

# Development of Comprehensive Volunteer Water Quality Monitoring Education and Support in Response to Agency-directed Targeted Watershed Improvements: Lessons Learned



Channah M. Rock, Department of Soil Water and Environmental Science;  
Candice Rupprecht and Kristine Uhlman, Water Resources Research Center; University  
of Arizona

# Water Quality Problems in Arizona

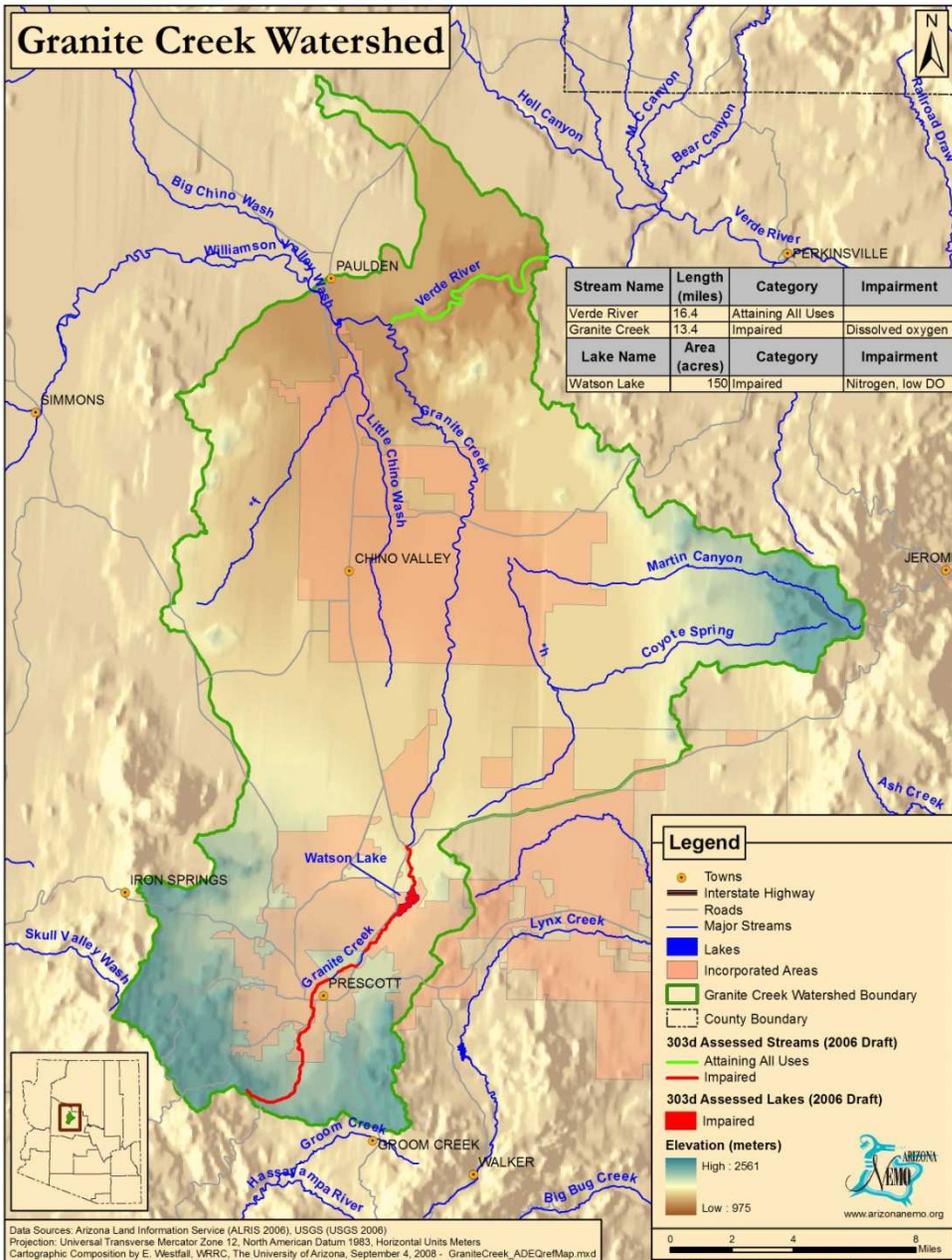


- Arizona Department of Environmental Quality (ADEQ) has about 124 lakes and stream reaches listed as “impaired”.
- More than \$12,000,000 in grants since 2000.
- Grant projects have resulted in delisting one part of one impaired stream (Nutrioso Creek).
- What has ADEQ been buying?

# ADEQ Targeted Watershed Grant Program



- The objective of this grant program is to focus on-the-ground Water Quality Improvement Grants on priority projects, so that in the near future an impaired water will meet water quality standards.
- Targeted plans will be developed for watershed drainage areas contributing pollutant loadings causing impairments.



- Granite Creek from headwaters to Watson Lake, in Prescott area.
- Pollutants of concern: nutrients and *E.coli* bacteria.

