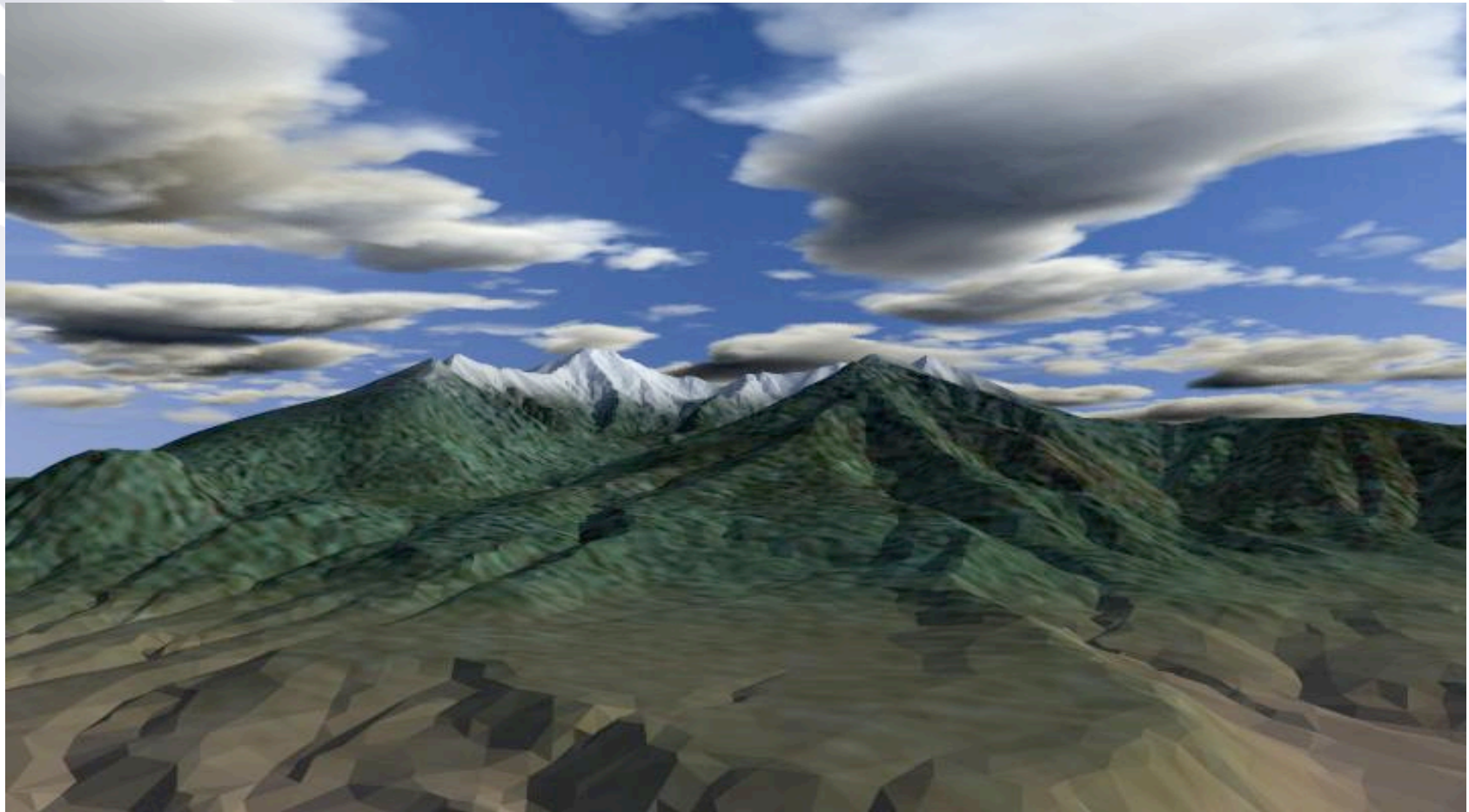


SAHRA Ed-KT Programs: Nov 2009



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Legacy - Education

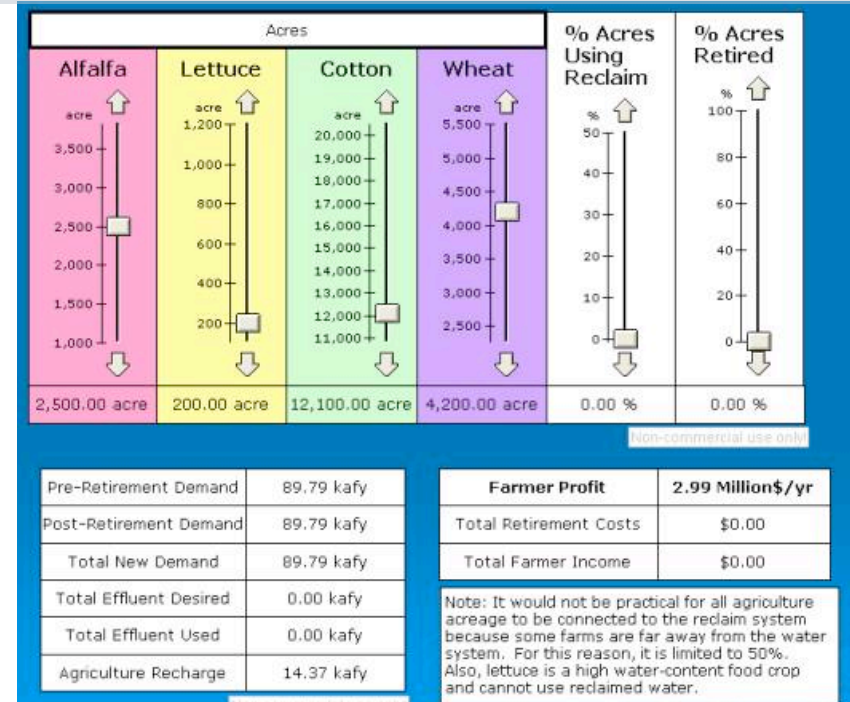
Enhancing hydrologic literacy by:

- Impacting **student actions and decision-making** through improved knowledge of regional water cycling & water resource issues;
- Producing a diverse generation of water professionals, students and faculty who approach water issues from a **multi-disciplinary**, basin scale perspective; and
- Improving **communication** between water professionals and stakeholders.



Arizona Water Issues

- Hydrologic Literacy
 - Watersheds
 - Water law/ Water markets
 - Water issues
 - Water resource mgmt.
- GenEd core for non-sci majors
 - 60 students; 8 groups
 - No lab, 75 min
- Innovations: DSS models
 - Teach **complex and inter-related concepts** while keeping model details hidden



