



## Arizona NEMO: Watershed Projects and Programs

To assure the sustainability of water resources, community character, and long-term economic health of Arizona, the Arizona Nonpoint Education for Municipal Officials (NEMO) Program supports volunteer efforts across the state to restore watershed health by reducing nonpoint source pollution. Nonpoint source water pollution results from a variety of human land uses that mobilize pollutants and impact the water quality of streams and lakes. These include increased sediment due to construction and road building, degraded stormwater runoff due to urbanization, and the introduction of fecal pathogens due to overgrazing in riparian areas. Arizona NEMO provides

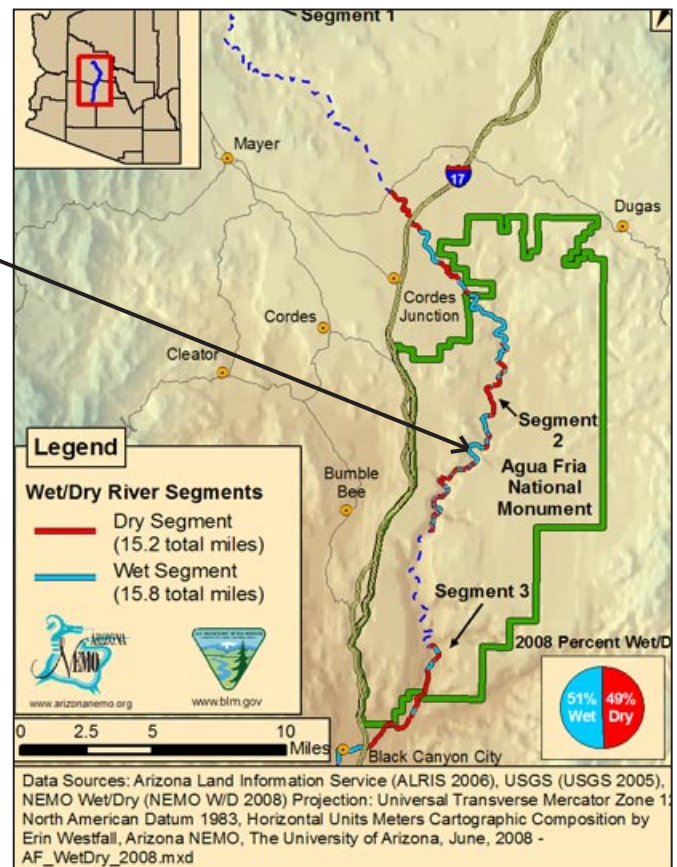
education in order to engage stakeholders and foster better land-use decisions to protect our water resources. Emphasis is on the linkages between water quality and land use, as well as water quantity and supply.

### NEMO Wet/Dry Mapping

In response to community interest in developing a volunteer river monitoring program, Arizona NEMO has developed a mapping protocol and GIS data management and processing methodology to record the perennial reaches of Arizona rivers. Built on a Nature Conservancy and Bureau of Land Management volunteer monitoring program on the San Pedro Riparian



The Agua Fria River



Perennial reaches of the Agua Fria River were mapped in June of 2009

Arizona NEMO is tasked with educating land-use decision makers to make choices and take actions to lessen nonpoint source pollution and protect natural resources. A program of the University of Arizona, Cooperative Extension and housed in the Water Resources Research Center, NEMO is a non-regulatory, research-based educational program using geospatial information and other advanced technologies for outreach education, analysis, and research addressing water quality and sustainability concerns in Arizona

educational outreach to an adult audience of policy makers, planners, and land use decision makers facing water management decisions.

In partnership with and funded by the Arizona Department of Environmental Quality (ADEQ), Arizona NEMO is also supported by the University of Arizona, Technology and Research Initiative Fund (TRIF), Water Sustainability Program through the

Water Resources Research Center, and is a program of Arizona Cooperative Extension. Arizona NEMO integrates watershed management and planning with research-based, professional

National Conservation Area, this project records where water flows in the San Pedro River. NEMO formalized the volunteer monitoring program and expanded the activity across Arizona. The main objective of the monitoring program is to create a map that shows where water is present, and where it is not, in the driest time of the year immediately prior to the Monsoon rains of summer. By mapping during the 'dry' season, information as to river base-flow and the interrelationship between surface

