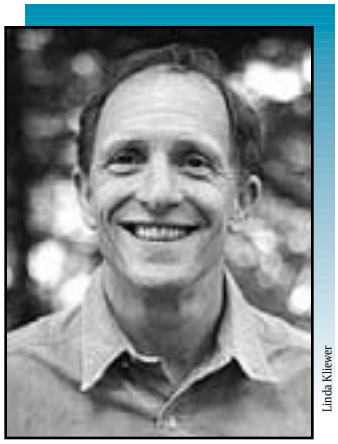
*River Network is a national organization whose mission is to help people understand, protect and restore rivers and their watersheds.*

# From the President


Linda Kliewer

## The Mapping Revolution

All species tend to expend their range until they bump up against the edges of the habitat that supports their needs. Among mammals, none approach the expansion success of Homo sapiens. Surely, no other life form comes near us for the exfoliating variety of adaptation strategies we have developed. Through them, we inhabit nearly every terrestrial ecosystem type, and dominate most of them.

Mapping must have been one of the earliest adaptation technologies humans developed. Sticks or fingers probably drew the earliest maps in dirt. The water hole is there, over the second ridge. We saw the game moving in this direction. At some time, some ancient cartographer developed the concept of including unknown regions on maps. For many centuries cartography advanced by progressively filling in the blank spaces at increasingly fine levels of resolution. For many, filling in the blank spaces was preparatory to occupying them.

Today, there are no more blank spaces, but the ramifications and importance of mapping continue to grow. All over the world, indigenous peoples are mapping their cultural and subsistence sites as a step toward gaining protection for them. Thus, today, mapping not only reflects, but can be used to help drive management decisions.

Urban governments map the hidden conduits that send services around the city. Neighbors map boundaries. More and more elements of society are participating in mapping ecosystems and watersheds as functional management areas.

Geographic Information Systems have invested mapping with new power by enabling us to map our increasingly complex and detailed knowledge about the world. We can compare such attributes as slope, soil type, management regime and erosion, and can use those layers of information to compare relationships between erosion and fish population trends on similar streams with different management regimes. The permutations of combining layers of information are nearly endless, and in this area we are still learning.

Grassroots groups can't afford to be left out of the revolution in mapping. Ultimately, you can't talk about or plan for watersheds without including cartographic information in the discussion. This is a set of conversations from which none of us can afford to be excluded.

# The Power of Maps, cont.

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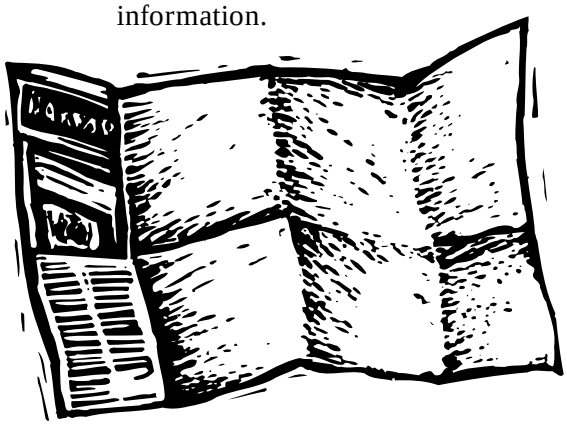
In less than 50 years, the new process of computer-assisted mapping has been invented and implemented. The analog map (two-dimensional map) is being replaced by the digital file or record in which all locations and characteristics are coded in a binary system. This technology is influencing how people think about maps, how data is collected and compiled, and how maps are produced and reproduced. The conventional graphic map is no longer the only product to be generated in the cartographic process. Geographic Information Systems (GIS) are complex databases that not only store data and create graphic outputs, but also allow analysis of spatially explicit data to create new information.



## Fundamental cartographic concepts

While all of these technical advances have changed map production, none of the fundamental concepts of map-making have changed. In effect, these changes simply create the old map in new forms.

The fundamental concepts of cartography include:

- scale (what shall be seen and what shall not be seen)
- projection (what shall be distorted)
- legend (what is being mapped)
- symbolization (what story is told)

All of these cartographic concepts are employed in making a map. In addition, all maps should contain these additional map elements:

- title (what is the map about)
- direction (how is the map oriented with regard to the earth)
- source (where did the data come from)
- date (how old is the information)
- author (who made the map)

## Underlying assumptions of maps

In constructing maps, we assume a certain level of commonality with regard to geographic reference points or coordinate systems. We assume the map is oriented in an established and accepted way: north is the top of the map and we reinforce this using a directional arrow. We recognize outlines of certain shapes to refer to such things as watersheds, states, countries or continents. We identify mapped elements based upon their color—water is blue. Also, we agree on fundamental symbolization where certain symbols refer to specific features: points are wells or cities, lines are rivers, roads or contours, and polygons are ecosystems or land uses.

Maps are composites of this world and are necessarily selective. We recognize that maps are simplifications of complex landscapes—representations of space and place that reflect our assumptions and biases. In fact, every map is as much about what is not represented as what is represented.

Generally, it is easier to determine the boundaries of human-made features because their extent tends to be discrete. The properties of natural features may not be easy to calculate because the boundaries defined by the map maker will always be

artificial. Exactly where does the forest end? Is the boundary of a lake the spring maximum or the fall minimum? Nature tends to be fuzzy, and maps are discrete. There is a fundamental disparity between the two.

Cartographic generalization is composed of the following:

- *simplification*: related to scale, involves omitting details that will clutter the map or confuse the reader,
- *classification*: reducing the information to a form that can be easily presented on a map,
- *induction*: the process whereby more information is represented on a map than is actually supplied by the original data. Information is inferred or interpolated based upon sampled data (i.e. contour maps, topographic maps, precipitation maps).

## Better Maps?

The question must be asked again: are we making better maps? More fundamentally, are we communicating better? To communicate complex ideas and compete in the contentious atmosphere of land use management decisions, it is necessary to utilize new tools: Geographic Information Systems, Global Positioning Systems & Remote Sensing. These new tools may lend legitimacy to alternative perspectives by creating a common language. However, are alternative perspectives truly represented? What happens to such intangibles as values, cultural perceptions about place or even language differences? Maps represent a reality that exceeds our vision and embody a point of view. Maps can be viewed as a moment in the decision-making process—they can help to visualize and solve problems. In this context, the map-maker assumes a significant responsibility. In addition, computer-based maps are powerful tools of persuasion. We need an educated citizenry that understands the pitfalls, problems and potential in the use of digital data and the outputs created.

*Melinda J. Laituri is an Associate Professor of Geography in the Earth Resources Department at Colorado State University. Her research interests include environmental justice issues, indigenous knowledge, natural resource management and geographic information systems.*

## TIPS FOR MAKING BETTER MAPS

- **Prepare maps based upon their final use:**
  - Large poster display, on-screen display, reproduction.
- **Don't work too large or too small.**
- **Start with a good base map.**
  - Register all your other information to this map.
- **Use standard symbols.**
- **Don't crowd.**
- **Use maps to make a point.**
- **Beware of bad reproduction.**
- **Take advantage of the printing process:**
  - Compare your on-screen display with printed maps.
  - Colors and patterns often appear different on paper.
- **Observe lettering conventions:**
  - i.e. italicized fonts are used for water bodies.
- **Watch your choice of color and patterns:**
  - Think about your audience.
  - Intensity, hue and tone are linked to preferences based upon culture, gender and age.
- **Question the value of a thematic map.**
- **Think about your data classes.**
  - Do they make sense? Are you comparing appropriate types of data?
- **Beware of software defaults!!**
  - Software defaults are not designed for the product you have in mind, they are designed to sell the software. Be sure to create maps that reflect your needs.