chubasco.hwr.arizona.edu/education/azwater

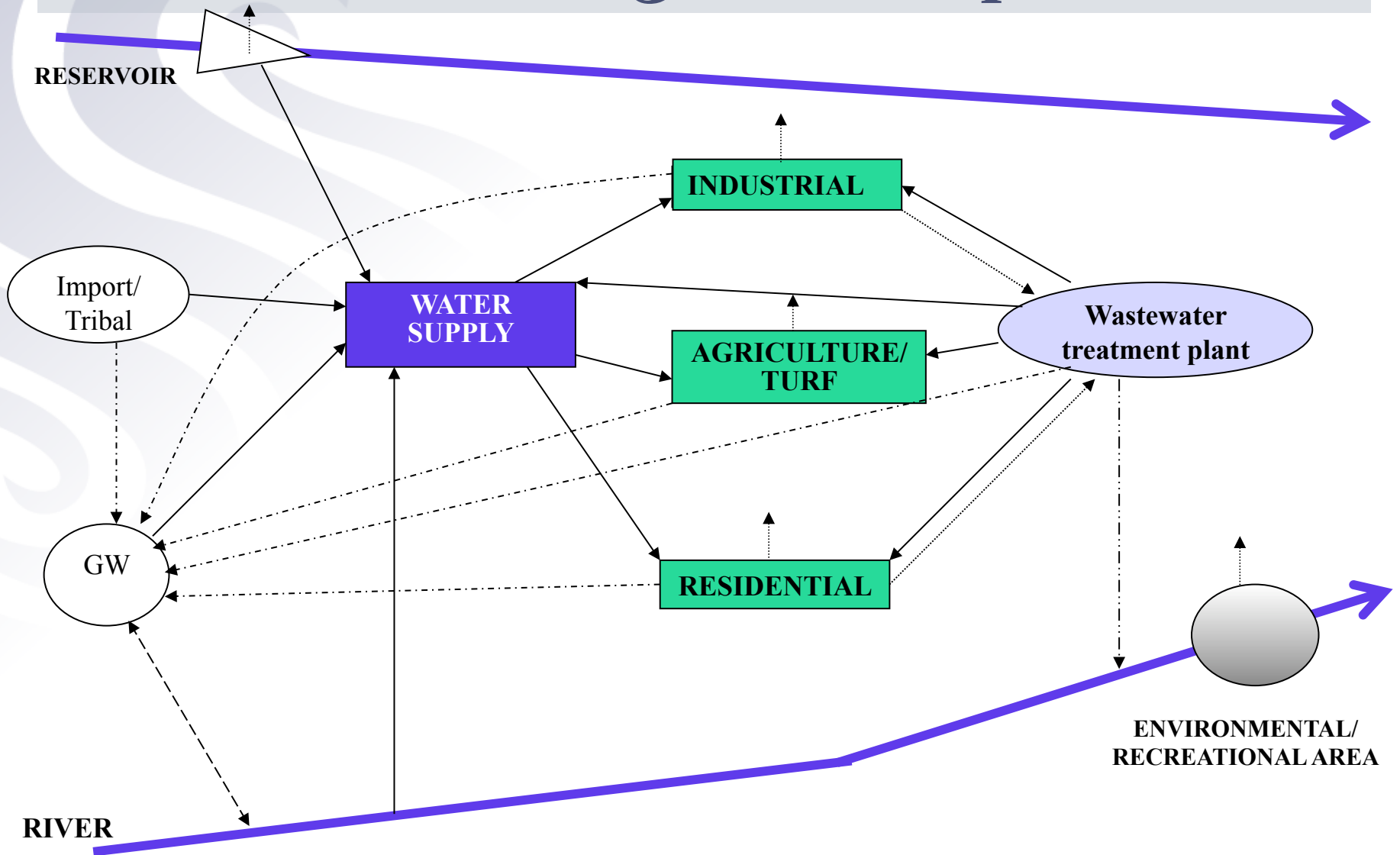


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Water Plan 2030 – conceptual model



USPP Decision Support Model

- Evaluate impact of alternative water transfer scenarios or water conservation / recharge measures

(1) define timing and magnitude through interface pages

(2) DSS computes the magnitude and spatial distribution of pumping and recharge.

Public Works Projects

Input for the nine public works projects can be supplied through this page. Detailed descriptions of the same options and similar input boxes can be accessed through the three detailed Public Works Pages in the navigation bar. Selection only needs to be made once.

Bisbee/Naco Projects Implementation Year

Recharge Bisbee effluent

Reuse Bisbee's treated effluent to irrigate T.V.G.C.

Recharge Naco's effluent

Sierra Vista Projects

Select at most one Sierra Vista recharge project

a) Recharge Sierra Vista effluent in infiltration basins

b) Recharge Sierra Vista effluent upstream of SPRNCA

c) Treat Sierra Vista effluent and use to irrigate SV parks and Pueblo Del Sol golf course

Connect Golden Acres subdivision to sewage collection system, treat and recharge/reuse effluent

Huachuca City Projects

Select at most one Huachuca City effluent project

a) Treat and recharge Huachuca City effluent recharge on Fort Huachuca through recharge basins

b) Treat Huachuca City effluent on Fort Huachuca and use to irrigate Pueblo Del Sol golf course

uspp.ce.arizona.edu/webapplication1/



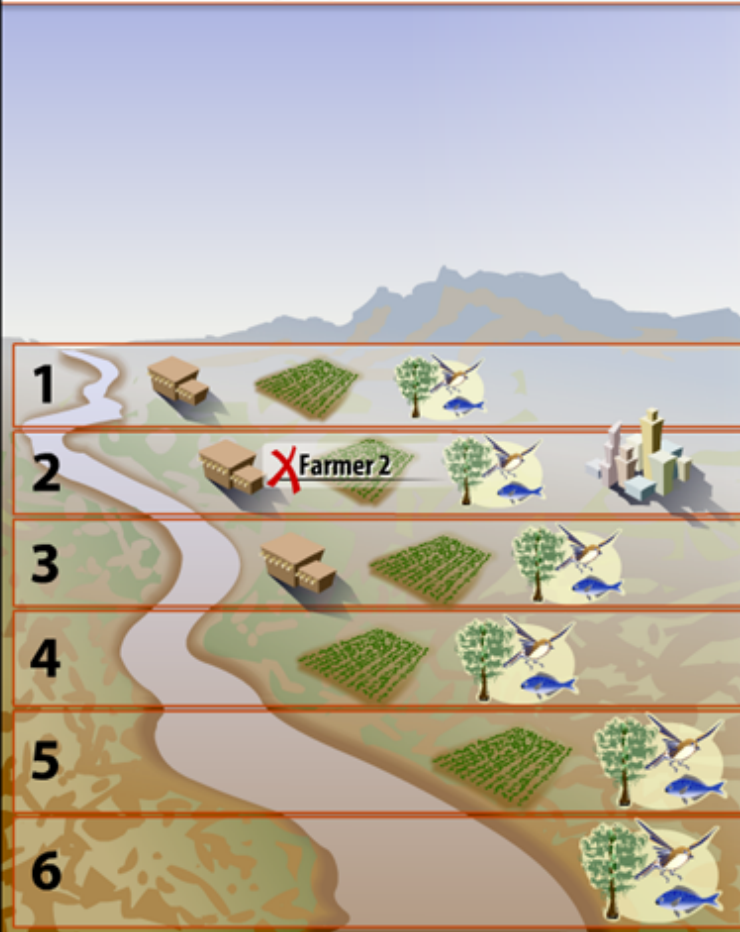
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Water Trading Experiment

UNM Water Banking Experiments



You and the other participants in the experiment will be buying and selling water from different, fixed locations on a river. Different types of users are represented on the river. This river is structured as follows:

Your location on the river is marked by the red **X** and you are **Farmer 2**

The distributions of other water users at other locations along the river are designated. The river is divided into six sections called "reaches" The river flows from top to bottom, starting at the top with "reach 1" going to "reach 6". Notice that some participants may be above or "upstream" from you while others may be below, or "downstream" from your position. Uses of the water include:

Farming



Environmental



Urban consumptions

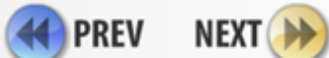


Native American farming



Notice that you are in **REACH 2**

page 3



www.sahra.arizona.edu/UNM/experiments/tutorial3/type_a/index.php



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Water Trading Experiment

UNM Water Banking Experiments



#	User	User	AF	\$
10	Cash Farmer 3	<< Pecan Farmer 2	1	\$0.80
09	Cash Farmer 2	<< Cash Farmer 4	0.3	\$1.50
08	Urban	>> Pecan Farmer 3	1	\$0.50

[Water Balance Value Key] (AF for 10 acres of pecan)

Mo.	1	2	3	4
AF	2.66-4.5	2.66-4.5	2.66-4.5	2.66-4.5
	0 ton	0 ton	0 ton	11.29-12.9 ton

You are Pecan Farmer 2 on Reach 3

TIME LEFT THIS MONTH: 03:32

Growing Season 1	Month 1	Month 2	Month 3	Month 4
		Forecast	Forecast	Forecast
Initial Water Allocation	1.75 AF	± 3.24 AF	± 3.24 AF	± 3.24 AF
Water Acquired	+0.00 AF	+0.00 AF	+0.00 AF	+0.00 AF
Current Water Balance	1.75 AF			
Trading Cash Available	\$10.00			
[Water Balance Value]				

A box pops up where Pecan Farmer 2 enters an amount of 1 AF at a price of \$5. The computer automatically calculates a price of \$5 an acre foot for this transaction. Pecan Farmer 2 then clicks on the submit button to place this bid on the trading interface.

