FSPPC116

Watershed Prioritization for Managing Nonpoint Source Pollution in Arkansas

Introduction

The Arkansas Natural Resources Commission (ANRC) administers programs aimed at protecting water resources on behalf of the state. These efforts include programs that address soil and water conservation, nutrient management, water rights, dam safety and water resources planning and development.

When establishing policies and regulations, it is often necessary to identify priority areas where much of ANRC's focus will be directed.

For the state's Nonpoint Source (NPS) Pollution Management Program, the agency identifies priority watersheds with the input of engaged stakeholders and federal guidance.

NPS pollution is caused by rainfall or snowmelt moving over and through the ground. As the runoff moves, it picks up and carries away natural and human-made pollutants, finally depositing them into lakes, rivers, streams, wetlands and even underground sources of drinking water.

ANRC receives federal assistance each year from the Environmental Protection Agency (EPA) to fund projects associated with the abatement, reduction or control of NPS pollutants. Using the NPS Management Program Plan and federal guidelines as a guide, the NPS management plan currently targets eight-digit watersheds for project spending.

The agency's prioritization process and recent efforts to administer the program are explained in this fact sheet.

What are eight-digit watersheds?

The EPA defines a watershed as "the area of land where all of the water that is under it or drains off it goes into the same place."

Watersheds are classified based on their drainage area using the Hydrologic Unit Code (HUC) system developed by the United States Geologic Service. The HUC system classifies watersheds in four levels using two to 12 digits to identify a unique area of the watershed.

The greater the number of digits there are, the smaller the watershed area being described. For example, the eight-digit HUC "11010012" refers to the Strawberry Creek watershed (769 mi^2), while the 12-digit HUC "110100120201" refers to the Greasy Creek subwatershed (28.1 mi^2) within the Strawberry Creek watershed.[1]

There are 58 eight-digit HUC watersheds [Figure 1] in Arkansas. Unique characteristics of these eight-digit watersheds, such as land use and water quality information, can be explored interactively by visiting **www.arkansaswater.org** or the Arkansas Watershed Information System web site at **http://watersheds.cast.uark.edu**.

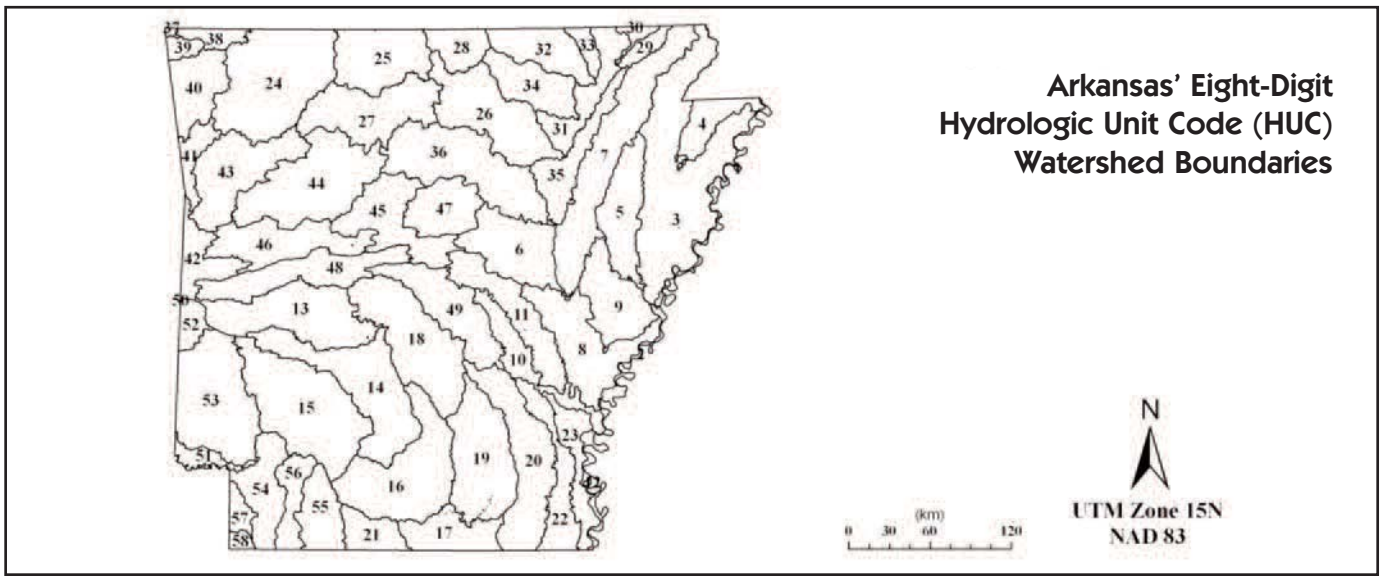


Figure 1. Eight-digit hydrologic unit code (HUC) boundaries in Arkansas

Why use a watershed prioritization approach in developing management plans?