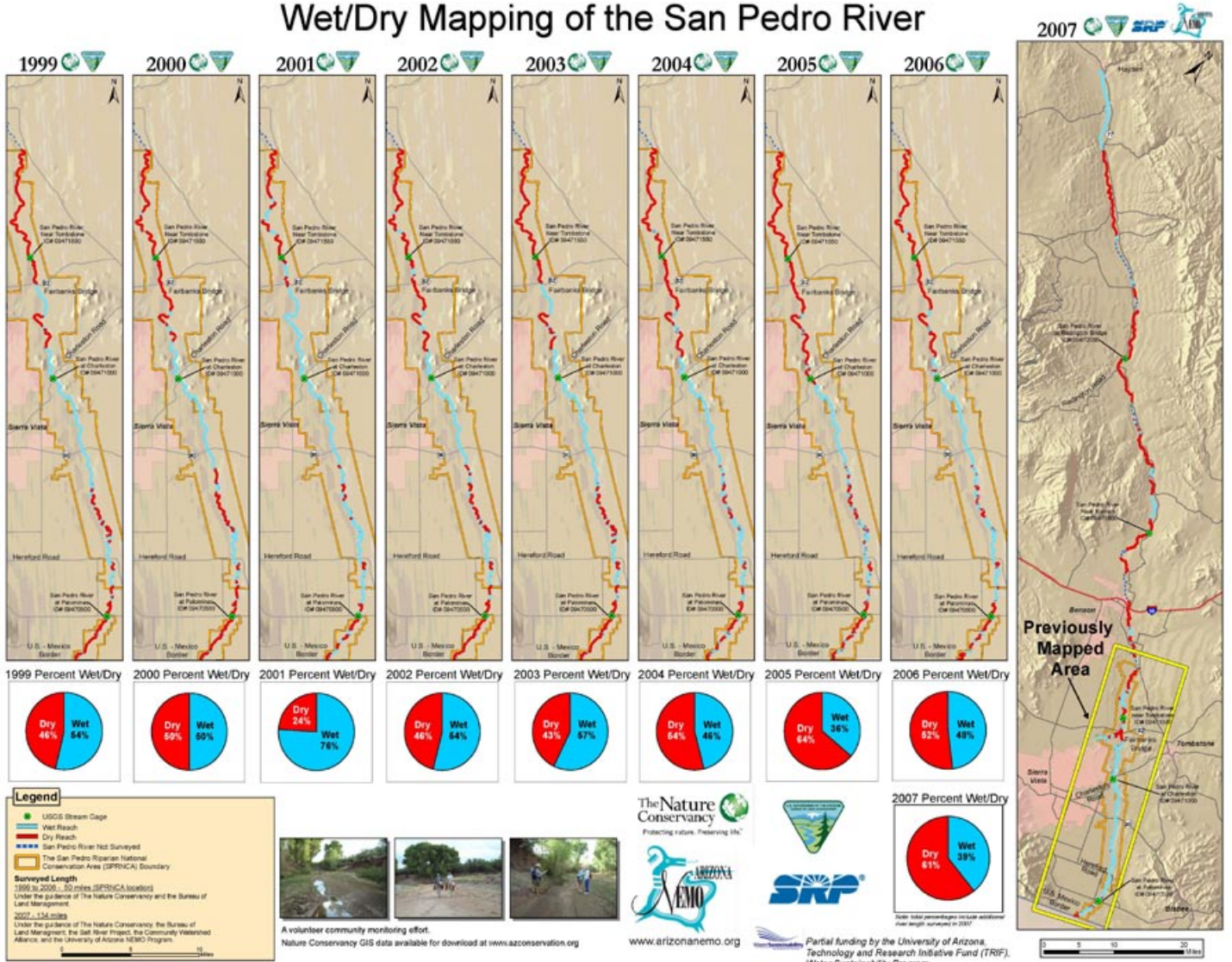
water and ground water is documented and better understood.

The goal of annual monitoring is to create a long-term record of changes in that flow; while the record of any single year is interesting it is a record for multiple years that may show what is really happening to the flow in the river. In addition, the goal of Wet/Dry is to build community participation, provide outreach education on the importance of long-term monitoring of our natural environment, and foster understanding of and responsibility for the health of Arizona watersheds. Global Positioning System (GPS) technology is used to record where

ing the June 2007 mapping effort, Arizona NEMO then initiated a mapping program on the Agua Fria River in June 2008.