Trade Type: Buy water
 Round Destination: 233
 Units: 1.00 AF
 Price: \$ 5
 Cost of water per AF: \$5.00/AF

PROCESS and EXAMPLES

There are four ways to make a trade:

Example 1: Your bid can be accepted by a seller

2. Your offer can be accepted by a buyer

3. You can accept a buyers bid

4. You can accept a sellers offer

In this example Pecan Farmer 2 decides to submit a bid to buy water in month 1. This is done by first clicking on the buy button located in the month 1 column and the Pecan Farmer 2 row.

	REACH	Month 1	Month 2	Month 3	Month 4
Cash Farmer 1	1	YOU BUY			
Cash Farmer 2	2				
Pecan Farmer 2	3	BUY WATER	SELL WATER	BUY WATER	SELL WATER
Cash Farmer 4	4				
Cash Farmer 5	5				
Environmental	6				

Welcome to SAHRA Scenario Development!

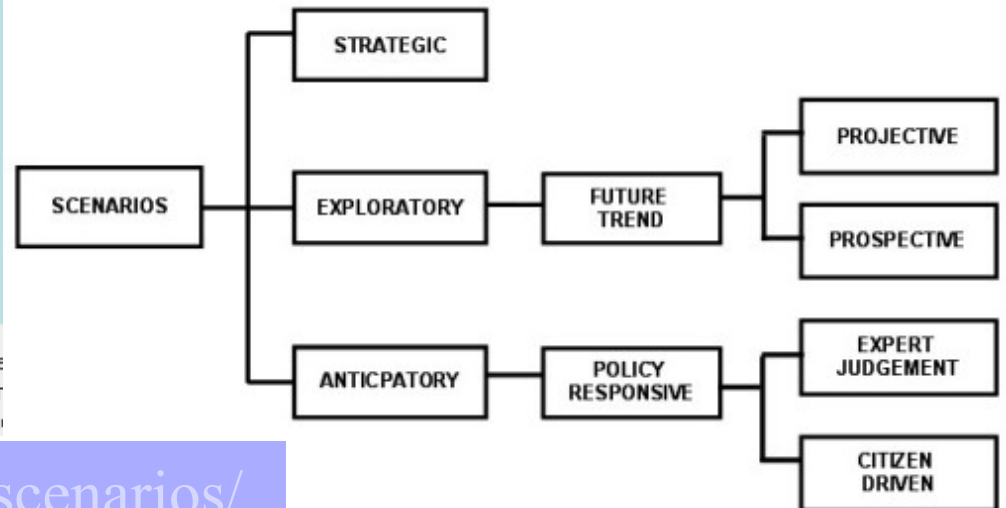
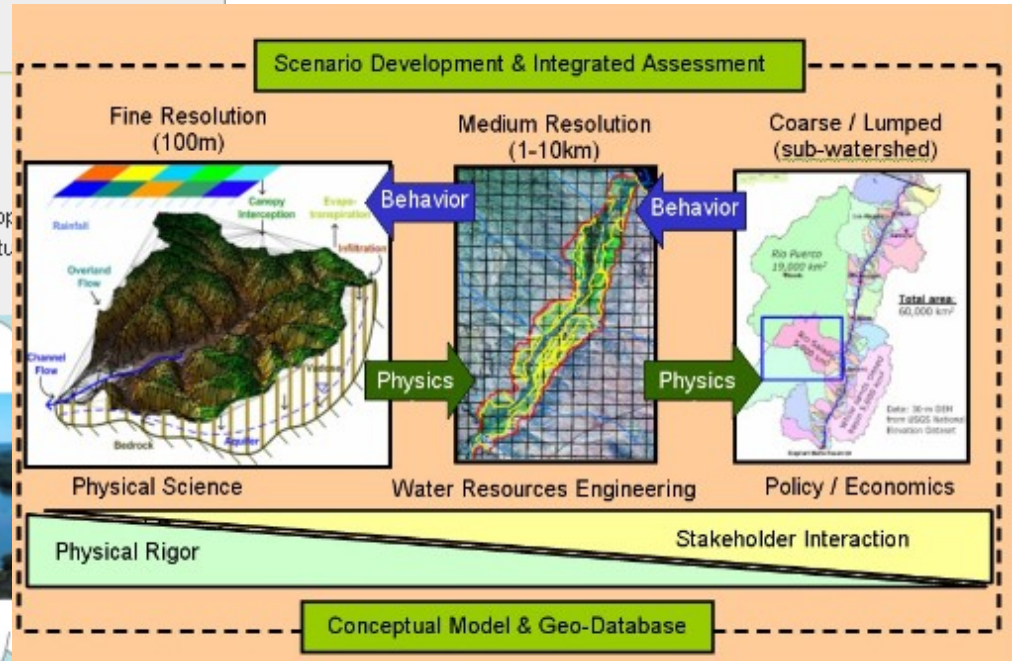
Welcome to the scenario development web community!

While there are a lot of resources on the web and in print media about scenario development, many of those resources are specific to the unique problems of developing scenarios for natural resource management and environmental modeling.



Scenario planning allows us to imagine all possible futures that can occur, including the range of possibilities between them. Scenarios require us to think with an open mind about what may happen, since we want to consider all plausible futures and not just the most likely one.

www.sahra.arizona.edu/scenarios/



SAHRA

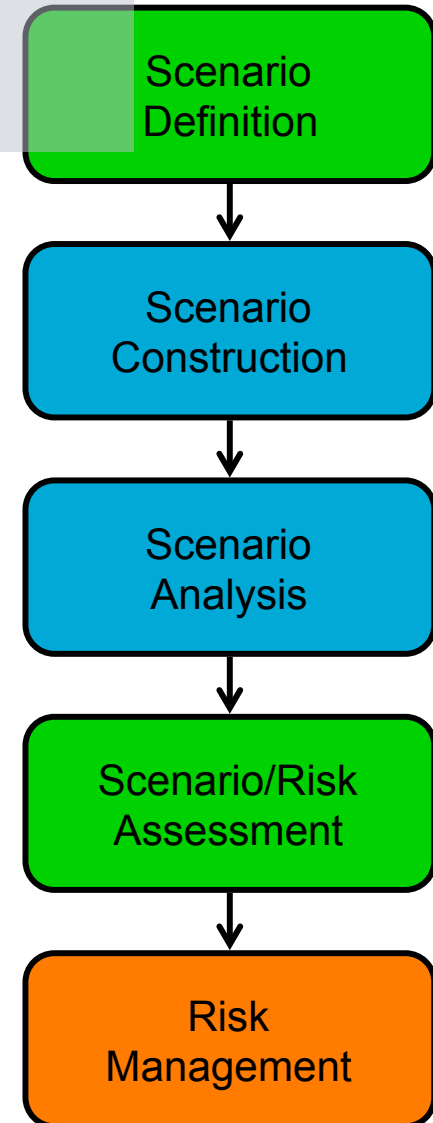
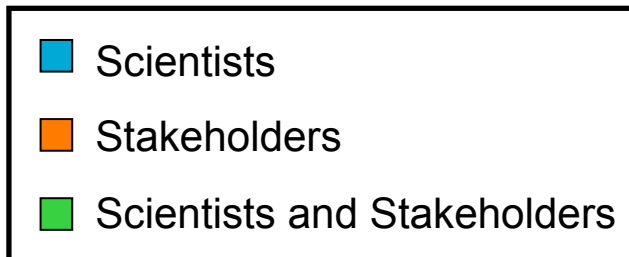