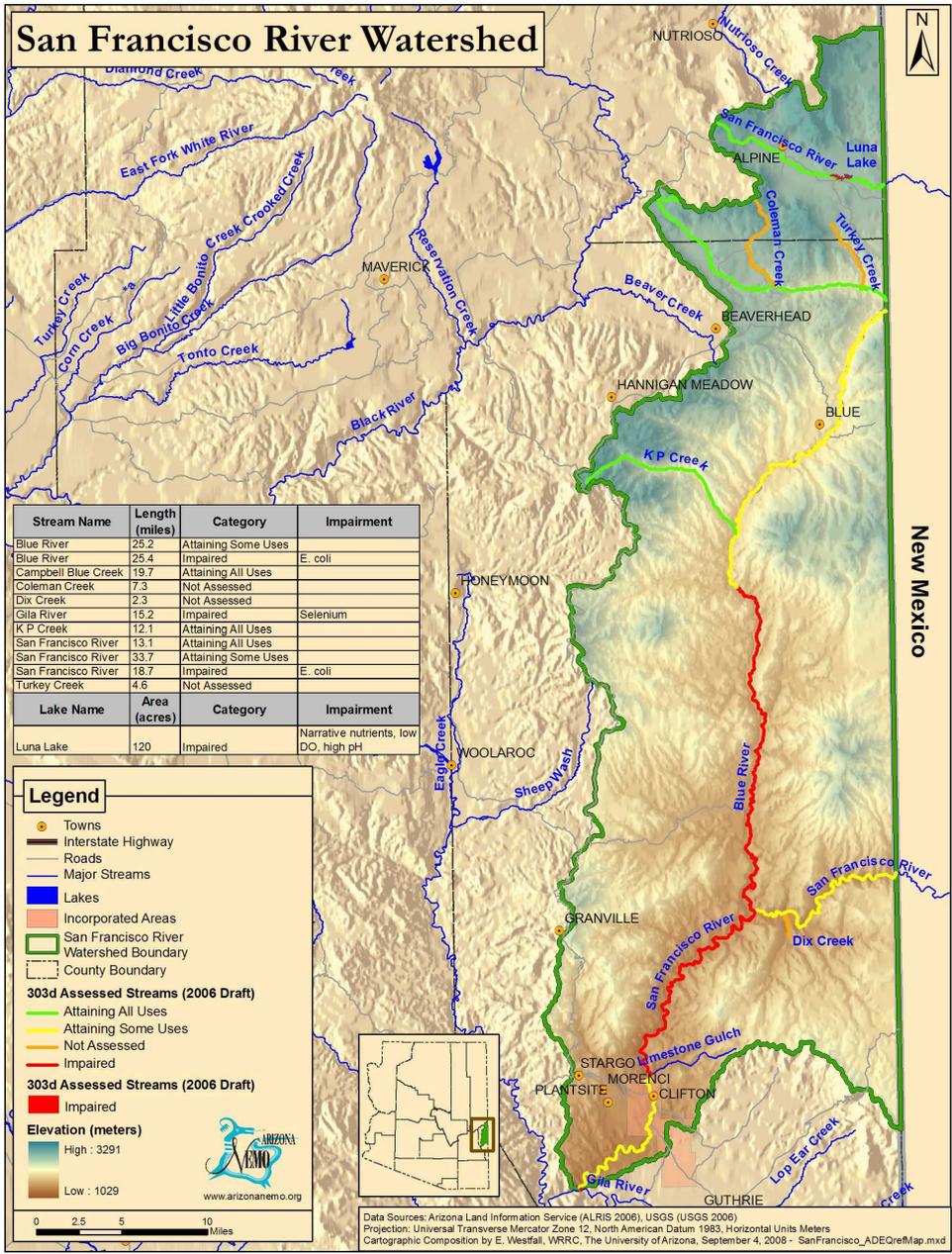
## Oak Creek Watershed

Stream Name	Length (miles)	Category	Impairment
Munds Creek	17	Attaining All Uses	
West Fork Oak Creek	15.8	Attaining All Uses	
Sterling Canyon	3	Attaining Some Uses	
Dry Creek	22.7	Not Assessed	
Oak Creek	35	Impaired	E. coli bacteria
Oak Creek -- Slide Rock	1	Impaired	E. coli bacteria
Spring Creek	6.4	Impaired	E. coli bacteria



□ Oak Creek drainage area from its headwaters to Spring Creek and the Spring Creek drainage, in the Sedona area.

□ Pollutant of concern: *E.coli* bacteria.



- San Francisco River drainage area, primary for the Blue River to Limestone Gulch, near Clifton.
- Pollutant of concern: *E.coli* bacteria.

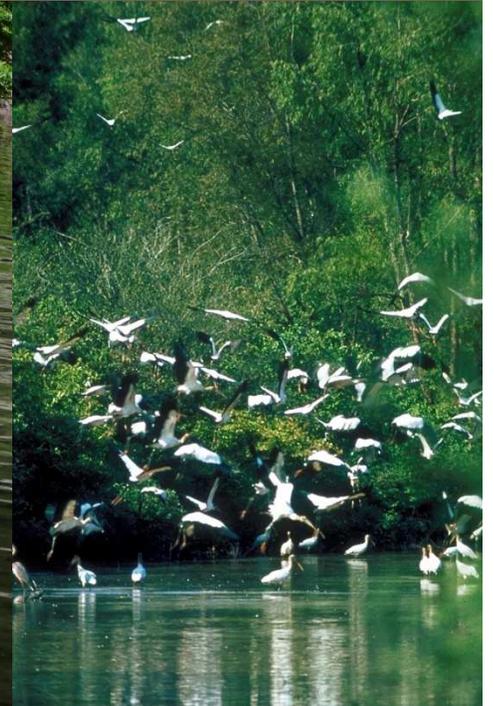
# CONTAMINATION OF SURFACE WATER WITH PATHOGENS



**Wastewater**



**Recreation**



**Wildlife**

There's *E.coli* in the water, but where did it come from?