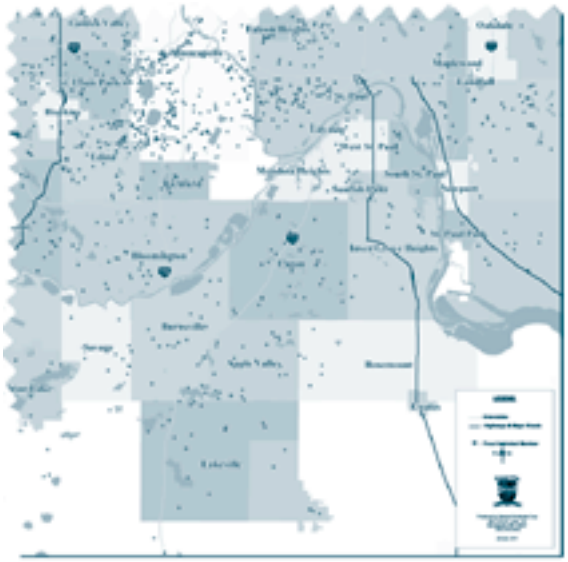
CASE STUDY:

# Mapping Your Membership

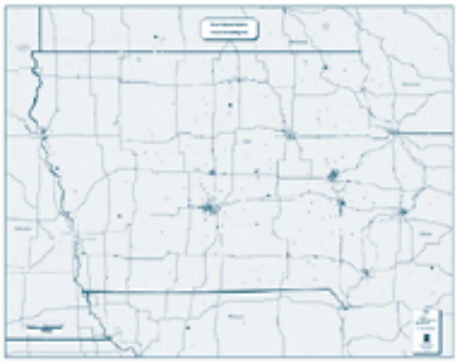
by Elliot Olsen

Membership lists are helpful, but they do not let you analyze the spatial relationships that exist between your members and their geographic, political and economic environments. At the Minnesota Council of Trout Unlimited, we have found that maps of members can help reduce wasted volunteer effort, so important to our group without paid staff. We have used maps to help plan outreach into an adjoining state with no Council, to cluster names for member solicitation, to match members with legislators, to match members with adjacent environmental threats and to look for gaps in membership. And, we are presently gathering data to map projected population growth near trout streams to help anticipate and predict future threats.

Maps display data as a point, a line or an enclosed area such as a circle or rectangle. Point data includes locations such as a church or a TU member. Line data includes roads, boundaries and rivers. Enclosed areas include political divisions such as counties, cities, wards and districts or zip codes. These areas can be colored to identify them or to show features such as population growth or average age.



One of our first mapping projects was a simple one. We wanted to look at the location of TU members in Iowa to help plan some meetings. The first step was get the geographic location of our members. We matched the member's address with a Census



Bureau street file named Tiger. Internet programs such as MAPQUEST can also provide a map of a single location or address. We use a "batch process," which allows us to run the whole membership list and then plot it on a commercial mapping package. The Iowa map is one of the first that we produced. We then did the same thing for Minnesota and the Twin Cities.

Our next project was in membership development. The Twin Cities Chapter purchased the list of names and addresses of trout stamp purchasers in the state. We had these records compared with our membership roster and purged current members from the list. This gave us a list of non-members who fish for trout. We then plotted and sorted them by calling or mailing area.

Once the new legislative districts are selected, we will sort our membership list by representative districts and group them for call lists.

The list of possibilities increases daily, and we anticipate that mapping will continue to grow as a tool for our organization.

*Eliott Olsen is the Chairman of the Minnesota Council of Trout Umlimited, a voluntary position. As a boy growing up in Illinois, he witnessed the mass die off of birds from DDT, the stinky beaches of Lake Michigan littered with dead alewife and the erosion of stream banks in Southwest Wisconsin and he has tried to make a difference.*

# GIS for River Groups

by Amy Haak

## What is GIS?

Geographic Information Systems, or GIS, may be easiest to describe in terms of what it is not. GIS is not a drafting program. It is not a graphics program. It is not a spreadsheet. So what is it? While a GIS can support many of the analytical and graphic functions found in these computer programs, what makes a GIS unique is that these functions have a spatial, or geographic, component to them. Any feature that can be mapped can be put into a GIS, and any data associated with that feature can also be put into the GIS to support analytical functions.

The inter-actions between different features can be evaluated based on their geographic relationship. For example, erosion prone areas within a watershed can be identified by looking at the spatial relationship between soil type, land cover/land use, and topography. Simply stated, steep areas with erosive soils that have been logged are going to have a greater risk for surface erosion than flat areas with trees. Being able to apply this type of analysis across large geographic regions with multiple layers of data can be a powerful tool for conservation groups that can be used in a variety of ways.

## How can groups benefit from GIS?

One of the greatest benefits to an organization from a GIS is developing a better understanding of the physical and biological conditions and influences on the resource of concern. A comprehensive GIS, built on credible data with defensible analyses, will provide a conservation group with an effective means of evaluating and communicating complex inter-relationships affecting the resource or region of interest. This improved understanding can be used to focus organizing strategies and provide a solid basis for evaluation of proposed policies and actions. The results of these analyses, portrayed in well-done maps (often used in conjunction with photographs), can be used to tell a story in an understandable manner to a non-technical audience that may consist of politicians, judges, the media or the general public.

The results of GIS analyses can help to build the credibility of an organization in the public process by enabling you to quantitatively show the gaps that often exist between science and policy.

For example, Conservation Geography recently completed an evaluation of proposed forest plans for the Boise-Payette-Sawtooth National Forests in southern Idaho. These forests are characterized by steep erosive slopes and contain a number of water-quality-limited stream segments. While the activists reviewing the plans intuitively know that erosion and sedimentation are significant issues across many of the forest watersheds, it was difficult to evaluate the site-specific management prescriptions being proposed relative to these water quality concerns. In order to help with this review, a GIS was developed for the three forests which contained data on topography, water quality, road network, land type, fire history, vegetative cover, and existing and proposed management prescriptions.

A detailed analysis was performed across the three forests that identified undisturbed areas with low to high erosion sensitivity index as well as disturbed areas with low to

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## KEEPING IT IN PERSPECTIVE

*by Angie Reed*

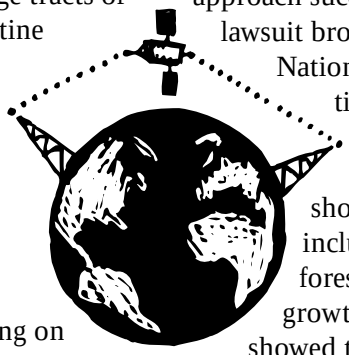
*It is important to remember that map perspectives are often incomplete. This is especially true of the Native people that call this place "home," and did so long before it was "mapped" and "named." Each of the many different Native cultures are intimately connected with and defined by the place to which they belong, and their way of life and oral history have made maps, as we are discussing them, unnecessary.*

*Knowing people that are so defined by the land helps me to remember that the watershed perspective is nothing new. It also heightens my sense of the impact of artificial political boundaries.*

*The process of making and sharing watershed maps has nurtured and changed my own sense of place on the ground an in the web of inter-connections that is life. Perhaps, if maps could get us all back to that perspective, we would no longer need them.*

*EXCERPTED FROM "NURTURING YOUR SENSE OF PLACE: USING MAPS AS TOOLS FOR SEEING DIFFERENT PERSPECTIVES" BY ANGIE REED. THE ARTICLE IN ITS ENTIRETY IS AVAILABLE ON RIVER NETWORK'S WEB PAGE: WWW.RIVERNETWORK.ORG.*

high erosion sensitivity index. These areas were evaluated relative to the management recommendations. Interestingly it was found that the heavily disturbed highly erosive areas with water quality limited streams, were NOT the targets for proposed watershed restoration work, but rather were recommended for more commercial logging, while the restoration work was focused on the undisturbed erosive watersheds. When we looked a little further we found that the areas targeted for 'restoration' (which permits logging and road building) also contained large tracts of relatively pristine ponderosa pine stands.