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Scenario Development - 5-Phase Plan

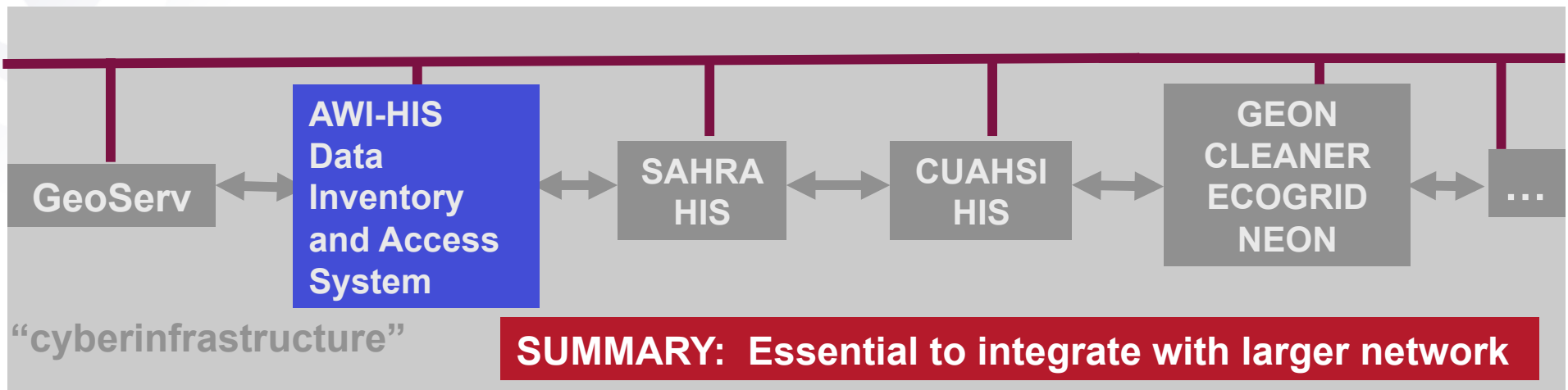
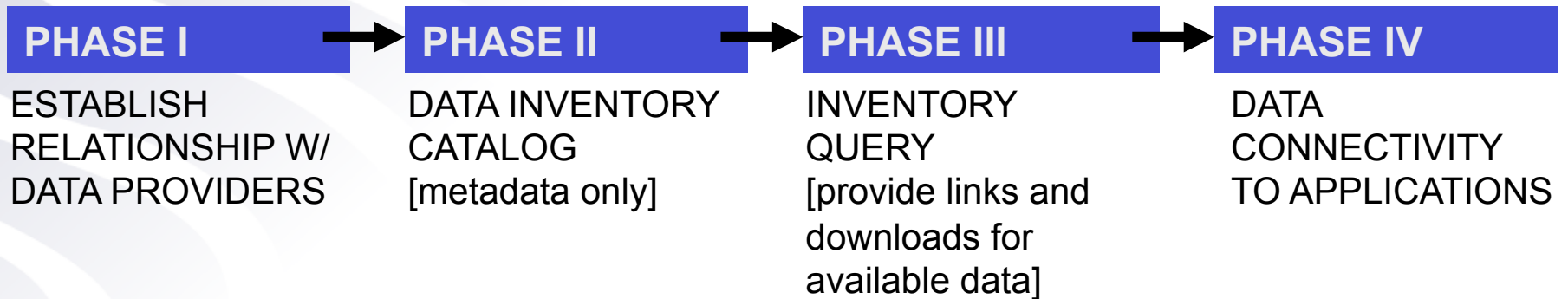
What is a Scenario?

- IPCC definition:
" A scenario is a coherent, internally consistent and plausible description of a possible future state of the world. It is not a forecast; rather, each scenario is one alternative image of how the future can unfold."



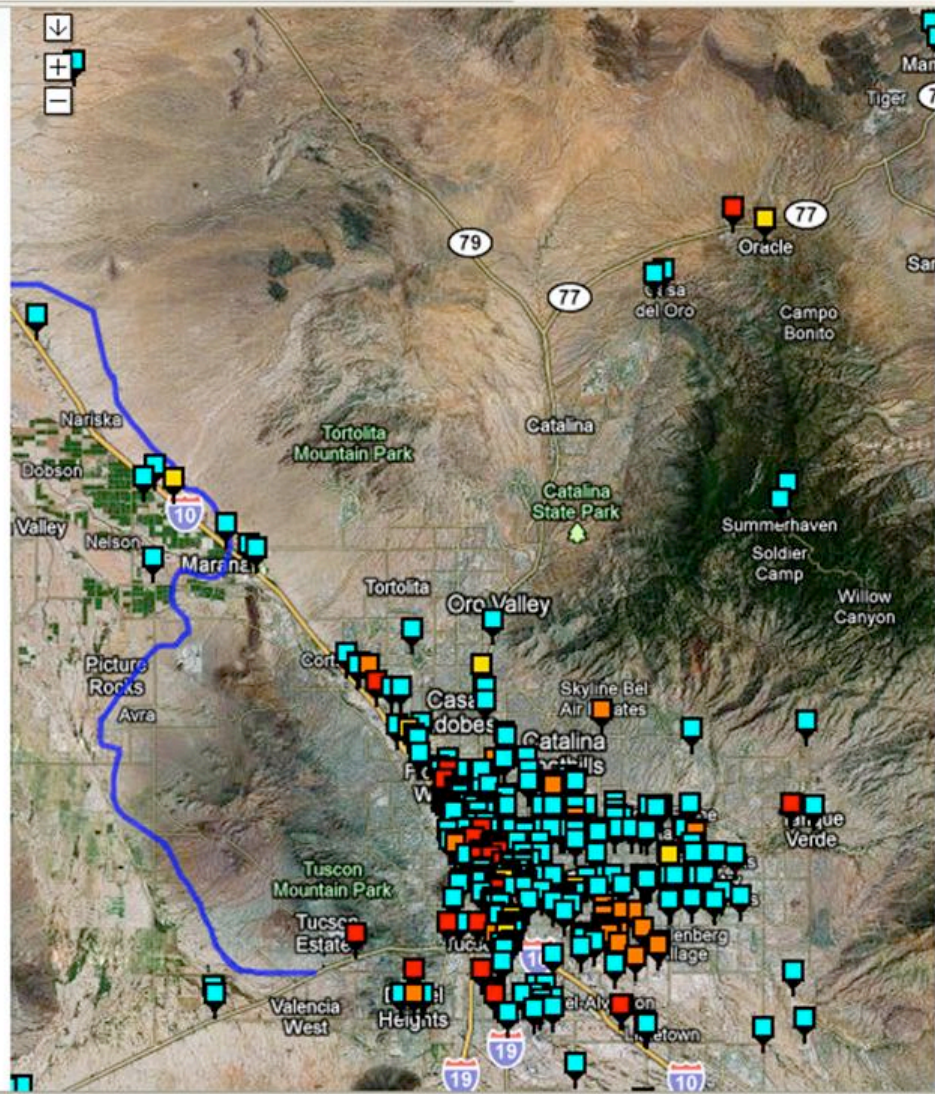
AHIS – AZ Hydrologic Information System

Water Related Data Inventory and Access System



AZ Hydrologic Information System

- Meta
- Inte
- Web
- Attr
- Revi
- Sea
- Pipe



center
-111.323°E 32.400°N -110.499°E
-110.911°E
31.994°N

Showing 1529 points and 1 polygon.