# Where does UA fit in?



- ADEQ's Grant Program has contracted with the University of Arizona's Cooperative Extension to provide technical support and training opportunities.
- The NEMO program in cooperation with UA Cooperative Extension faculty, staff, and the MWS program will provide technical support in the development of watershed based plans, as well as modeling, GIS assisted mapping, and information concerning applicable Best Management Practices (BMPs), volunteer and community trainings, and water quality testing relating to microbial source tracking.

# New Acronyms!!!!



- WIPs

- Watershed Improvement Plans

- A tool (a whip) for directing movement and getting results

- WICs

- Watershed Improvement Council or Coalition

- The team to shed light on the problems, establish priorities, and make decisions.

- Boots-on-the-Ground

- Walking the watershed to document key sites and critical issues.

# WIP Grants

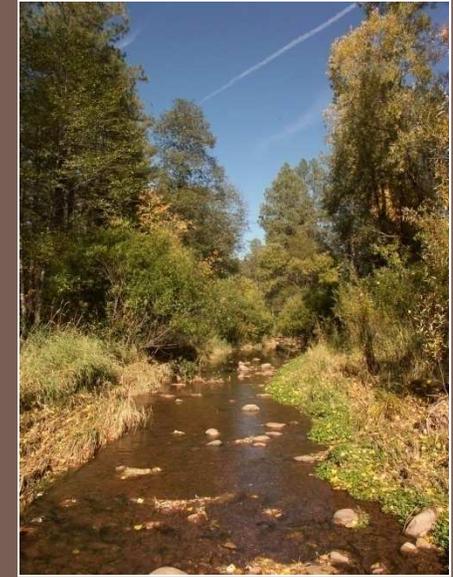
## □ Phase I

- Learn about the impairment
- Establish a WIC
- Identify critical sites in the watershed
- Identify best remedies
- Write up WIP

## □ Phase II

- Initial phase of implementing improvement and education projects





# Arizona's NEMO Program



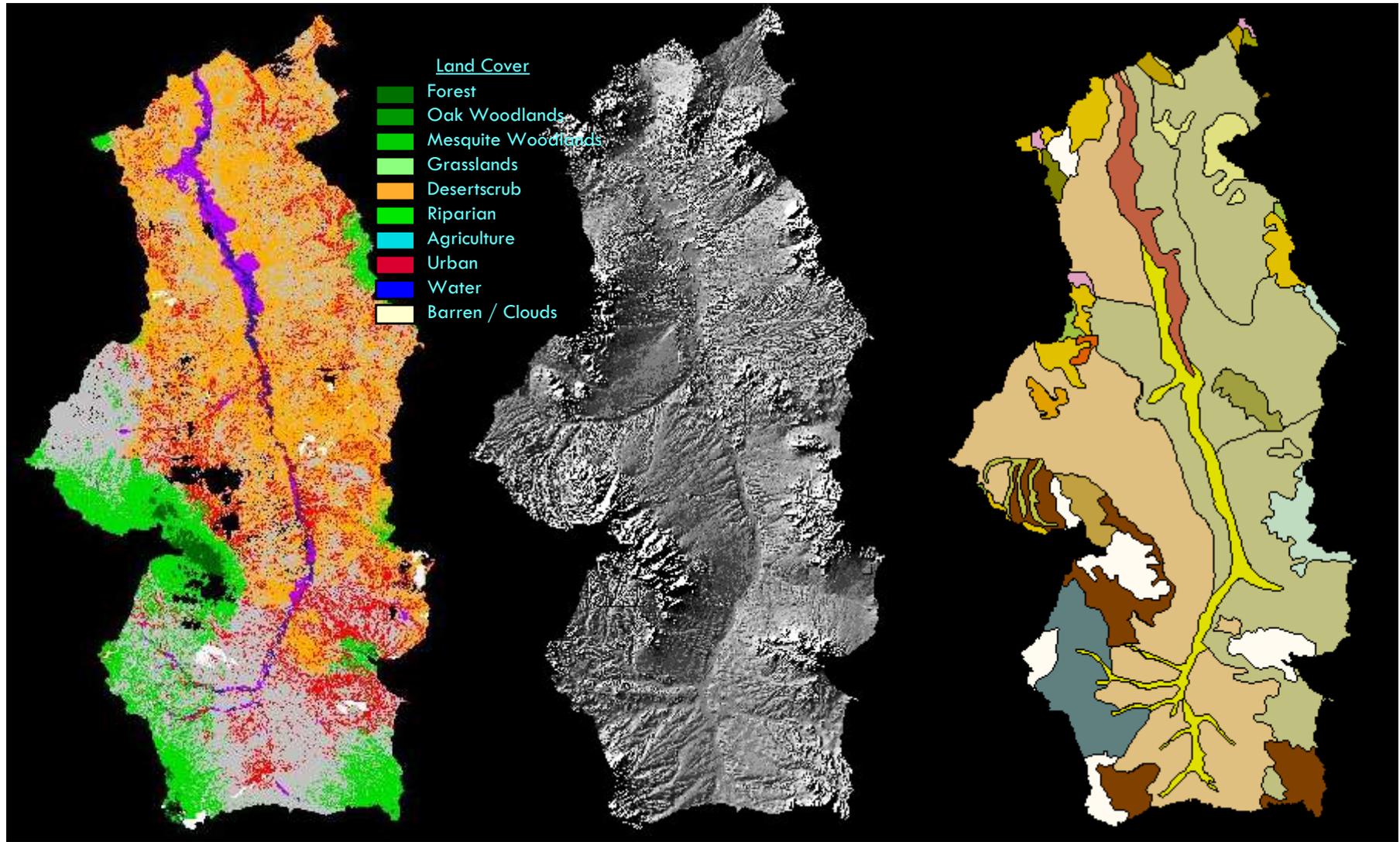
Kristine Uhlman, RG  
University of Arizona Cooperative Extension & WRRRC