Several watersheds in Arkansas are considered impaired because of nonpoint pollution and are unable to support their designated uses.[2] Financial or staff constraints typically limit the ability of agencies to fully rehabilitate these impaired watersheds. Sometimes, political considerations also influence the choice project selections.

Different states use a variety of methods for prioritizing watersheds. In Arkansas, a science-based process with meaningful stakeholder involvement was developed to help identify critical watersheds for NPS program planning purposes. This process is meant to ensure proper resource utilization and minimize political influence in project selection.

Why use a watershed-based approach in addressing nonpoint source pollution?

Implementing nonpoint source pollution programs at the watershed level has been a goal of the nation's NPS pollution management plan from its inception.

Section 319 of the Clean Water Act states: "A state shall, to the maximum extent practicable, develop and implement a management program under this subsection on a watershed-by-watershed basis within such state." (USC Section §1329)

In 1997, the EPA increased its commitment to watershed implementation with the publication of *Picking Up the Pace* (EPA, 1997a). The strategic plan included policies on "targeting risk" or tasks that would help prevent or address nonpoint source pollution.

The guide called for enhancing the total maximum daily load (TMDL) program by creating tools and establishing best practices, helping states identify water quality standards and improving identification of water impaired by nonpoint sources.

Supplemental guidance for the program published that year said that states are to use "a balanced approach that emphasizes both statewide nonpoint source programs and on-the-ground management of individual watersheds where waters are impaired or threatened" (EPA, 1997b).

In the years since, the EPA has strengthened its stance on the use of the incremental funds for restoration of impaired waters. In 2003, supplemental grant guidance issued for section 319(h) grants indicated that the spending priority would be on nonpoint source programs implemented expeditiously to achieve the goals of the Clean Water Act.

Programs included the restoration and maintenance of the chemical, physical and biological integrity of waterways.

To achieve this objective, the guide places top priority on implementing on-the-ground measures and practices that will reduce pollutant loads and contribute to the restoration of impaired waters.

How are Arkansas' watersheds prioritized?

ANRC follows an established process to allocate its incremental Section 319 funds for the development and implementation of watershed-based plans designed to restore impaired waters identified under Section 303(d) of the Clean Water Act.

In 2004, the Ecological Engineering unit of the University of Arkansas Department of Biological and Agricultural Engineering initiated the development of a qualitative risk assessment-based prioritization approach for Arkansas watersheds.

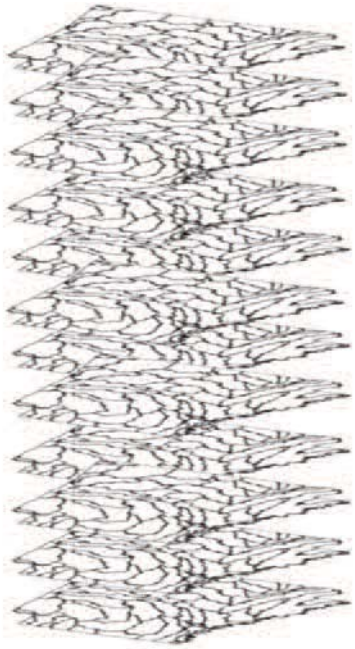
On behalf of ANRC, an NPS Task Force was established with representatives from state and federal agencies, commodity and industry trade groups, environmental organizations, soil and water conservation districts and other interested individuals. Through a series of meetings and facilitated discussions, the task force identified 11 risk categories and subcategories that should be statewide priorities of a NPS program.

The risk categories were based on either readily available data or derived from available datasets. The importance or weight of each category/subcategory was determined through discussions with the task force. The available data for each selected category/subcategory was compiled in a geodatabase, a database designed to store and query geographic information. Finally, a risk matrix was developed that tied together weights for all the categories on an eight-digit HUC watershed basis.

Subsequently, watersheds were divided into quintiles according to the values assigned by the matrix. ANRC's executive director then selected eight watersheds from the top quintiles as the agency's priorities.

Data in categories one through four are updated on a two-year cycle using biennial water quality inventory data published or compiled by the Arkansas Department of Environmental Quality (ADEQ). This is the most frequently updated data in the risk matrix. The other data in the matrix is updated when new information becomes available.