Clear All Data

Best Map Extent

Map navigation

STEP 1: Choose a map navigation method

Select a pre-defined region

STEP 2: Select a pre-defined region

Tucson

STEP 3: Update Map

[\(22d\)](#)

[Return to top](#)

State of Arizona sources

- [Central Arizona Project](#)
- [Aqueduct](#)
- [Dept. of Environmental](#)

Quality

- [CWA Sec. 319\(h\)](#)

projects

- ices
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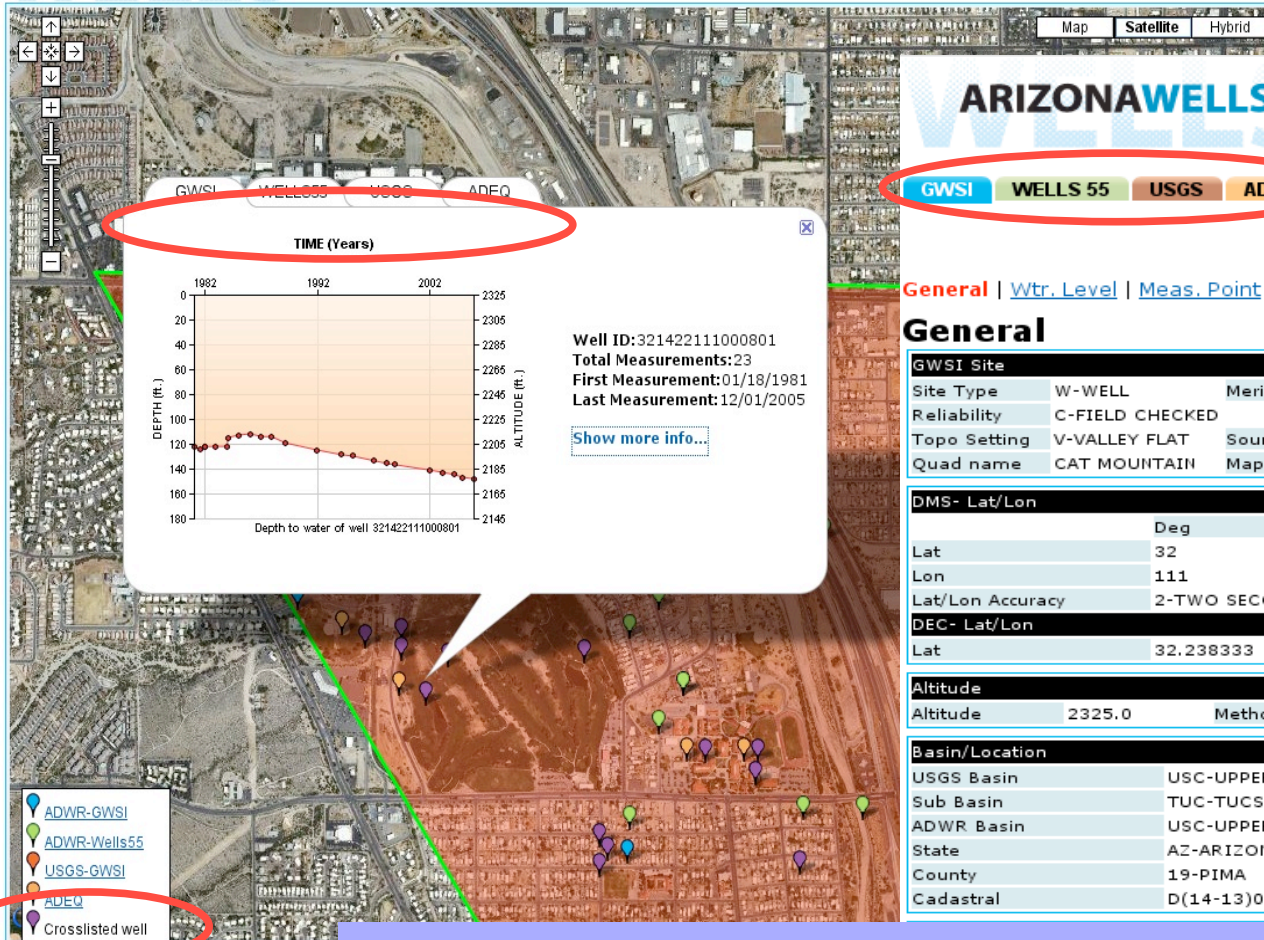


Hydrologic
Information System

chubasco.hwr.arizona.edu/ahis-drupal/

Arizona Wells

ARIZONAWELLS



ARIZONAWELLS

GWSI WELLS 55 USGS ADEQ

General | [Wtr. Level](#) | [Meas. Point](#) | [Remark](#) | [Const.](#) | [Owner](#) | [Lift/Pump](#) | [Logs](#) | [Other ID](#) |

General

GWSI Site			
Site Type	W-WELL	Meridian	G-GILA AND SALT RIVER
Reliability	C-FIELD CHECKED		
Topo Setting	V-VALLEY FLAT	Source	USGS-UNITED STATES GEOLOGICAL SURVEY
Quad name	CAT MOUNTAIN	Map Scale	024000

DMS- Lat/Lon				
Lat	32	14	18.0	
Lon	111	0	5.0	
Lat/Lon Accuracy	2-TWO SECONDS		Lat/Lon Method	-
DEC- Lat/Lon				
Lat	32.238333		Lon	-111.001389

Altitude			
Altitude	2325.0	Method	M-MAP
		Alt Accuracy	005

Basin/Location	
USGS Basin	USC-UPPER SANTA CRUZ BASIN
Sub Basin	TUC-TUCSON AMA
ADWR Basin	USC-UPPER SANTA CRUZ
State	AZ-ARIZONA
County	19-PIMA
Cadastral	D(14-13)03 DCB

www.sahra.arizona.edu/wells/



SAHRA



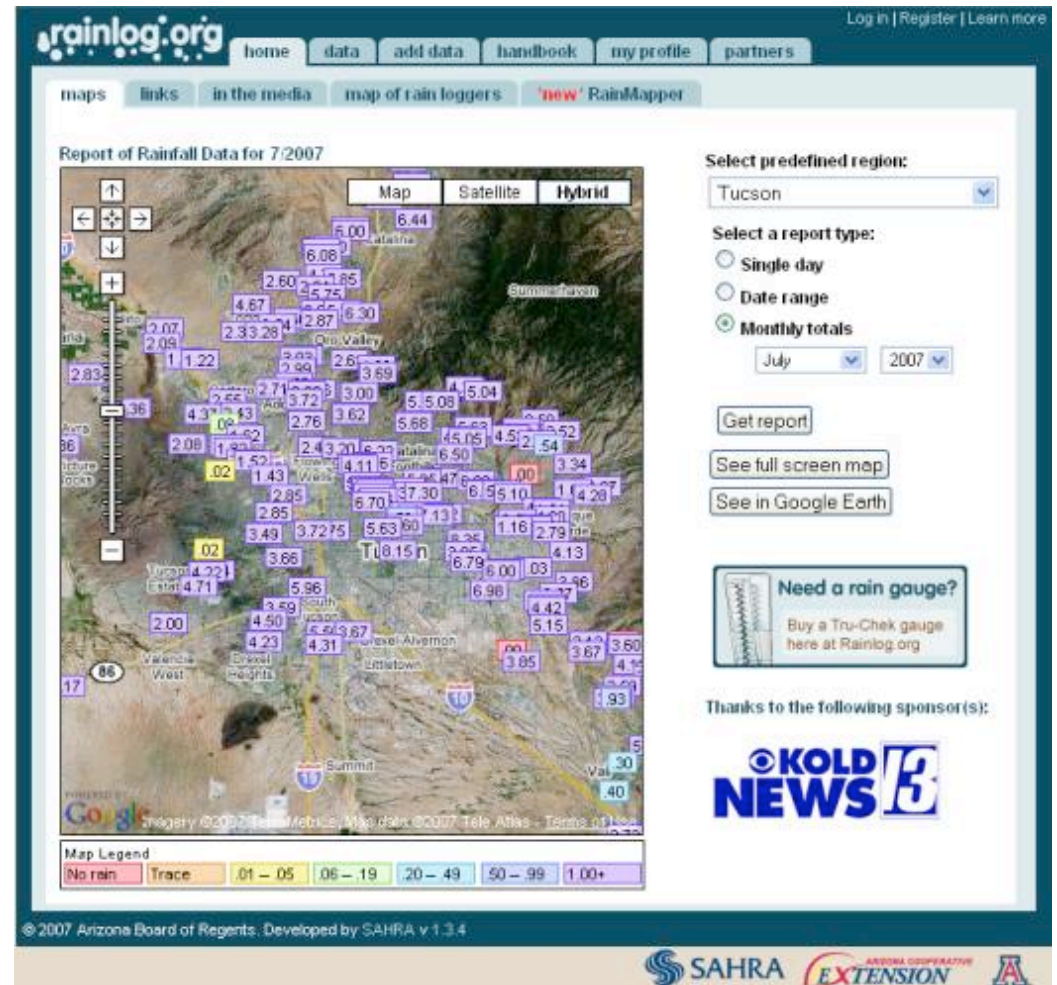
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Rainlog.org: Volunteer Data Collection