# Arizona NEMO: Watershed-Based Plans

- **GIS**-based hydrologic watershed modeling
- **AGWA** - Automated Geospatial Watershed Assessment
- **Fuzzy Logic** – Risk assessment for pollutant groups located in subwatersheds



# Automated Geospatial Watershed Assessment - AGWA



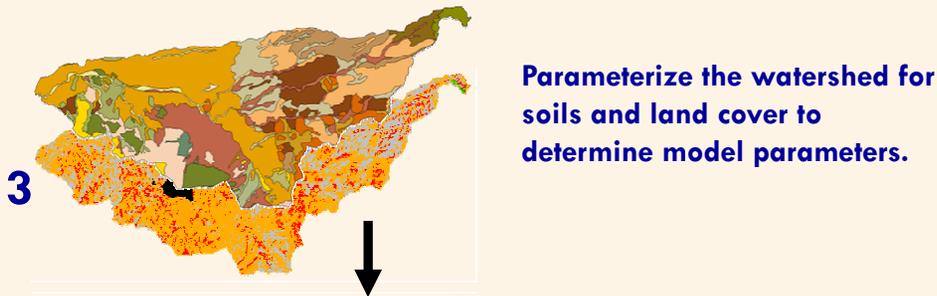
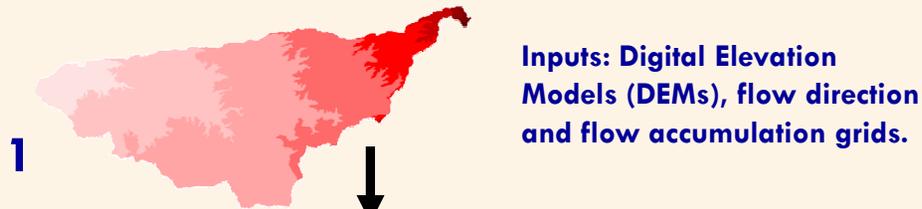
Land Cover

Elevation

Soil Type

## Automated Geospatial Watershed Assessment Tool (AGWA)

- Extension for ArcView 9.x
- Runs two runoff/erosion models:  
KINEROS2 & SWAT
- Model simulations identify subwatershed areas vulnerable to increased sedimentation and erosion due to soil and slope conditions as well as land use practices across the watershed.



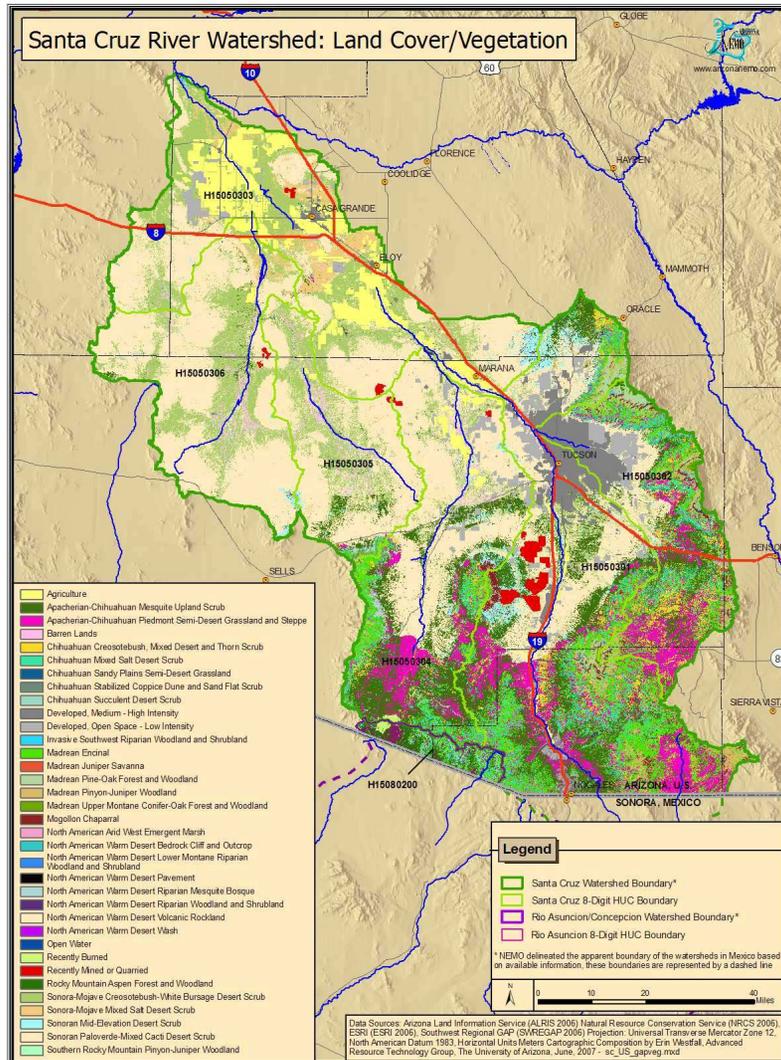
[www.tucson.ars.ag.gov/agwa](http://www.tucson.ars.ag.gov/agwa)