The Agua Fria Wet/Dry mapping project brought together local citizens and representatives from governmental and non-profit organizations including the Bureau of Land Management, the Upper Agua Fria Watershed Partnership, Friends of the Agua Fria National Monument, the community of Arcosanti, and the Arizona Riparian Council. Roughly 24 miles of the 82 mile long Agua Fria River that flows through the rugged Agua Fria National Monument were mapped, along with various

### Wet/Dry Mapping of the San Pedro River



The Nature Conservancy and the Bureau of Land Management had originally designed the volunteer monitoring program for the San Pedro Riparian National Conservation Area. Arizona NEMO is taking the program state-wide.

the water starts and stops, and Geographic Information System (GIS) technology is used to produce the final maps. Re-mapping the river each year at the same time can provide valuable data on long-term trends and changes to base flows.

After contributing to the expansion of the Wet/Dry mapping of the San Pedro River from 50 miles to a total of 134 miles dur-

reaches north and south of the Monument.

Arizona NEMO trained the volunteer groups, some walking and others on horseback, to map the Agua Fria River. Starting early in the morning to avoid the heat, 34 volunteers were provided with GPS units and data sheets to accurately record their observations. Data sheets included entries for the starting and

stopping points of the water (in the form of GPS coordinates) and whether the water was flowing or pooled. Volunteers also included observations such as the existence of fish, wildlife, illegal dumping and vehicle tracks in the river. The June mapping date was chosen to get a snapshot of the river because it is typically one of the driest days of the year, before the start of the monsoon storms. Any water in the river at that time is unlikely to be the result of a rain event but rather part of the perennial flows.

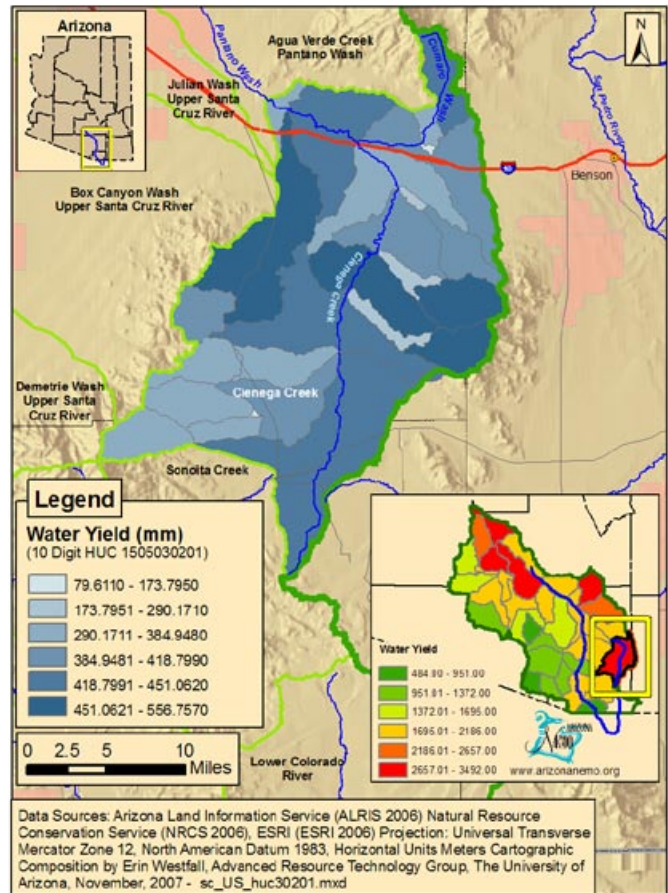
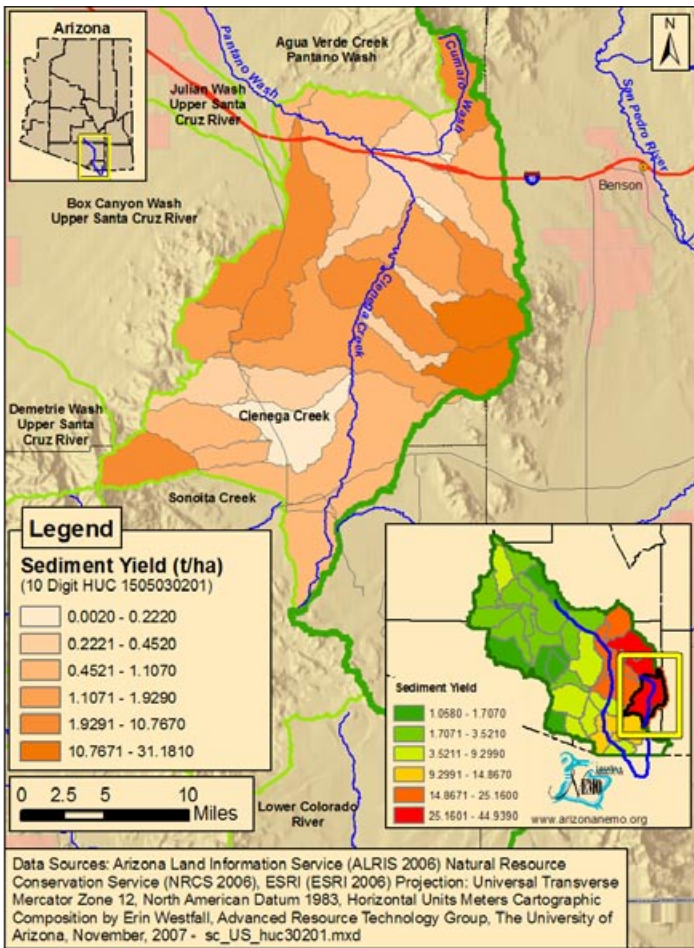
**NEMO Watershed Modeling**