Potential users for these data include:

- drought monitors
- master watershed stewards
- irrigation schedulers
- weather reporters
- water educators
- invasive species eradicators

rainlog.org



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SAHRA GeoData Database

The screenshot displays the SAHRA GeoData Database interface. At the top, the SAHRA logo and the title "Upper San Pedro Precipitation Data" are visible. The main map area shows a geographical region with various data layers overlaid, including precipitation gauges (represented by colored dots and triangles) and hydrological features (represented by red and blue lines). A legend on the left side of the map lists the layers and their symbols:

- rainGages
 - AGENCY
 - EPG
 - EPG/USDA
 - ▲ NWS
 - USDA-ARS
 - USGS
 - HydroEdges
- imageArea
- Watersheds
- Roads
- MXStates

On the right side of the interface, there are several utility panels:

- Data Web Service**:
 - [Get Variables](#)
 - [Get Variables Info](#)
 - [Get Sites](#)
 - [Get Site Info](#)
 - [Get Values](#)
 - [Get Chart](#)
 - [Get Image](#)
- Metadata**:
 - [HTML](#)
 - [XML](#)
- Help**:
 - [Web Service Methods](#)
 - [About Data Access](#)

At the bottom of the interface, the URL www.sahra.arizona.edu/research_data/SAHRAGeoDB/ is displayed.



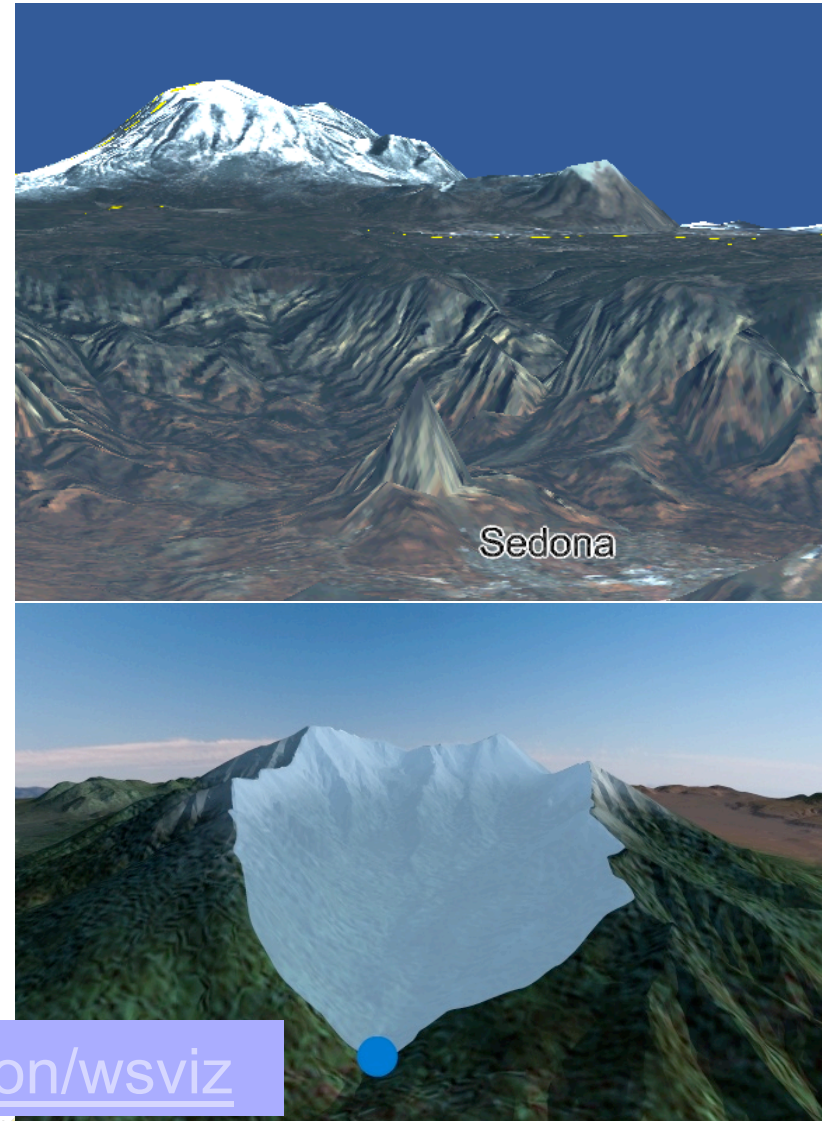
SAHRA Hydroarchive

The screenshot shows the SAHRA Hydroarchive website. At the top left is the SAHRA logo and the text "SAHRA Hydroarchive". At the top right is a link for "SAHRA home". Below the header is a search bar with the text "search software" and a "Go!" button. A navigation menu contains "main page", "advanced search", and "submit". The main content area is divided into two columns. The left column has a heading "Instructions:" and text: "To see the archive, simply select a category in this animation or do an advanced search:". The right column has a heading "Welcome to SAHRA's Hydroarchive." and text: "Click here to read more about this Hydroarchive Site and for a welcome message from Jim Shuttleworth, Director of SAHRA. + Jan 26, 2004 - Read article from Hydrological Processes about this Hydroarchive." Below the text is a circular navigation menu with buttons for "Mod", "ANN", "Opt", "GIS", "Dat", "Gen", and "Eva". The "Mod" button is highlighted, and a large yellow button labeled "Models" is positioned to its right. Below the "Models" button are two columns of sub-navigation buttons. The first column has "View all Rainfall-Runoff >" and "View all Sub-surface >". The second column has "View all MODFLOW packages a Response Functions". At the bottom of the page is a blue banner with the URL www.sahra.arizona.edu/software/.