This GIS analysis was extremely useful to the conservation groups working on the project since it helped identify their strongest arguments and enabled them to counter specific management recommendations with quantifiable data rather than more qualitative comments. Detailed maps of the analysis as well as supporting statistics were incorporated into the 40 pages of comments.

Results from a GIS may also be used to refine and enforce legal arguments. This is particularly powerful when data from the agency being challenged can be used to show the inconsistencies in their own actions. By using their data, the argument over 'advocacy science' is eliminated and the discussion is focused on the proposed actions rather than the validity of the data. In general, resource agencies today are collecting fairly credible inventory data. The problems tend to arise when they allow politics and 'business as usual' to drive the decision-making process and control the parameters used in evaluation and manipulation of their resource data. By going back to their original inventory data, it is often possible to demonstrate that their actions can not be justified based on their own resource information and governing mandates.

Conservation Geography used this approach successfully in support of a lawsuit brought against the Clearwater National Forest over an old growth timber sale. Using the forest's own data and aerial photography, we were able to show that the forest service was including clearcuts and non-forested lands as part of their old growth inventory. The analysis showed that they were not meeting the forest's requirement for 10% old growth retention, thus any additional old growth logging was a clear violation of their forest plan. Two declarations were generated that described every step of the analysis and large format maps were produced for the courtroom. The judge remanded the sale.

In another case related to stream diversions in the upper Salmon River basin that kill endangered fish species, Conservation

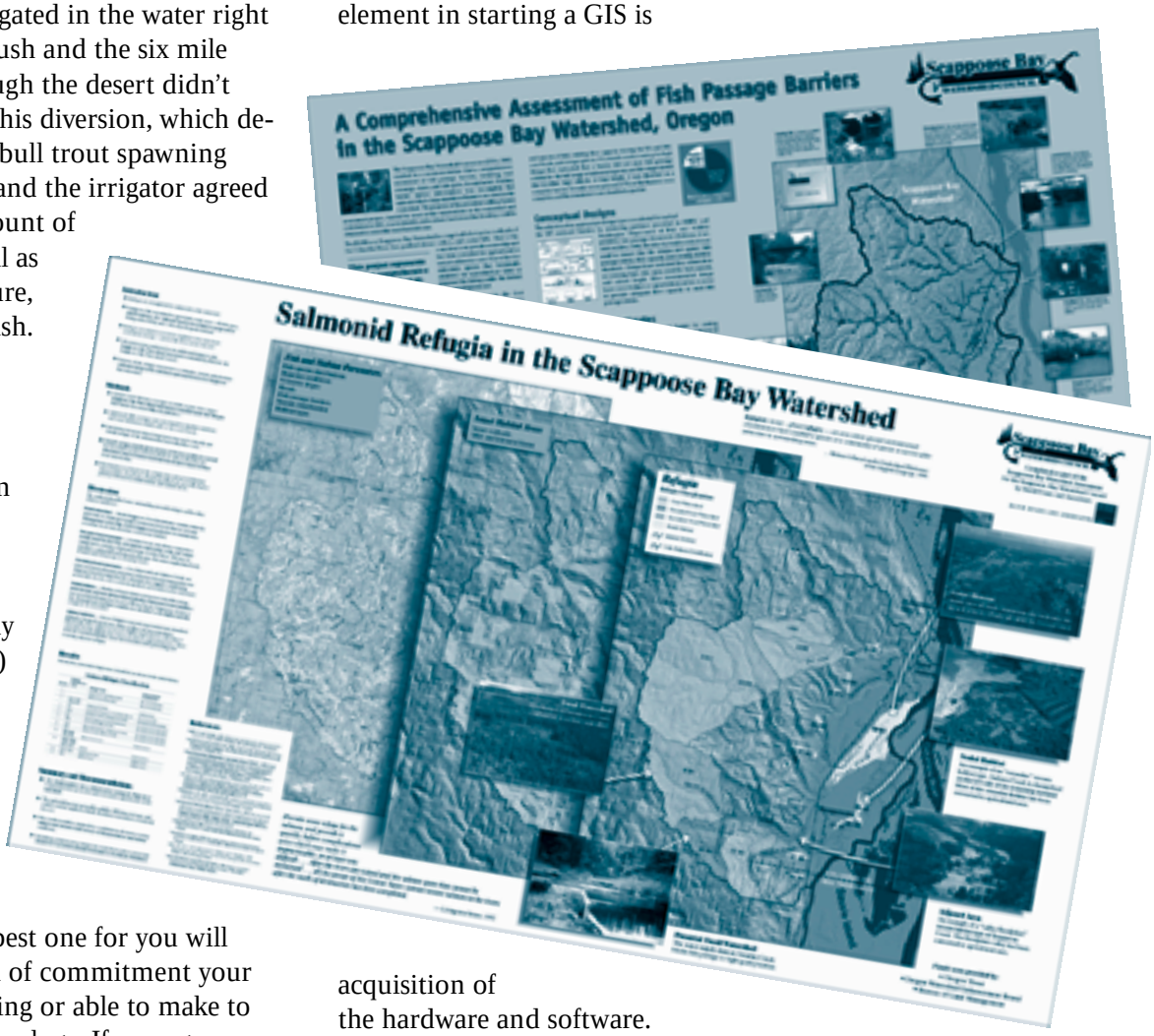
Geography was able to show with satellite imagery and aerial photography that a diversion claimed for irrigation purposes was really being used to water livestock. The land claimed as irrigated in the water right was actually sagebrush and the six mile ditch that ran through the desert didn't irrigate anything. This diversion, which dewatered important bull trout spawning habitat, was illegal and the irrigator agreed to decrease the amount of the diversion as well as improve the structure, making it safe for fish.

## How can groups access GIS?

If your conservation group wishes to integrate GIS analyses into your work, you essentially have two choices: 1) develop the capability internally or 2) work with a GIS service provider. There are pros and cons to each approach, and the best one for you will depend on the level of commitment your organization is willing or able to make to developing the technology. If your group wants the scientific analyses and information provided by a GIS but doesn't want to expand the organization to accommodate a new department, then developing a relationship with a service provider is probably the best option.

There are numerous for-profit GIS consulting businesses located across the country, as well as some nonprofit GIS service providers, such as Conservation Geography.

If an organization wants to make the commitment to developing its own GIS capability, it needs to consider a number of issues. The simplest and probably cheapest element in starting a GIS is acquisition of the hardware and software. Although purchasing a powerful computer and the necessary peripheral devices is not a trivial expense, programs such as the Conservation Technology Support Program provide hardware and software grants to conservation groups. If your organization can demonstrate that it has the resources and commitment to develop an in-house GIS capability, you have a good chance of being granted at least a simple hardware and software configuration.