The watershed prioritization risk matrix used for the draft 2011-2016 NPS Pollution Management Plan was based on the 2010 biennial water quality inventory published by ADEQ. As a result of these deliberations, the current risk matrix consists of 12 categories/subcategories, compared to 11 that were used for ANRC's previous plan for years 2005-2011 [Figure 2].



1. Water body impairment
2. Designated use impact
3. Biotic impact
4. Human exposure
5. Urban/suburban population
6. Impervious surface
7. Economic activity
8. Cropland
9. Livestock and pasture
10. Unpaved roads
11. Forestry
12. Priority of neighboring states

Figure 2. Schematic of the geodatabase used to prioritize eight-digit watersheds in Arkansas

Figure 3 shows the categories and their assigned weights for the watershed prioritization risk matrix used in developing Arkansas' 2011-2016 NPS Pollution Management Plan.

How is the priority for a watershed calculated within the matrix?

For the purposes of Arkansas' 2011-2016 NPS Pollution Management Plan, the state's 58 eight-digit watersheds have been scored using 12 different categories and subcategories, with each watershed receiving a score between 0 and 10.

While some categories receive scores on a scale of 0 to 10 (for example, categories 1, 2, 3, 4, 11 and 12), scoring for other categories is arrived at using a formula based on watershed-specific information (for example, categories 5 to 10). The source and link to data layers used for each category is provided in Table 1.

The continuous categories are first assigned a percentile score between 0 and 1, which is then multiplied by 10 to provide a score between 0 and 10. Weights for each category are discussed annually during a NPS stakeholder meeting to arrive at a consensus. The formula used for calculating the priority rankings for eight-digit watersheds is as follows:

= Value of category 1 * Sum of the weights for categories 2 through 12

What is the ARWAP tool and why was it developed?

The Arkansas Watershed Prioritization (ARWAP) tool was developed to improve understanding of Arkansas' eight-digit watershed prioritization process, to increase collaboration and to make watershed prioritization more accessible to stakeholders [Figure 4].

This desktop-based computer tool uses a spatial database and user-defined weighting to identify watersheds that are at greater risk for nonpoint source pollution. Various watershed data layers in Arkansas on the eight-digit hydrologic unit code (HUC) scale are built into the spatial database, based on the 2008 iteration of the Arkansas watershed prioritization approach [Figure 2 and Table 1]. Users are allowed to interactively adjust weighting for these layers to instantaneously visualize priority watersheds.

ARWAP seeks to educate current and new users and to create transparency in the process of designating and allocating greater resources to a few watersheds in Arkansas.

How can the public obtain and use the ARWAP tool?

The ARWAP tool can be obtained by contacting Tony Ramick, Nonpoint Source Program manager at the Arkansas Natural Resources Commission. He can be contacted by calling **501-682-3914** or by e-mailing **tony.ramick@arkansas.gov**.

The tool comes with a user's manual containing step-by-step instructions for installing the program on the desktop. Once installation is complete, the tool allows the user to adjust the weight each category/subcategory holds and evaluate possible "what if" scenarios [Figure 5].

For example, Figure 3 shows the default weight for subcategory 1e (nutrient sensitive watersheds) as 5, while the default weight for 1d (ADEQ 2010 "low" priority) is 2. What if the user feels 1d is of more priority than 1e? The user can simply adjust the base weights of 1d and 1e, recalculate the risk matrix with the new weights and reprioritize the watersheds.

Figure 4 shows a screen capture of the ARWAP tool showing Category 1 (waterbody impairment). The user can select any of the six tabs on this tool titled Category 1, Category 2, Category 3, Category 4, Category 5-8 and Category 9-12 to adjust the weights.

Finally, using the Display tab, the user has the option of visualizing and printing a customized map of the priority watersheds.