## Pollutant Modeling

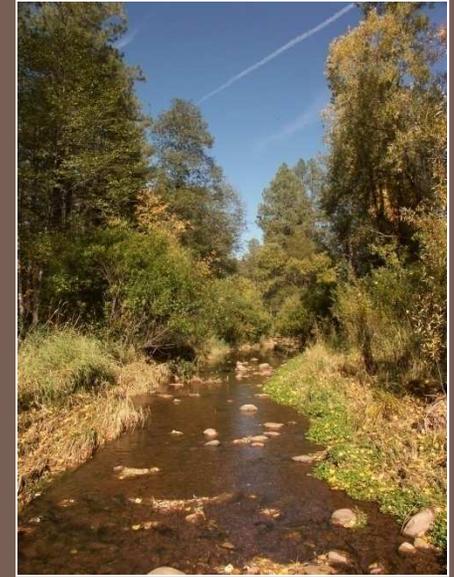
- ADEQ Water Quality Data for Nitrogen, pH, *E.coli*, DO
- GIS Analysis of Land Use
  - ▣ Agriculture
  - ▣ Range land
- GIS Analysis of Human Use
  - ▣ Urban
  - ▣ Exurban
  - ▣ Recently Mined
- Final ranking using Weighted Combination method of Fuzzy Logic for each subwatershed



# Mapping, Project Support, Decision Tools



- Land Cover/Vegetation
- Land Use
- Assessed Streams/Lakes
- Stream Types
- Slope
- Soil Texture
- Primary Ores
- Riparian Vegetation
- Water Yield
- Sediment Yield
- Land Ownership
- Population Density
- Housing Density
- ADEQ, ADWR, USGS, AZ Land Dept., US Forrest Service, BLM, U.S. Census...



# Arizona's Master Watershed Steward Program



Candice Rupprecht  
University of Arizona Cooperative Extension & WRRRC

# How MWS came to be

- Polarizing issues related to watershed health
- Citizens became concerned and wanted to “take action!”
- **EPA** gives each state money from **CWA 319** funds to create programs that address nonpoint source pollution
- 2001 – Yavapai & Cochise Counties started first state MWS class
- **UA Cooperative Extension** applied to **ADEQ** for Water Quality Improvement Grant funds in 2003



# Arizona MWS Goals

The MWS Program educates and trains citizens across the state of Arizona to serve as volunteers in the protection, restoration, monitoring, and conservation of their water and watersheds.

- Program Goals:
  - ▣ *Create* a network of motivated volunteer stewards to tackle watershed issues.
  - ▣ *Develop* personal relevance to increase motivation for watershed protection.
  - ▣ *Enhance* critical thinking and critical observation skills in the target audience.
  - ▣ *Facilitate* collaboration among citizens, watershed groups and natural resource managers.
  - ▣ *Enhance* public knowledge of watershed issues throughout Arizona.

# MWS Structure & Organization

- **20** classroom hours and
- **20** field hours of active, relevant learning about local watershed issues
- **40** hours of volunteer service
- Class Topics:

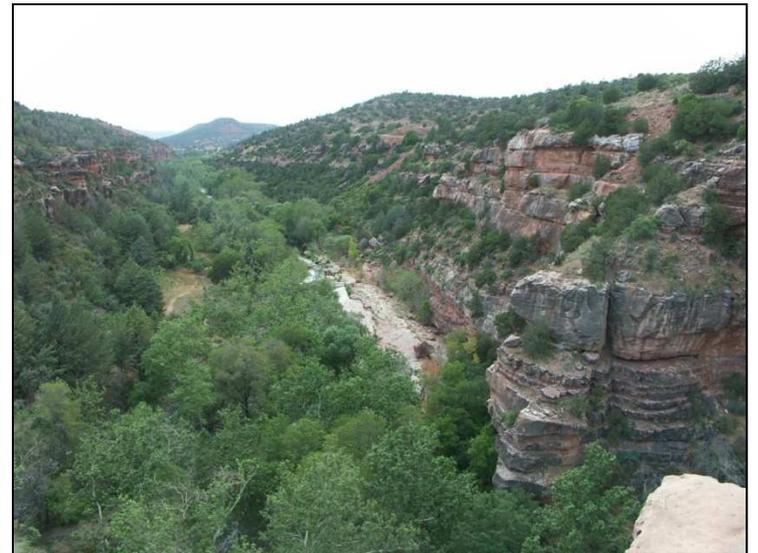
<b>Watershed Issues</b>	<b>Hydrology &amp; Streams</b>
<b>Geology &amp; Soils</b>	<b>Ecology &amp; Wildlife</b>
<b>Water Quality</b>	<b>GIS/GPS Technology</b>
<b>Watershed Planning</b>	<b>Best Management Practices</b>