These maps were prepared as projects for the Scappoose Bay Watershed Council by David Evans and Associates, Inc. (Peter Bahls, Project Manager)

However, having hardware and software on-

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site does not constitute a functional GIS program. The most critical component in the system is qualified personnel. If your organization is unwilling or unable to invest in an experienced GIS analyst, you should seriously reconsider your interest in developing in-house GIS capability. In order to realize the full potential of an integrated GIS program, the operator needs to know not only how to run the software, but should also understand issues related to data integrity, data structure and how to design and implement effective spatial analyses. Without this level of understanding, you may never get more than very expensive maps of baseline information from your GIS.

The final element of the GIS is the data. It has been said that today's society is data rich and information poor. GIS can help you turn the vast quantities of data being produced by public agencies into usable information to help guide policy development and management actions. There are numerous sources of data on a variety of subjects. A great deal of statewide and regional data can be downloaded directly from the internet. More detailed information can often be obtained directly from a specific agency through a Freedom of Information Act request. The challenge comes in integrating these data sets, being able to separate the good data from the bad and determining what is an appropriate use for any given data element. Taking data that was developed for regional or national planning purposes and applying it to a detailed watershed analysis will produce inaccurate and inconsistent results.

## Investing in GIS

One of the most important things to consider when integrating GIS work into any program is that the bulk of the cost of a GIS is at the front end. The power of a GIS comes from its data-driven analytical capabilities and the single greatest expense is the compilation of appropriate data into a versatile and effective application. Once the data has been compiled, running different analyses, what-if scenarios, generating maps, statistics, etc. is relatively inexpensive. However, if a GIS system is only used for making a map, it will be the most expensive map a group has ever paid for since even the simplest map requires real data. The value of a GIS is in the long-term development of a comprehensive information system and database for your area of interest that you can build on over time as resource conditions change and new information becomes available. Whether this is done internally or through a relationship with a GIS service provider, it is important to view this as a long-term investment that will increase in value and decrease in unit cost every time you use it.

*Amy Haak is the founder and Executive Director of Conservation Geography and a partner in Spatial Dynamics, a GIS consulting firm. She is on the board of directors for Idaho Rivers United and the Idaho Conservation League and is working on a PhD in watershed-based risk assessment in Guatemala.*

## ABOUT CONSERVATION GEOGRAPHY

Conservation Geography is a Boise, Idaho-based nonprofit organization that was founded solely for the purpose of providing GIS expertise to the conservation community.

Conservation Geography's work is done by GIS professionals, and it maintains a state-of-the-art hardware and software system with over 100 gygabytes of resource-based data, primarily for Idaho and the Intermountain West.

While Conservation Geography primarily works with the Idaho conservation community, it has supported large projects around the west for various non-Idaho based organizations.

Conservation Geography is funded through a combination of foundation grants and subsidized fees from the groups it supports.

CASE STUDY:

# Mendenhall Watershed Partnership

by Cheryl VanDyke

The Mendenhall Watershed Partnership in Juneau, Alaska is a volunteer citizens' group working to enhance the environmental quality and economic vitality of the Mendenhall Watershed. The Partnership has frequently used GIS to map land use and environmental information for the Mendenhall Valley Watershed.

Because the valley was formed by a receding glacier, the landscape and geologic forms are continually changing. "Isostatic rebound" occurs when land compressed by a glacier slowly springs back to its pre-glacier elevation (much like a saturated sponge that has been squished.) Wetlands and estuarine zones are especially susceptible to changes from isostatic rebound, in addition to man-made influences.

Housing nearly half of Juneau's population of 30,000, the Mendenhall Watershed has seen intense development over the last century. Mapping current development, land ownership, land use plans, wetlands, salmon streams and tributaries has helped the watershed partnership to facilitate "smart growth" and plan restoration and educational projects. A database of water quality data created by interns from the University of Alaska Southeast will be linked to the map electronically. The map is made available to the public free on the Partnership's website: www.mendenhallwatershed.org.

Future plans for the Partnership's GIS maps include training volunteers to use hand-held GPS equipment to plot failing culverts, storm water outfalls, restoration sites and other points of interest in the watershed. The Partnership has also teamed with the City and Borough of Juneau to find funding for updated topography mapping of the watershed. More accurate topo maps will help the Partnership work with FEMA to improve floodplain maps of the watershed, reducing unnecessary flood insurance for some homeowners.


GIS mapping has been an inexpensive way for the Mendenhall Watershed Partnership to present a variety of information in a clear way. The Partnership considers it to be a wonderful tool so far, with limitless possibilities for the future.

***For more information about the Mendenhall Watershed Partnership, visit www.mendenhallwatershed.org, or write: P.O. Box 32559, Juneau, AK 99803.***

*Cheryl Van Dyke is the former Executive Director of the Mendenhall Watershed Partnership in Juneau, Alaska. She spends her free time seas kayaking and hiking.*

# Mapmaker, Mapmaker

## *Make Me a Map*

Maps are an amazingly efficient vehicle for storing and communicating complex information. And while technological developments have greatly impacted the manner in which maps are created and utilized—expensive and sophisticated technology are not the only means by which to produce maps. From planning a route to hike or canoe along a river to displaying sites of historical events or habitat loss, maps not only play a substantial role in everyday life, they also offer watershed groups a powerful tool with which to convey our message.

How are grassroots groups across the country incorporating maps into river conservation work? Here is a sampling of the creative ways in which maps are being used, along with some hints and strategies from your colleagues.

Compiled by Kathy Luscher

### Mount Desert Island Water Quality Coalition, ME

**Purpose:** *Community Awareness*

This map shows which storm drains were stenciled "Dump No Waste, Drains To Bay" by third graders (assisted by high school sophomores) in Bar Harbor, Maine. This is part of a community awareness campaign, to inform residents and visitors about storm water pollution. The digital data for the map came from College of the Atlantic's GIS (Geographic Information System). The map was produced in ArcView by individuals involved in the "Sophomores for Clean Shores" program at Mount Desert Island High School (MDIHS).

Dr. Jane Disney

## Hennepin Conservation District, MN


**Purpose:** *Stream Monitoring*

This map has been very popular with both the school groups we work with and the watershed districts and municipalities responsible for management decisions on these streams. The ratings categories—good, fair, and poor—were developed based on Hilsenhoff's Family Biotic Index scores for the sites in our program. The watershed boundaries were delineated from the legal parcel descriptions.

## Pure Water for Kansas

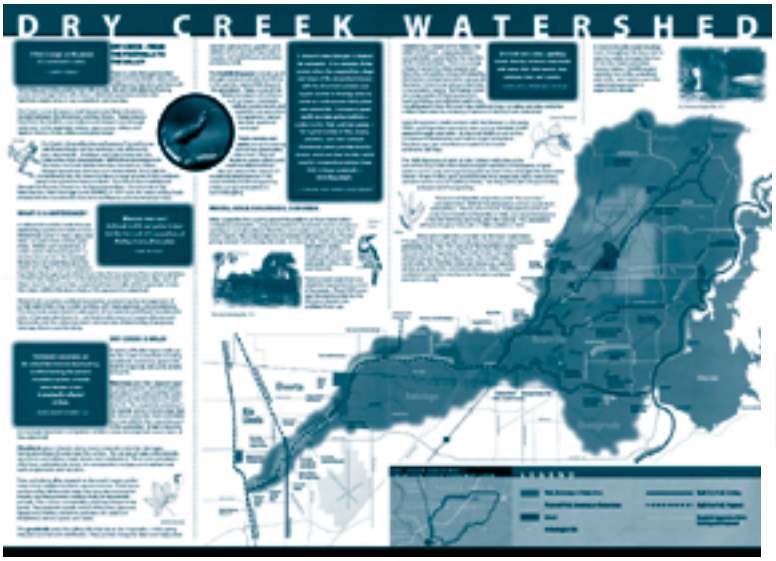
**Map Purpose:** *Watershed Perspective*

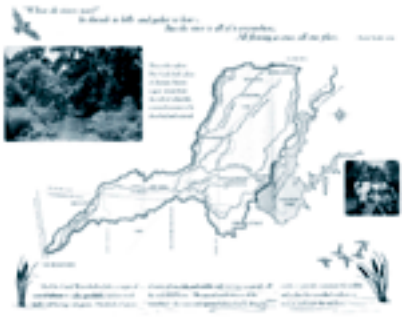
A Pure Water For Kansas partner in the Kansas City metro area created basin maps that wiped out the political boundaries between Kansas City, MO and Kansas City, KS. The map was as an effective tool for joining two, politically distinct states and cities in shared watersheds.