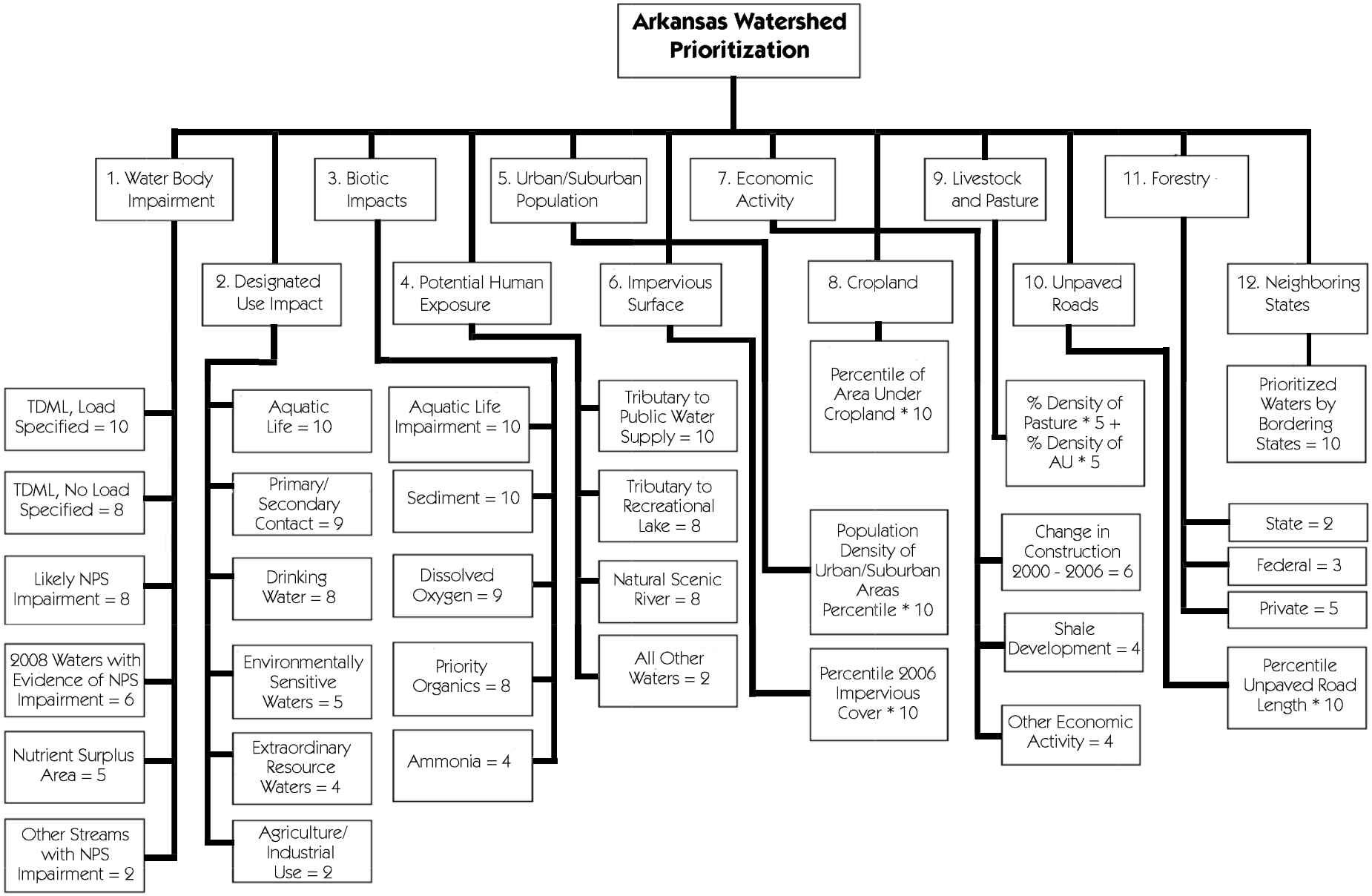


Figure 3. Flow chart of categories and assigned weights used to prioritize Arkansas' watersheds

Table 1. Source and location of data layers used in Arkansas watershed prioritization