For each watershed across the state, the NEMO program has simulated watershed response to rainfall in a series of numerical models. Model results are reported in a Watershed-Based Plan identifying locations susceptible to nonpoint source pollution. The Plans also advocate land management practices designed to protect, restore, and manage the watershed.

The models compute runoff and erosion for each watershed, and are able to address varying soils, land use, and management conditions. GIS provides the framework within which spatially-

distributed data are collected and used to prepare model input files and evaluate model results. GIS-based tools, such as the Automated Geospatial Watershed Assessment – Soil and Water Assessment Tool (AGWA – SWAT), are used to illustrate the effects of land use practices on runoff and erosion, and to support watershed-wide land use management decisions.

The USDA-ARS Southwest Watershed Research Center and



*Nonpoint source pollutant transport by overland flow is simulated here in the Santa Cruz River Watershed south of Tucson. Pathogens and nutrients originating from grazing or agricultural practices may be transported to the water body by overland flow.*

the UA Advanced Resource Technology Group (ART), in cooperation with the US EPA Office of Research and Development, have developed AGWA to facilitate simulation of the impact of land management practices on water and sediment yields on a watershed scale. AGWA-SWAT is a component of the AGWA tool-box of hydrologic simulation. Based in Tucson, the Southwest Watershed Research Center conducts research with a focus on the unique hydrology of our semi-arid climate and topography. In developing AGWA, research was supported by field experiment at the USDA Walnut Gulch Experimental Watershed, near Tombstone, Arizona (<http://www.epa.gov/esd/land-sci/agwa/>).

A program within the School of Natural Resources, ART provides leadership in such areas as GIS environmental database design and development, application of cartographic and

*Excessive sediment is a principal nonpoint source pollutant in 28 percent of the 409 stream miles classified as impaired by ADEQ in 2006. GIS AGWA modeling identifies where in the Santa Cruz River watershed nonpoint source pollutants may be originating and if transport to the water body is by sediment.*

spatial analysis, as well as AGWA modeling support. The ART Group provides the primary focus for research and extension in cartographic and spatial analysis for the College of Agriculture and Life Sciences at the University of Arizona.