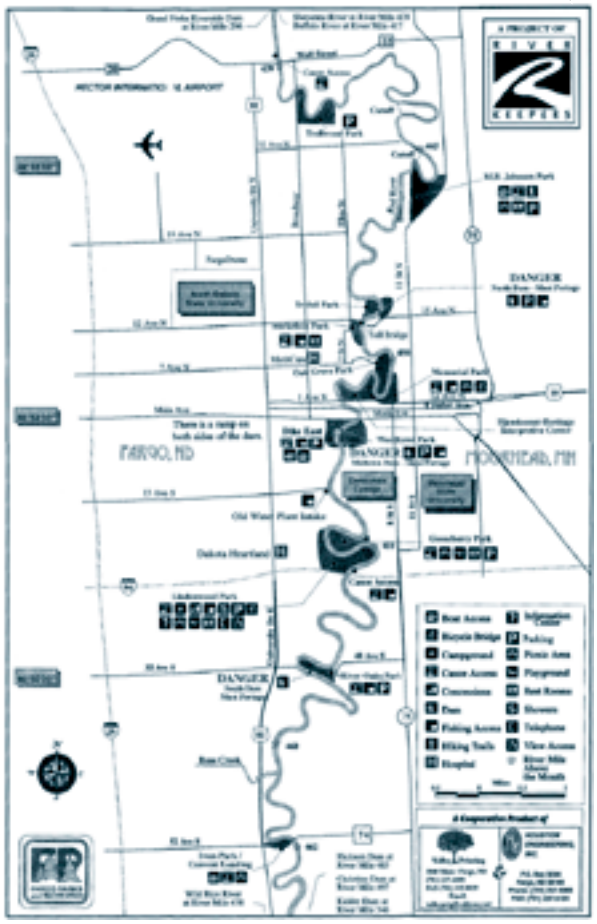
## Dry Creek Conservancy, CA

**Purpose:** *Greenway Promotion*

This map, created to help promote a greenway, is being used by all groups and agencies working on the greenway. It is also used to educate people to understand the watershed concept and the area and issues of the Dry Creek watershed. Because the notion of a watershed is somewhat abstract, the map is an ideal tool for communicating with the public. We use a smaller, less detailed version of the map in our membership brochure.






## River Keepers, ND

**Purpose:** *Canoe Guide*

We made this map as part of our mission to "advocate sustainable use of the Red River of the North." There was nothing available to give to people when they asked "where are the dams?", "where are the public access sites?" "where can I canoe?" etc.

Projects like this always seem to take more time than anticipated. We encountered numerous challenges during the creation of this map, including compiling and “ground-truthing” existing data. (Many existing maps are incorrect; be sure to verify everything.)

## Indian Law Resource Center, MT

**Purpose:** *Land Claims*

We have helped the Maya in Belize produce an entire book-length atlas to substantiate their land claims and environmental protection work. We have also begun mapping work on the Yukon with native tribes.

## Kentucky River Authority, KY

**Purpose:** *Watershed Assessment Report*

The assessment report and watershed rankings reflect data compiled during the watershed management cycle to date (1997-2000). The report includes data collected by state agencies and volunteers. This report is one of the principal ways that information compiled at the state and basin levels is provided to local Watershed Task Forces for use in planning.

The information is provided via an on-line map. Viewers can click on the relevant section of the watershed to see the data for a particular region—including volunteer data, agency data assessment, primary land uses and geographical information.


http://www.uky.edu/WaterResources/Watershed/KRB_AR/INDEX.htm

## The Charles River Conservancy, MA

**Purpose:** *Visioning*

We turned a map of the Charles River Basin Parkland into a poster. We started with an aerial view of Cambridge, Boston, Watertown and Newton in black and white. The poster measures 2 1/2 by 5 feet. Below the map we included quotes by Thoreau, Longfellow and Eliot, as well as a description of the Charles River Conservancy. We are about to go to print (off-set) with this artwork and then distribute it to schools, agencies and organizations with the support of corporations. The map poster will be mounted, ready to hang.


We made the image large scale so that every individual building along the basin parkland would be recognizable, thus enabling people who work or live along the route of the river to identify their location on the poster. We are seeking foundation and corporate funding to bring the mounted Parklands Map Poster, which we think presents a powerful message, into as many classrooms, corporate offices, environmental agencies, waiting areas and family rooms as possible. We view the poster as a conversation starter to stimulate people to talk about the Charles River and its Basin Parklands and how they would like to use them and see them restored.

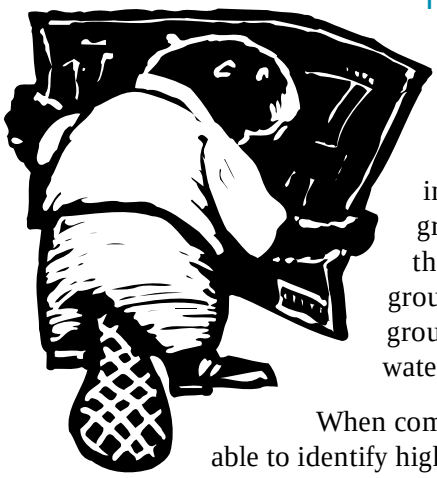
## Organization for the Assabet River, MA

**Purpose:** *Events Planning*

Our “non-technical” map shows a few put-ins along the Sudbury, Assabet and Concord Rivers with estimated boating times to encourage people to join us for a Solstice ceremony on June 21. We boated these stretches and timed ourselves to get the "data," a good excuse to get out on the rivers.

Dave Griffith for OAR; assabetriver.org

## Trees, Water & People, CO



**Purpose:** *Strategizing*

We are working to develop new layers for the recently completed NRCS map of Colorado watersheds including: a map of all the "activity areas" for watershed groups in Colorado (we anticipate adding in a click-through capability so you can click on any watershed group and see the underlying data about the watershed group and their projects) and a map of the high priority watersheds (defined by water quality needs).

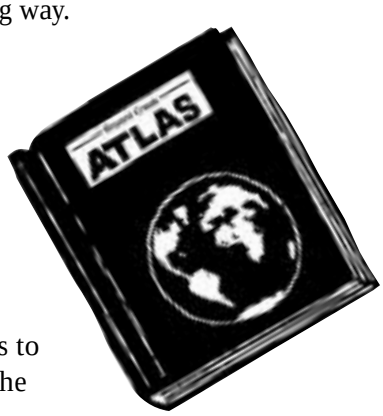
When completed, we will be able to identify high priority watersheds that have active watershed protection groups in them... and focus extra capacity building assistance to these areas. In those high priority areas where there are NO watershed groups active, we will be able to focus on helping new groups to start.