Category	Subcategory	Description	Data Source	Data Location
1	a-d, f	Water body impairments	ADEQ*	www.adeq.state.ar.us/water/branch_planning/pdfs/303d_list_2008.pdf
	e	Nutrient sensitive watersheds	ANRC	www.geostor.arkansas.gov/G6/Home.html?q=nutrient+surplus+area
2	a-c, f	Water use impairments	ADEQ	www.adeq.state.ar.us/water/branch_planning/pdfs/303d_list_2008.pdf
	d	Environmentally sensitive waters	ADEQ	www.geostor.arkansas.gov/G6/Home.html?q=ecologically+sensitive+streams
	e	Extraordinary resource waters	ADEQ	www.geostor.arkansas.gov/G6/Home.html?q=extraordinary+resource+line
3	a-e	Biotic impacts	ADEQ	www.adeq.state.ar.us/water/branch_planning/pdfs/303d_list_2008.pdf
4	a-d	Human exposure	Various	Ranking based on risk of human exposure to environmental pollutants
5		Urban/suburban population	U.S. Census Bureau	www.factfinder.census.gov
6		Impervious surface	CAST	www.geostor.arkansas.gov/G6/Home.html?q=Land+Use+Land+Cover+006
7	a	Change in economic activity	CAST	Difference of 1999 and 2006 land-use layers (www.geostor.arkansas.gov)
	b	Shale development	AOGC	www.geostor.arkansas.gov/G6/Home.html?q=Oil+Gas+Well+Point
	c	Other economic activity	ADEQ	www.geostor.arkansas.gov/G6/Home.html?q=Environmental+Permitted+Sites
8		Cropland	USDA	www.agcensus.usda.gov
9	a	Pasture	CAST	www.geostor.arkansas.gov/G6/Home.html?q=Land+Use+Land+Cover+2006
	b	Livestock	USDA	www.agcensus.usda.gov
10		Unpaved roads	AHTD	www.geostor.arkansas.gov/G6/Home.html?q=road+all+line
11	a-c	Forestry	Various	2006 land-use layer (CAST), state and private forest (USDA Forest Service)
12	a-b	Neighboring state's priority	ANRC	Based on stakeholder meeting discussions

*ADEQ = Arkansas Department of Environmental Quality; ANRC = Arkansas Natural Resources Commission; AHTD = Arkansas State Highway and Transportation Department; AOGC = Arkansas Oil and Gas Commission; CAST = Center for Advanced Spatial Technologies; USDA = U.S. Department of Agriculture.