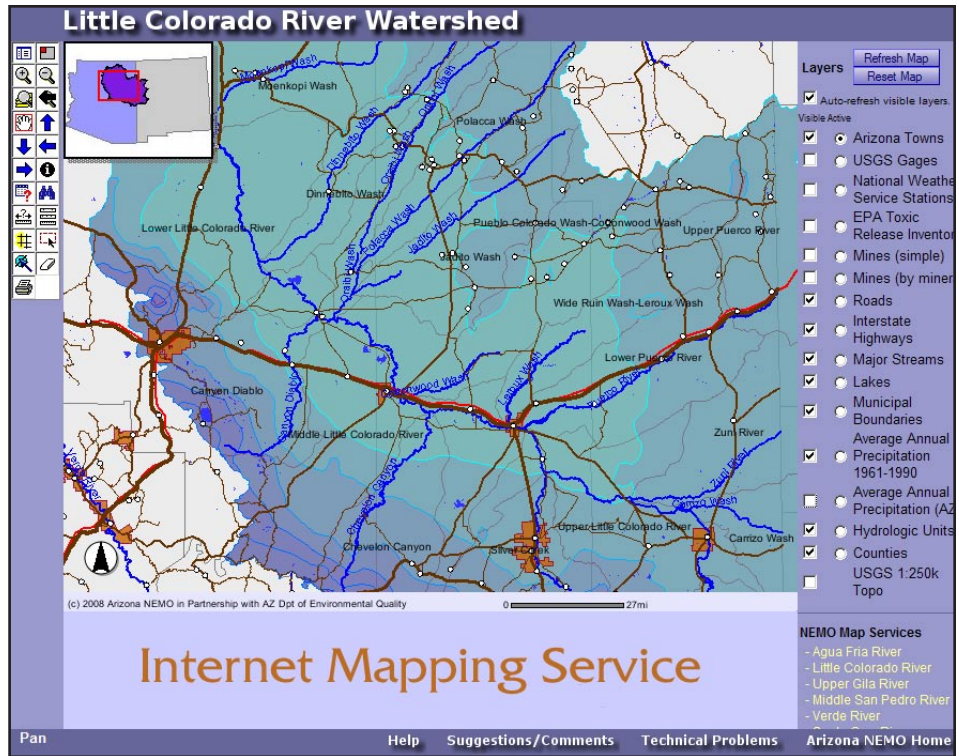
The NEMO Watershed-Based plans include watershed characterization in addition to the AGWA-SWAT modeling results. Characterization includes physical, biological, and social/economic data in a GIS database format, as both mapped and tabulated data. The characterizations represent an inventory of natural resources and environmental conditions that affect primarily surface water quality. In addition, the characterizations provide mapping and educational outreach material to stakeholders and watershed partnerships.

The NEMO Watershed-Based Plans follow guidance based on EPA's 2003 Guideline for the award of Section 319 Nonpoint Source Grants. The United States Congress amended the Clean Water Act (CWA) in 1987 to establish the Section 319 Nonpoint Source Management Program because it recognized the need for greater federal leadership to help focus State and local nonpoint source efforts.

Under Section 319 of the CWA, states, territories, and Indian tribes receive grant money which supports a wide variety of activities including technical assistance, financial assistance, education, training, technology transfer, demonstration projects, and monitoring to assess the success of specific nonpoint source implementation projects. Consistency of the NEMO plans with the key elements of the EPA Guidelines allows ADEQ to prioritize funding to stakeholders and watershed partnerships implementing projects across the state.

**NEMO IMS Mapping**

As part of the effort to empower rural communities and local watershed partnerships in their grant-writing efforts and overall watershed management activities, Arizona NEMO incorporated an Internet Mapping Service (IMS) in the tool box of land-use planning resources. Watershed stakeholders and community members are being taught how to access the NEMO web page to locate features in their watershed and customize their map at the scale defined by the map-



Screen shot of the [www.arizonanemo.org](http://www.arizonanemo.org) web page Internet Mapping Service showing mapping tools for the Little Colorado River watershed.

maker. Included in the map coverage are the USGS topographical maps and live-links to USGS gaging stations with stream gage data. Hikers learn how to design and print maps featuring their next hikes—maps that show geology, vegetation types, and soils. Maps that show precipitation, average annual temperature, or stream water quality can be created and printed on home or office computers. Grant writers learn to create maps to attach to their next grant applications.

**Nonpoint Education for Municipal Officials: NEMO**



*Avanyu, the NEMO Logo*

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*Found in the spiritual mythology of the ancient Zuni, Hopi and Pueblo cultures, Avanyu is the name for the water serpent, "one who lives in the water below the earth, and one who carries us through the water of change."*

*Avanyu is a mythical sea-serpent, the guardian of the mountain springs across the Pueblo cultures of the American Southwest. The Avanyu petroglyph was created long before Europeans set foot on this continent, and is believed to date back to the Anazazi, the "Ancient Ones." According to tribal wisdom, those who poison the water must face Avanyu's fiery revenge.*