## Bryant Watershed Project, Inc., MO


**Purpose:** *Environmental Education*

We publish the online Bryant Creek Atlas at http://www.watersheds.org.

To get teachers and students to use the Atlas, we gave each teacher in all sixteen elementary, middle and high schools large maps of our watershed and small maps for each of their students. This familiarized teachers (and students) with the concept of watershed and the image of ours, introducing our project in a non-threatening way.




Now, after five years, we are working with enthusiastic teachers in their classrooms and computer labs. We start with computer "tours" of the watershed. Since knowing where you are is most important, we start out asking elementary and middle students to find where they live on one of the Atlas' online maps.


## Rock River Coalition, WI

**Purpose:** *Presentations*

We use a map constantly during presentations to Rotary Clubs, civic groups and governmental organizations. We use a small map of the Rock River Basin that is contained within our latest brochure. We have a 3,800 square mile river basin with 750,000 people living there. The map helps bring perspective to our audiences and lets each person find their own municipality. The map also helps tie us all together and shows our common bond or commonality, which is the Rock River.

## Meduxnekeag Watershed Coalition, ME

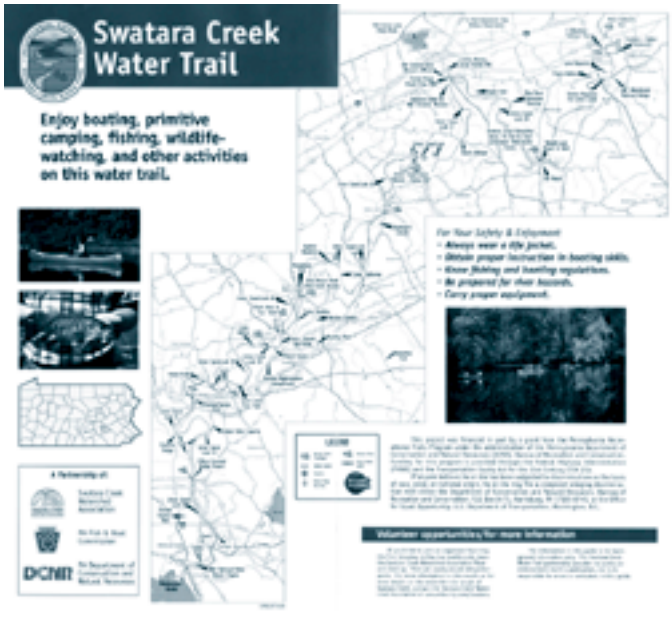
**Purpose:** *Education*

The Coalition printed placemats highlighting a map of the watershed and local river facts—which they then donated to area restaurants.

## Swatara Creek Watershed Association, PA

**Purpose:** *Water Trail*

After two years in the making, and as part of a collaborative effort, SCWA, the Pennsylvania Fish & Boat Commission and the state Department of Conservation and Natural Resources published a map identifying canoeists access points, dams, rapids and points of interest (descriptions of these points are on the back of the map). The maps are available free of charge to the public.



CASE STUDY:

# Mapping Your Watershed

by Dusti Faucher
President, Friends of the Presumpscot River

The 25-mile long Presumpscot River flows through the most populated cities in Southern Maine. Yet, it has largely gone unnoticed. Nine dams block all migratory fish species. Interstate 95 and several other commuter roads into Portland cross the river, but all most people remember about the Prescumpscot is the terrible smell from the pollution of the paper mill located upstream.


Today there is great potential to restore balance to this river. The pulp mill has closed, water quality is greatly improved on the river and the first dam is scheduled for removal. Five consecutive hydropower dams are before the Federal Energy Regulatory Commission (FERC) for relicensing. Friends of the Presumpscot River (FOPR), a local river advocacy organization is deep into the process of seeking selective dam removal and the installation of fish passage on these dams.

## Mapping the future

To grab the hearts and minds of the local people and to bring them to our cause, the board of FOPR brainstormed ideas. If we could present a tangible representation of our vision for the future and show how much it would resemble what existed in the past, we felt we could show the public and local officials that this river has value beyond hydropower production. We received a grant of $10,000 from the Davis Conservation Foundation to gather fisheries, habitat and natural resource economics information and to design and print a map.

Our initial thought was to produce a GIS map that would overlay the present river configuration, with all its impoundments and dams, onto a graphic representation of the historic river, before the dams were built. Our concept would include pictures or drawings of the species that are present today as well as those that are indigenous to the river, but have been wiped out because of the dams and the lack of fish passage.

Yet as the project progressed, the unexplored history and potential of the Presumpscot kept coming to the forefront in all our discussions. As we developed our case before FERC, new priorities emerged. We learned about important events that shaped the existing river and saw an opportunity to change the style of the map into a map/poster combination. The map would not only show the physical characteristics of the river, but its hidden past.

Our historical research for the FERC relicensing record also produced stories about a species of salmon that was thought to have existed only in the Presumpscot when it was a fast running river, silver with fish. The records show that Atlantic salmon, brook and sea run trout, shad, stripers, sturgeon, rainbow smelt and other fish once populated the river, where today we mostly see warm-water fish like bass and sunfish. All these species are shown on the map/poster as it depicts the story of the river.

## A Team Effort

Two volunteers worked tirelessly for a year to produce the final product. One FOPR board member, Michael Shaughnessy, a sculptor and art professor at the University of Southern Maine, involved other professors who volunteered to write narrative segments for the poster on the geology and native peoples of the region. Jack Barrett, a graphic designer, contributed his talents and helped put our ideas onto paper.

The map incorporated FOPR's Board members' knowledge of the river's characteristics such as river bottom, location of falls and rapids and the struggles that are taking place about river issues today. Our new vision became a map that would combine historical, cultural and physical elements. Dr. Michael Dadswell, a fisheries biologist, was engaged to assess the river's past, present and potential fishery; an analysis of the river bottom was also done for our FERC filings. We included summaries of the material we gathered concerning natural resource economics and fisheries. This truly was a collaboration of many people who sincerely believe in the restoration of the Presumpscot River.

## The Finished Product

In June, the public viewed proofs of the map at our river rally and our legislative informational event (area legislators were invited to hear our presentation and see our video of the river). There was very positive reaction to the design and the historic material.

In early July, 2000 newly-printed posters arrived at our office: 500 printed on heavy poster stock and 1500 on paper stock that can be easily rolled and mailed. The map portrays an unmistakable picture of the Presumpscot River. Its true nature shines through on the poster as a swift, clear, steep and rocky river that once was one of the best salmon rivers in Maine; one that today is heavily impacted by industrial development, but can thrive again as a resource for recreation and beauty for the people of Maine.

Many of the newly printed posters will be distributed through environmental educators to schools, some will go to FOPR's members and some will be given as a promotion vehicle to supporters and to organizations that will hang them in public view. Still others will be sold.