Watershed Visualization

- Finally Complete!
- NSF GeoEd funding \$260k
- Verde Basin Focus
- Products: DVD and Web site
- Primary Questions
 - What does a watershed look like?
 - What is a watershed (WS)?
 - Where does water in a WS come from? (water cycle)
 - How does GW recharge occur?
 - How does runoff become a river?



www.sahra.arizona.edu/education/wsviz

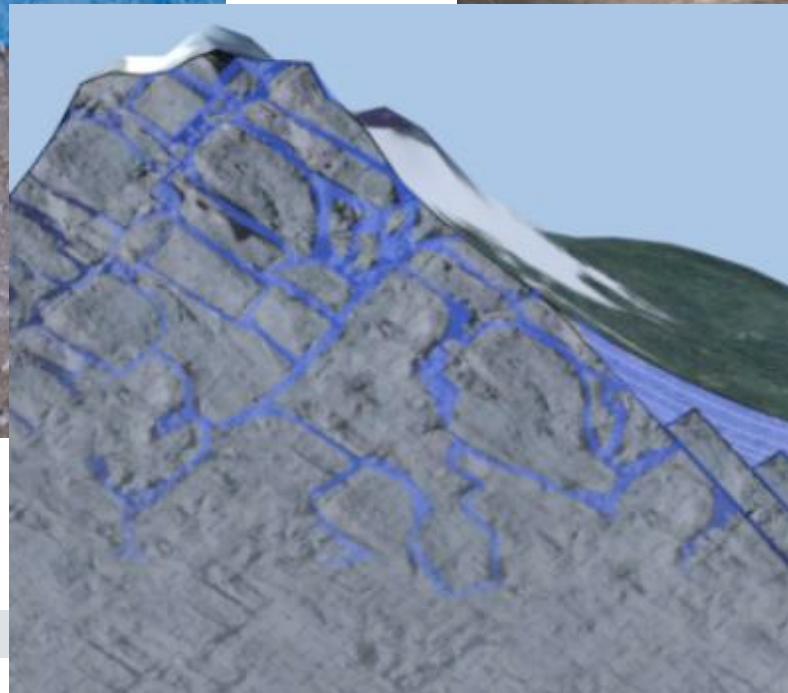
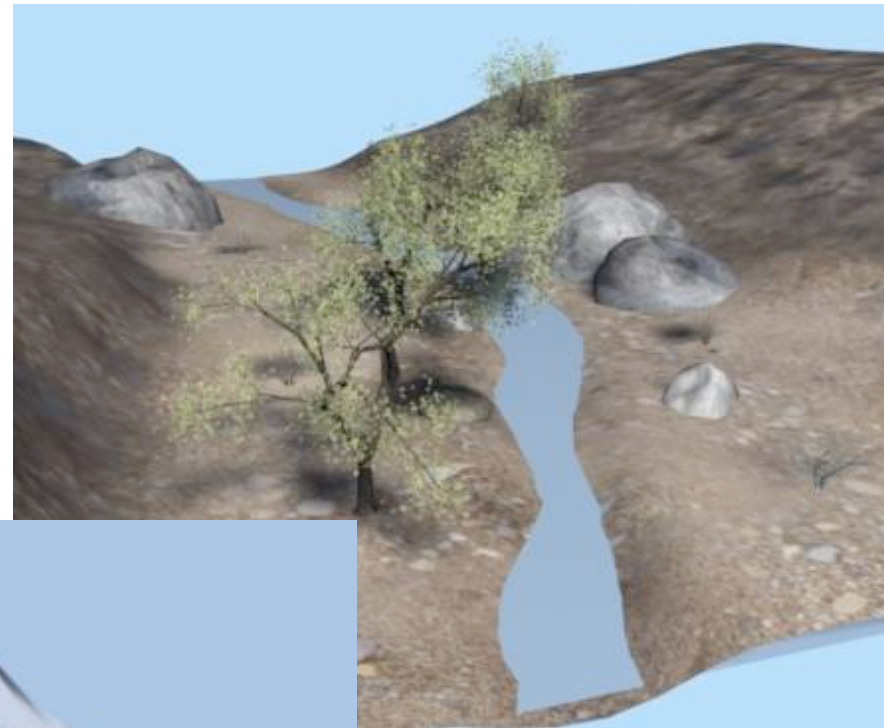


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WS Viz: Recharge & Infiltration



Balance between
realism &
conceptual process



Personnel Considerations

- Associate Directors of KT and Edu
 - Gary Woodard & Jim Washburne
- Editors
 - Betsy Woodhouse, Erika Noebel, Louise Shaler
- Database managers/developers
 - Matt Garcia, Matej Durcik
- Database/Web programming
 - Ramon Vazquez
- Graphic Artist
 - Shiloe Fontes
- Web development & Support
 - Cindy Grooms
 - Louise McDermott



EarthBuzz

- Collaboration with NCED & SMM & 5 STC's
- Focus is man's effect on the planet – Anthropocene era
- Product:
 - Kiosk / Web site
 - Ask a scientist
 - Blogs
 - Background



www.sciencebuzz.org/museum/ask/huxman



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Scientific Literacy Initiatives

- **Ocean literacy** is an understanding of the ocean's influence on you—and your influence on the ocean.

An ocean-literate person:

- understands the **Essential Principles and Fundamental Concepts** about the functioning of the ocean;
- **can communicate** about the ocean in a meaningful way; and
- is able to **make informed and responsible decisions** regarding the ocean and its resources.

Earth science literacy

- Big ideas- Earth is:
 - 3) a complex system of interactions between rock, water, air and life.
 - 4) continuously changing
 - 5) Earth is the water planet
 - Water is essential for life
 - Water's unique physical and chemical properties are essential to the dynamics of all Earth's systems
 - Earth's water cycles between atmo, lakes, ice, aquifers ...
 - Water shapes landscapes

COSEE

www.earthscienceliteracy.org



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Water Plan 2030 – User interface

Residential
Turf and Reclaimed Water
Agriculture

NOTE: If you override the default crops (on the Customization Page), please go to: [Agriculture Override](#)

% Older Homes with Fixture Retrofits: 50 %

Indoor Water Demand: [Slider]

Outdoor Water Demand: [Slider]

Residential Rainwater, Graywater, Irrigation Return: [Slider]

Yearly Residential Total Recharge: [Slider]

Acres	
Alfalfa	2,500 acres
Lettuce	200 acres
Cotton	12,100 acres
Wheat	4,200 acres

% Acres Using Reclaim	
0 %	0 %

Farmer Profit	
Total Water Demand*	89.79 kafy
Total New Demand	89.79 kafy
Total Effluent Used	0.00 kafy
Total Effluent Desired**	0.00 kafy
Agriculture Recharge	14.37 kafy
Total Farmer Profit	2.99 Million\$/yr
Total Retirement Costs	0.0 Million\$
Total Farmer Income	74.6 Million\$

*Total Water Demand is the demand after acreage has been retired. **Total Effluent Used may be less than Desired if not enough effluent is available.

Note: It would not be practical for all agriculture acreage to be connected to the reclaim system because some farms are far away from the reclaimed water system. For this reason, it is limited to 50%. Also, lettuce is a high water-content food crop and cannot use reclaimed water; reclaimed water will be divided between the other three crops.