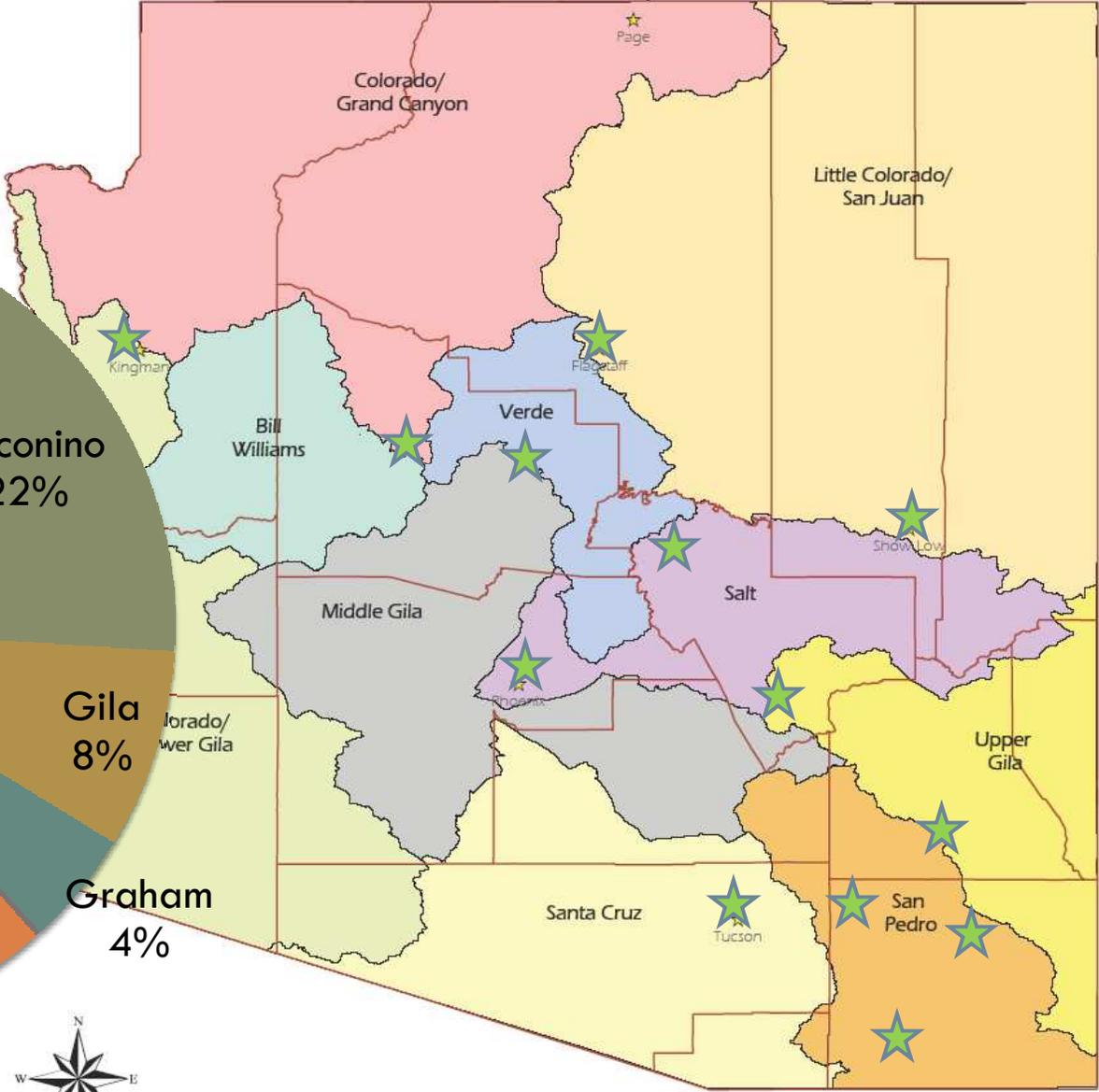
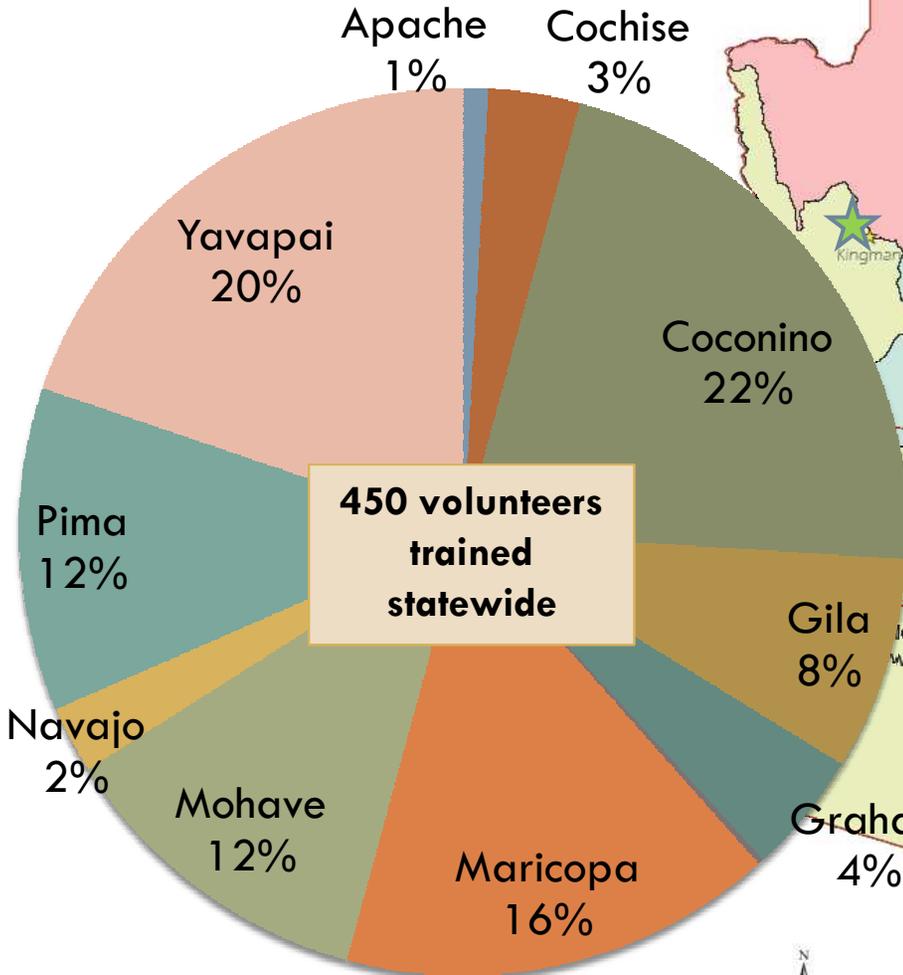
# MWS Stats