*CONTACT INFORMATION:*

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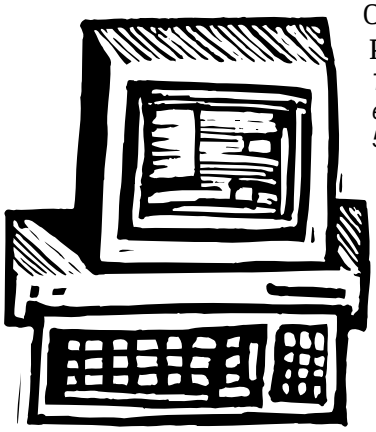
207/892-1472 • jbarrett@maine.rr.com

# Resources & References

## SOFTWARE, FUNDING, TRAINING AND CONSULTING

### Conservation Fund

*The Conservation Fund's GIS office, located in Chapel Hill, North Carolina, takes a broad-based approach to GIS, providing project and application development, training, technical support and strategic partnerships to community-based conservation efforts across the nation. Sponsors an online resource for conservation professionals: www.conservationGIS.com. Contact: Will Allen, GIS Director, The Conservation Fund, PO Box 271, Chapel Hill, NC 27514; Phone: 919/967-2223; Fax: 919/967-9702; E-mail: will@tcf.arcana.com*
*www.willallen.com*
*www.conservationfund.org/conservation/sustain/gis.html*



### Conservation Technology Support Program

*The CTSP annually awards grants of equipment plus software and training to 501(c)3 tax-exempt conservation organizations to build their Geographic Information Systems. To find out if a CTSP grant is right for you, complete the web-based CTSP planning tutorial for assistance in planning GIS work for your organization. Conservation Technology Support Program, 116 New Montgomery Street, Suite 500, San Francisco, CA 94105; Phone: 415/979-0474; E-mail: ctsp@ctsp.org. www.ctsp.org*

### Ecotrust

*Ecotrust is a nonprofit organization dedicated to supporting the emergence of a conservation economy along North America's rain forest West coast, the region from San Francisco to Anchorage. Ecotrust Consulting Initiatives provides community mapping, watershed restoration, conservation GIS training, GIS development and analysis, and more. Contact: Eileen Brady, 721 NW 9th Avenue, #200, Portland, OR 97209; Phone: 503/227-6225; E-mail: eci@ecotrust.org*
*www.ecotrust.org*

### Environmental Systems Research Institute (ESRI)

*ESRI is the leader of the GIS software industry, offering ArcInfo, ArcEditor, ArcView and ArcExplorer. In addition to software, ESRI provides publications, consultations, workshops, data and support. ESRI Environmental Services Consultants help people implement GIS tools and methodologies in assessing, monitoring and managing natural resources. Consultants can facilitate an entire project or support projects with software and methodology. The ESRI Conservation Program donates GIS software to conservation and environmental organizations. Grants are awarded all year. ESRI, 380 New York Street, Redlands, CA 92373-8100; Phone: 800/447-9778; www.esri.com; www.gis.com teaches all the basics of GIS.*
*ESRI Environmental Services: Peter Bottenberg; Phone: 909/793-2853, ext. 1-1249.*
*ESRI Conservation Program: Charles Convis, 909/793-2853.*
*ESRI's virtual campus: http://campus.esri.com.*
*Download ArcExplorer, a free data viewer: www.esri.com/software/arcexplorer/index.html.*
*ESRI Canada, 49 Gervais Drive,Toronto, ON M3C 1Y9; Phone: 416/441-6035 or 800/GIS-XPRT; E-mail: info@esricanada.com*

### GreenInfo Network

*GreenInfo Network brings the power of computer-based mapping to nonprofits, public agencies and other public interest organizations. GreenInfo provides access to GIS resources, supports groups who desire their own GIS and fosters collaboration around data and GIS projects. GreenInfo Network, 116 New Montgomery, Suite 500, San Francisco, CA 94105; Phone: 415/979-0343 x301; E-mail: info@greeninfo.org*
*www.greeninfo.org*

### Land Evaluation and Site Analysis (LESA)

*LESA is a ranking system adopted by Pennsylvania counties to prioritize potential farmland for the Agricultural Conservation Easements Purchase Program. LESA is a 2-part ranking system based on soil productivity and analysis of the potentials for development, farmland and clustering. LESA utilizes GIS technology to increase the efficiency and speed of calculating the rankings.*
*LESA, Rick Day, Land Analysis Lab, Department of Agronomy, 116 Agricultural Sciences Building, University Park, PA 16802; Phone: 814/863-1615; E-mail: r4d@psu.edu*
*www.gis.psu.edu/outreach/lesa*

### National Park Service Rivers & Trails

*The Rivers & Trails program staff has a great deal of expertise and experience with river and trail conservation mapping. Contact River & Trails DC office at 202/565-1200 for the office nearest you.*
*www.ncrc.nps.gov/rtca*

### Natural Resources Canada Center for Topographic Information

*Center for Topographic Information, Geomatics Canada, Natural Resources Canada, 615 Booth Street, Room 705, Ottawa Ontario, Canada K1A 0E9; Phone: 800/465-6277; E-mail: topo.maps@NRCan.gc.ca*

### NAUTILUS

*Northeast Applications of Usable Technology in Land Planning for Urban Sprawl (NAUTILUS) makes the power of remote sensing technology available, accessible and usable to land use planners and decision makers concerned about sprawl. NAUTILUS has land use/land cover maps and town-based watershed maps for Connecticut. In addition, they work nationally and have four study watersheds in New England that can be viewed on the Internet. Connecticut maps are sold at the Connecticut Department of Environmental Protection Book Store. NAUTILUS, University of Connecticut, College of Agriculture and Natural Resources, Haddam Extension Center, 1066 Saybrook Road, Box 70, Haddam, CT 06438; Phone: 860/345-4511; E-mail: NAUTILUS@canr.uconn.edu.*
*http://nemo.uconn.edu/nautilus.htm*
*Study watersheds on the Internet:*
*http://resac.uconn.edu/maps_data/index.html*
*Connecticut DEP: Phone: 806/424-3555.*

### Nonpoint Education for Municipal Officials

*The Nonpoint Education for Municipal Officials Project (NEMO) is an educational program for land use decision makers that integrates mapping and addresses the relationship of land use to natural resource protection. NEMO offers educational programs to municipalities in addressing such topics as the relationship between land use and water quality, approaches to natural resource protection, and how to reduce nonpoint source pollution from developed and/or developing areas. NEMO, Middlesex County Extension Center, 1066 Saybrook Road, Box 70, Haddam, CT 06438; Phone: 860/345-4511*
*http://nemo.uconn.edu/default.htm*

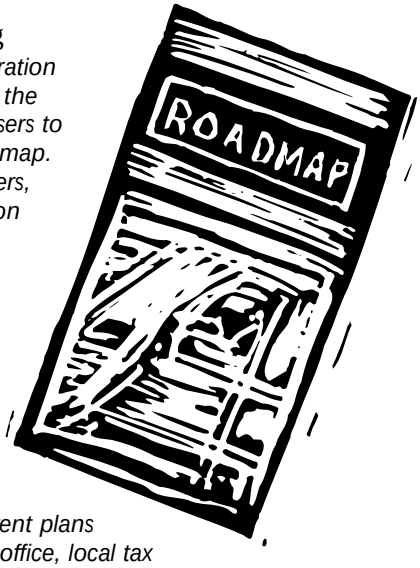
### The Nature Conservancy

*The Nature Conservancy's Geographic Information Systems website provides TNC staff and partners with GIS knowledge, systems, data, maps and community resources. Some sections of the site are restricted to registered users only.*
*www.gis.tnc.org*

### The Urban and Regional Information Systems Association (URISA)

*URISA is an interdisciplinary and international society of public and private sector professionals with a special interest in the effective application of information technologies and the integration of urban and regional data. URISA specializes in education through large-scale conferences, regional trainings and one-day intensive workshops. Urban and Regional Information Systems Association, 1460 Renaissance Drive, Suite 305, Park Ridge, IL 60068 USA; Phone: 847/824-6300; E-mail: info@urisa.org*
*www.urisa.org*

## MAPPING DATA




### BPA Environmental Mapping

*The Bonneville Power Administration oversees a mapping system for the Pacific Northwest that allows users to create their own user-specified map. Map themes include land owners, hydropower projects and salmon stock.*
*www.efw.bpa.gov/cgi-bin/E/MAPPING/MappingIntro*