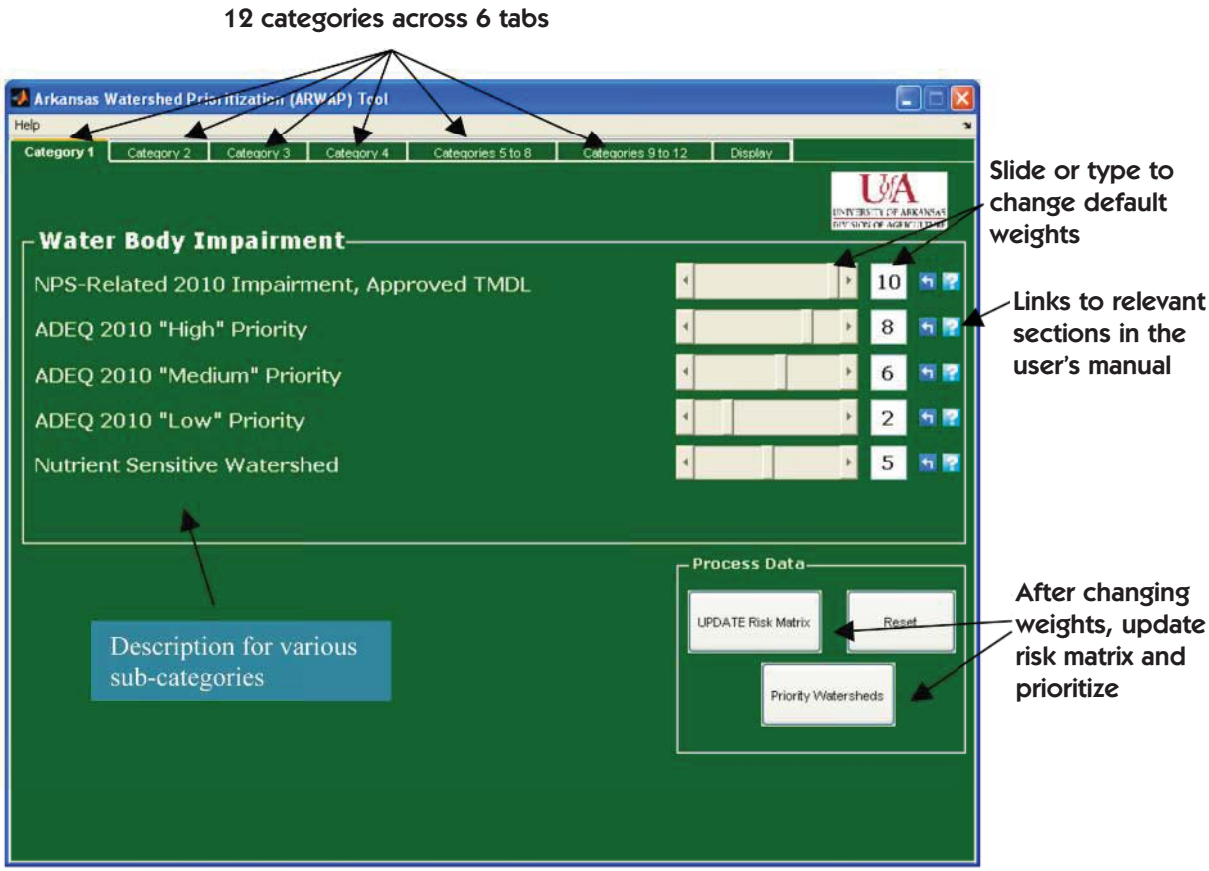


Figure 4. Arkansas Watershed Prioritization (ARWAP) tool user interface

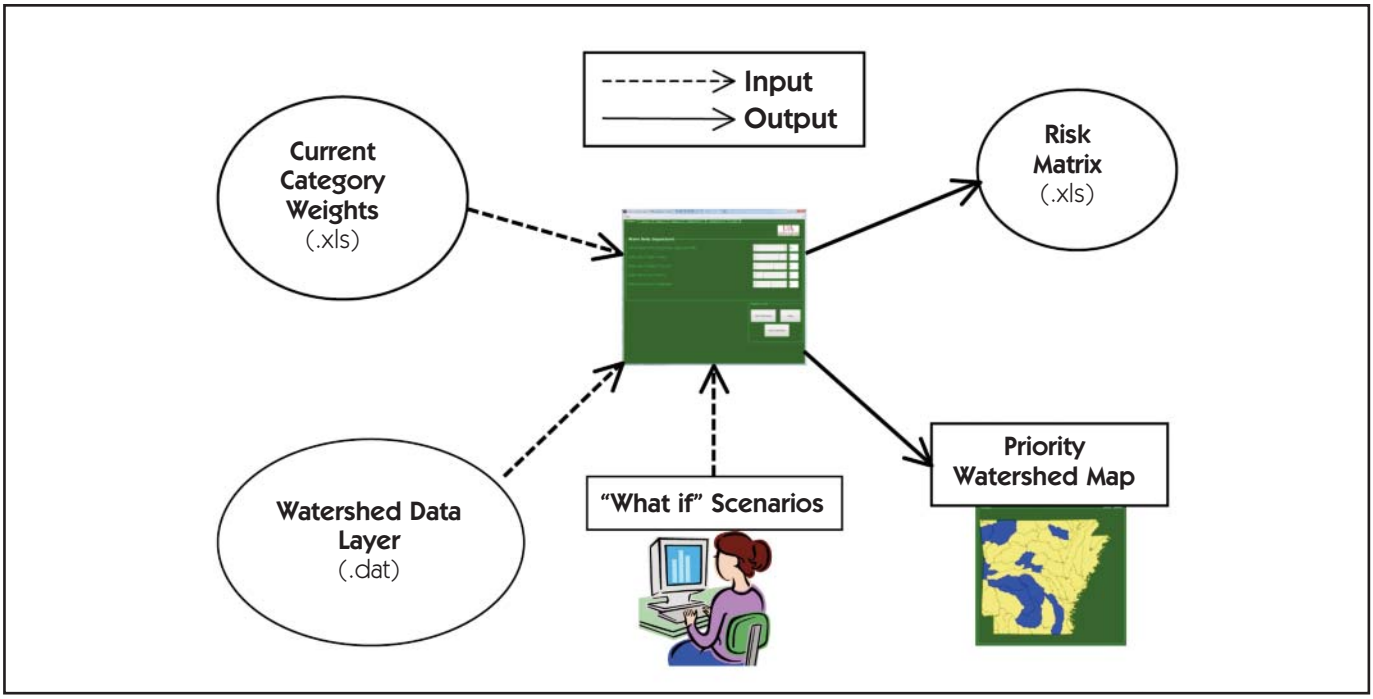


Figure 5. ARWAP tool's procedure to test a "what if" scenario

Additional Reading

Morgan, R., and M. Matlock. 2008. A collaborative learning matrix for combing science with stakeholder involvement to prioritize watershed implementation in Arkansas' nonpoint source state management plan. *Journal of Environmental Assessment Policy and Management* 10(3):307-331.

Footnotes

[1]For more detailed information on Arkansas watersheds and the HUC system, refer to Fact Sheet 9521, *Arkansas Watersheds*, **www.uaex.edu/Other_Areas/publications/PDF/FSA-9521.pdf**.

[2]**http://www.adeq.state.ar.us/water/branch_planning/303d/303d.htm**.

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