- **30** classes taught by University faculty & local experts in **14** cities since 2001.
- **450** people have been trained as “Stewards” throughout Arizona.
- Collaboration with 33 NGO’s and 8 Agencies.

In 2007 & 2008, volunteers contributed **6,000** service hours to Arizona watersheds & communities annually.

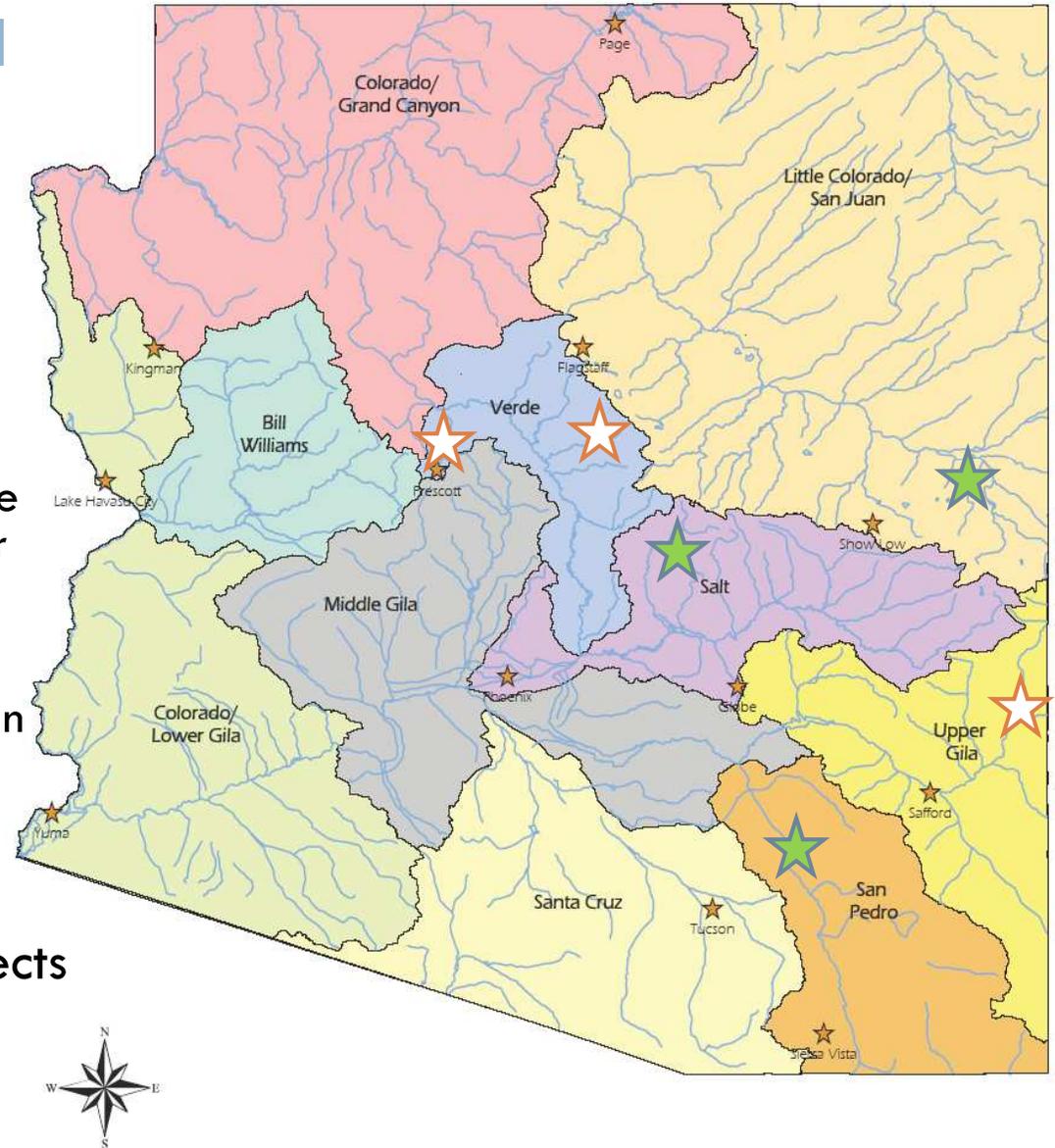


# Volunteer Distribution



# Improving Arizona's Watersheds

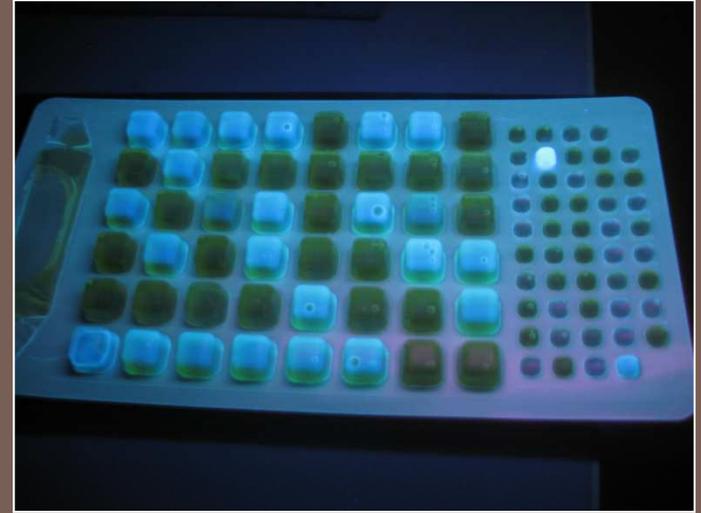
- ADEQ wants NPS water quality impairments addressed
- Targeted watersheds are identified
  - ▣ 2009: Oak Creek, Granite Creek, San Francisco River
  - ▣ 2010: Tonto Creek, Little Colorado Headwaters, San Pedro River
- MWS to develop on-the-ground & education projects to identify & reduce pollutants



# Stewards Serving our Watersheds

- Our volunteers:
  - ▣ Do recon work to identify pollutant sources & project sites
  - ▣ Monitor water quality from lakes & streams
  - ▣ Help implement watershed projects





# UA Extension Water Quality Specialist, Environmental Microbiology Laboratory Support

Channah Rock, PhD

Department of Soil, Water and Environmental Science, UA

# There's *E.coli* in the Water, But Where Did it Come From?

- Volunteer Assisted Monitoring
- Microbial Source Tracking (MST) uses laboratory tests to determine if *E.coli* (or other fecal bacteria) in water samples came from animal or human feces



# Polymerase Chain Reaction

- ❑ Polymerase Chain Reaction (PCR) amplifies the genetic material or DNA/RNA of the bacteria of interest



# Problems with *E.coli*



- High degree of genetic diversity not attributed to a specific host animal source
- Potential for *E.coli* to replicate outside of the host
- Geographic and temporal variability

# Alternatives to *E.coli* : *Bacteroides*

- Bacteria belonging to the genus *Bacteroides* have been suggested as alternative fecal indicators to *E.coli* or fecal coliforms
- They make up a significant portion of the fecal bacterial population
- Have little potential for re-growth in the environment