### Your Local City or Town Hall

*Master plans, zoning bylaws, subdivision regulations and road specifications. Check with public works, transportation and parks and recreation departments for current plans and projects. Real property tax office, local tax assessors office, local planning or regional department.*

### Federal Emergency Management Agency

*Floodplain maps.*
*National Flood Insurance Program, 500 C Street, SW, Washington, DC 20472, 202/646-3445; 877/FEMA-MAP (877/336-2627).*
*www.fema.gov/mit/tsd/*

# Resources & References, continued

### Geo Community-GisDataDepot
*A depository of free GIS data for the environment and natural resources, including parkways and scenic rivers, National Wetlands Inventory data, USGS data and maps of dams, aquifers, mining sites and more.*
*www.gisdatadepot.com*

### LandView
*A collaborative project of the US EPA, US Census Bureau, USGS and NOAA.*
*LandView is a desktop mapping system that plots jurisdictional boundaries, detailed networks of roads, rivers, and railroads, census block group and tract polygons, schools, hospitals, churches, cemeteries, airports, dams, and other landmark features. Users may create their own maps using LandView themes.*
*http://landview.census.gov*

### National Geophysical Data Center
*The national repository for geophysical data provides a wide range of science data services and information for habitat and solid earth geophysics.*
*www.ngdc.noaa.gov*

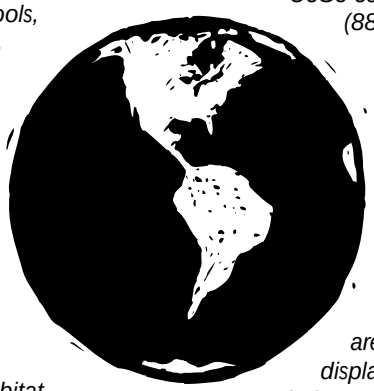
### National Spatial Data Infrastructure (NSDI)
*The NSDI has a data clearinghouse that allows access to over 250 spatial data servers, primarily using GIS technology.*
*www.fgdc.gov/nsdi/nsdi.html*

### Natural Resources Conservation Service
*Soil survey maps, soils reports and farmland soils. Watershed plans, river basin surveys and studies, and flood hazard analyses. Natural Resources Conservation Service, Headquarters Office, US Department of Agriculture, PO Box 2890, Washington, DC 20013, 202/720-4527. Cartography & Geospatial Center, 817/509-3420.*
*www.nrcs.usda.gov*

### US Fish and Wildlife Service
*Information about wetlands, endangered species and water courses.*
*USFS, US Department of the Interior, 4401 N. Fairfax Drive, Rm #180, Arlington, VA 22203.*
*www.fws.gov/data/gislist.html*

### Your State Department of the Environment
*Stream and river classifications and natural heritage information.*

### US Geological Survey: Map Distribution and National Hydrography Dataset (NHD)
*The US Geological Survey publishes topographic and thematic maps of all areas of the United States. Consult USGS publications for a complete list of resources. The NHD is a comprehensive set of digital spatial data that contains information about surface water features such as lakes, ponds, streams, rivers, springs and wells. USGS, Map Distribution, Box 25286, Bldg. 810, Denver Federal Center, MS 517, Denver, CO 80225.*
*http://nhd.usgs.gov*
*Demo: http://nhd.usgs.gov/app_demo.html*
*USGS Services & Products: 888/ASK-USGS (888/275-8747).*



### US Environmental Protection Agency
*The US Environmental Protection Agency web page has data and mapping resources available online. The Envirofacts Warehouse provides the public with direct access to the wealth of information contained in EPA databases. Other sites of interest are: WATERS, a mapping system that displays state water quality standards in their geographic context; Surf Your Watershed where users can locate, use and share environmental information on their watershed communities; the Index of Watershed Indicators (IWI), a compilation of information on the "health" of aquatic resources in the United States; Enviromapper, which combines EPA datasets to allow users to look at many geographical levels of environmental data; and the Watershed Atlas, a catalog of geo-spatial displays and analysis of information and data for watershed protection and restoration. The Geospatial Data Clearinghouse provides a pathway to find information about geospatial data available from the EPA.*

*Envirofacts Warehouse:*
*www.epa.gov/enviro/index_java.html*

*Watershed Assessment, Tracking and Environmental Results (WATERS):*
*www.epa.gov/waters*

*Surf Your Watershed: www.epa.gov/surf*

*Index of Watershed Indicators:*
*www.epa.gov/iwi*

*Enviromapper: www.epa.gov/iwi/iwimapper*

*Watershed Atlas: www.epa.gov/wateratlas*

*Geospatial Data Clearinghouse:*
*www.epa.gov/nsdi/*

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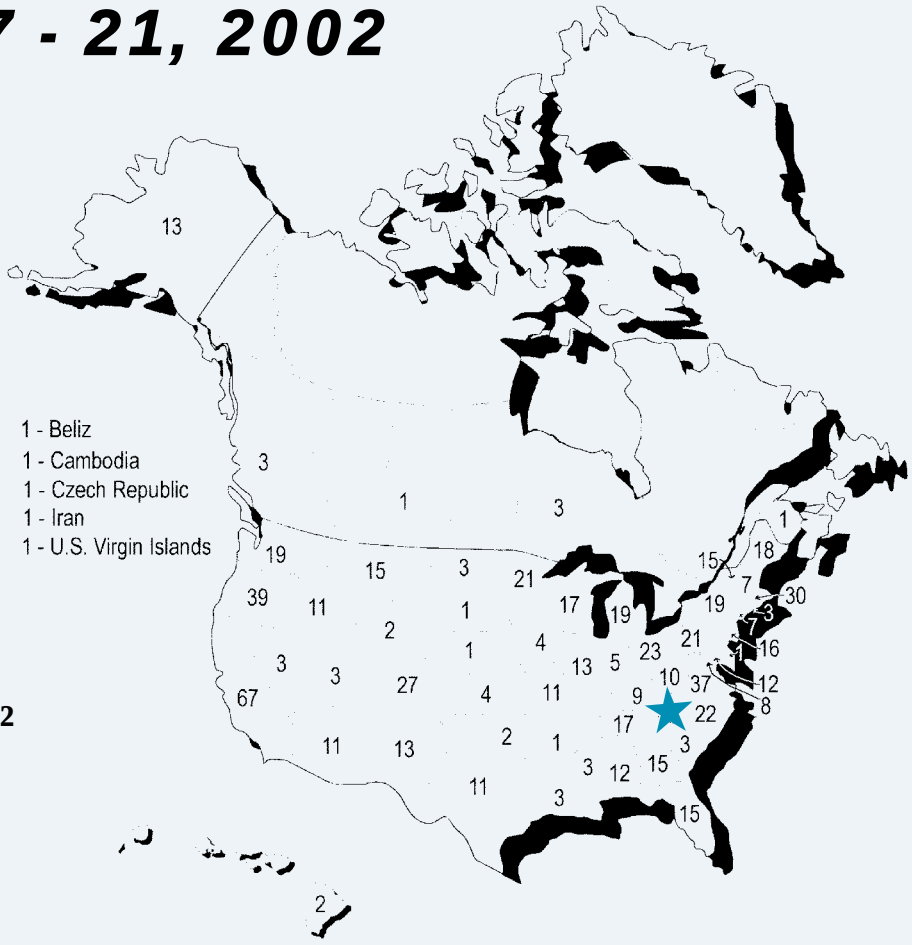


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