- Have a high degree of host specificity that likely reflects differences in host animal digestive systems

# Microbial Source Tracking

- These methods are designed to target specific DNA sequences present in feces from different animals
- Specific Primers and Probes are designed to select and amplify only to the DNA/RNA from the organism of interest

Other



Human



Bovine



## GOAL:

Determine the potential human or animal sources of *E.coli* contamination of water to aid development of TMDLs and watershed protection strategies

# Pulling it all together



Watershed Education + Pollutant Modeling +  
Volunteer Water Quality Data + Microbial Source  
Tracking Data + “Boots on the Ground” Watershed  
Assessment

= Watershed Improvement Plan



Targeted Watershed Improvement Plan  
= Delisting?

# Challenges



- ❑ Lack of support and mixed messages from ADEQ as to our role with the targeted groups.
- ❑ Overall perception (by ADEQ and the targeted groups) of who was responsible for training(s) - mixed communications led to....confusion.
- ❑ Groups need to understand the magnitude of generating a water quality improvement.
- ❑ Perception that they are being funded to sustain a group, not to sustain a project...

# Targeted MWS

## Challenges

- Most people in watershed groups work full time
- Funding 
  - University, agency & watershed partners
- Rate of volunteer involvement after a course is often low
- Often hard to engage county extension due to time & no funding

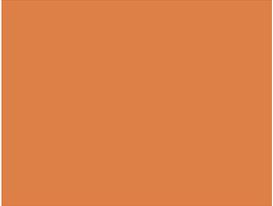
## Opportunities

- Smaller, engaged communities rally issues that impact community
- Address AZ specific issues and
- Develop specialized curriculum & training opportunities
- Additional funding
- Emphasize land grant mission

# Opportunities



- Once groups began to realize their needs appropriate lines of communication were set.
  - ▣ data management obstacles
  - ▣ data collection/mapping questions
  
- Increased Water Quality Awareness
  
- Community groups are being formed and recognized, allow for future capacity building.



Questions?