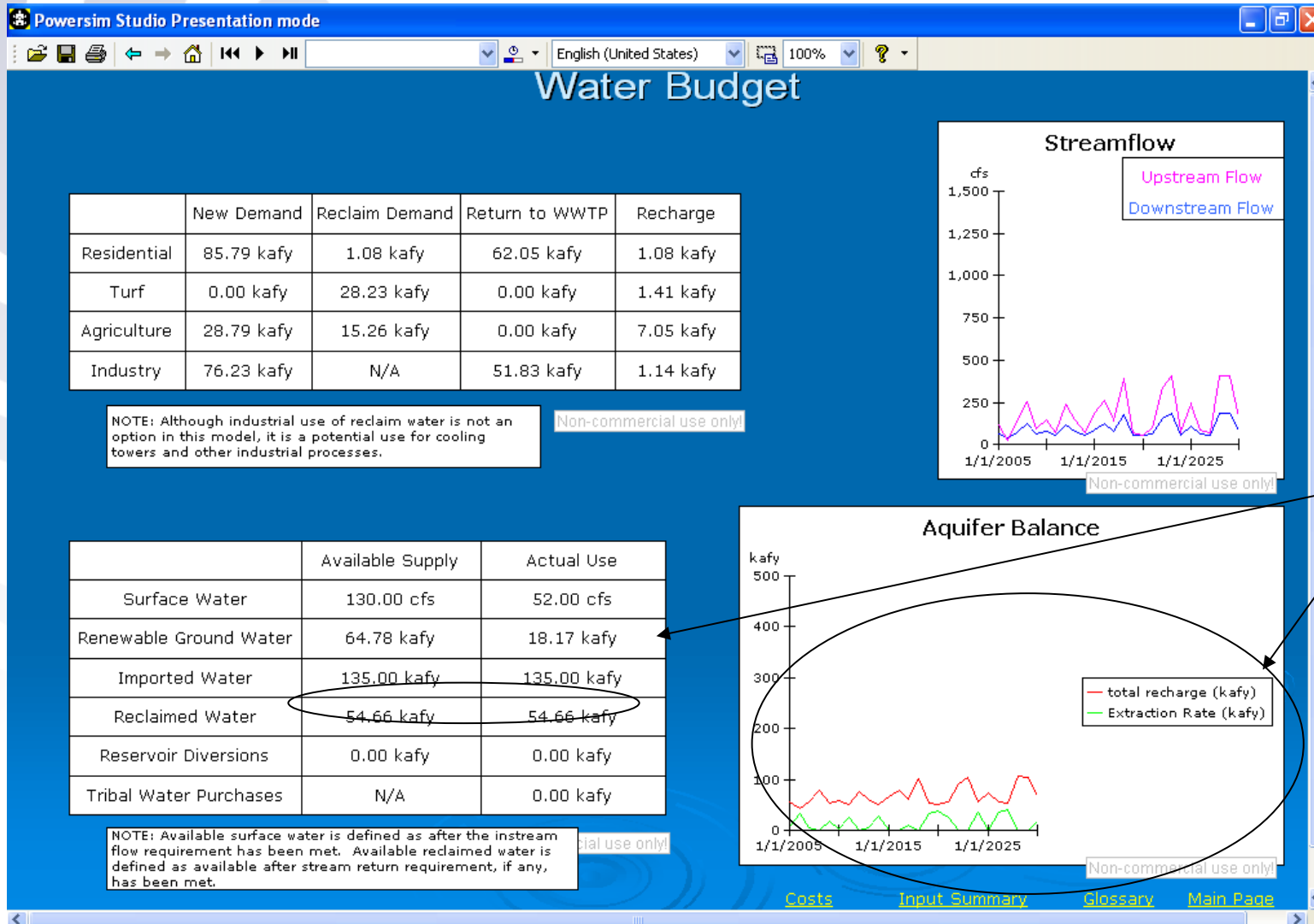
Streamflow: [Line Graph showing Upstream Flow and Downstream Flow from 1/1/2005 to 1/1/2025]

Aquifer Volume: [Line Graph showing Aquifer Volume in kaf from 1/1/2005 to 1/1/2025]

[Glossary](#) [Main Page](#)



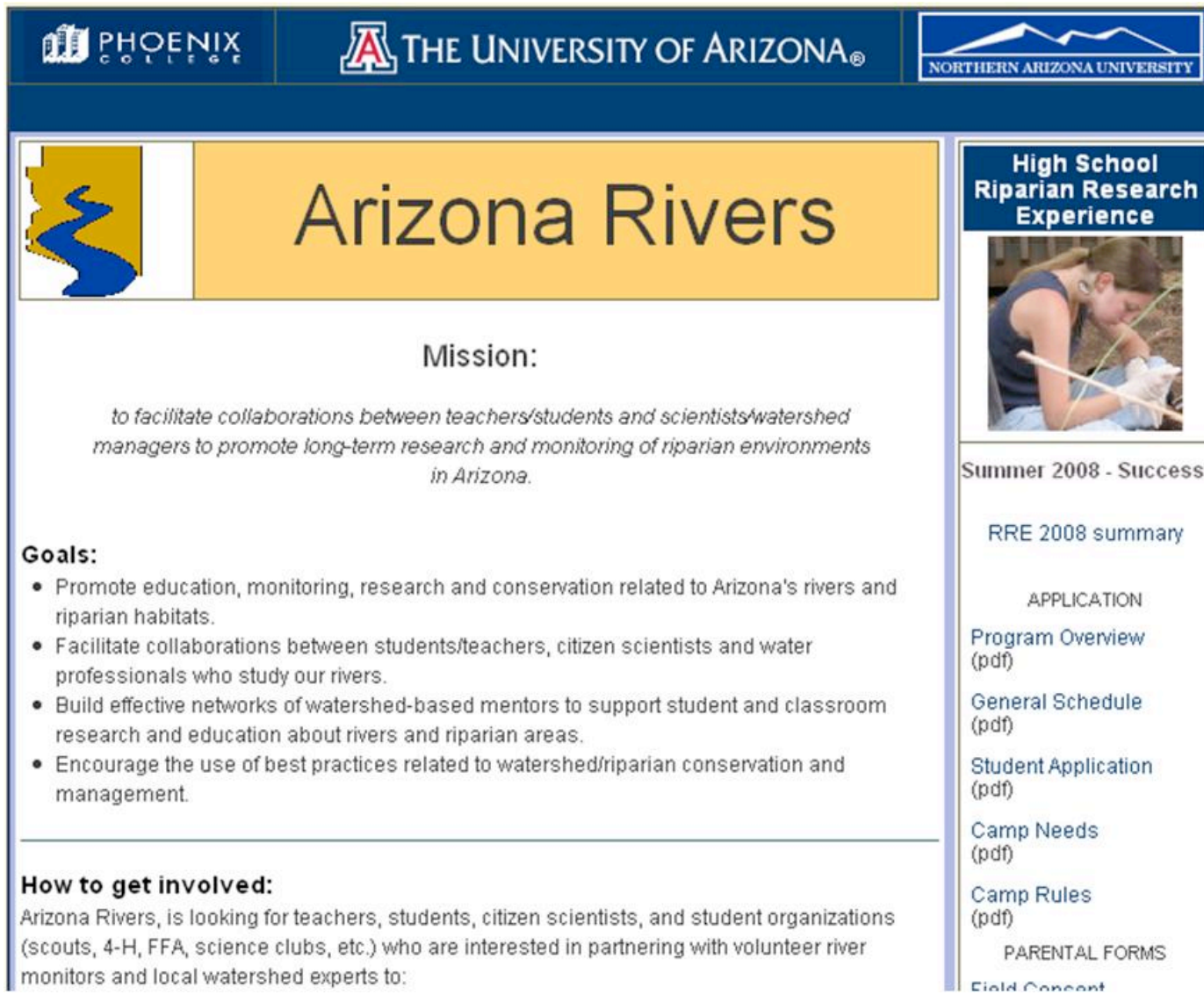
Water Plan 2030 – Goal: Safe Yield



An example of a region meeting safe yield. Extraction does not exceed total recharge, also known as renewable groundwater. The Aquifer Volume graph in this case would actually be slowly rising.



Web Site: www.azrivers.org



The screenshot shows the homepage of the Arizona Rivers website. At the top, there is a dark blue header with three logos: Phoenix College, The University of Arizona, and Northern Arizona University. Below the header is a yellow banner with the text "Arizona Rivers" and a small graphic of a river flowing through the state of Arizona. The main content area is divided into three columns. The left column contains the mission statement and a list of goals. The middle column contains information about the High School Riparian Research Experience, including a photo of a student working in a field and a list of resources for the Summer 2008 program. The right column contains a large graphic of the state of Arizona with a river flowing through it.

PHOENIX COLLEGE **THE UNIVERSITY OF ARIZONA®** **NORTHERN ARIZONA UNIVERSITY**

Arizona Rivers

Mission:

to facilitate collaborations between teachers/students and scientists/watershed managers to promote long-term research and monitoring of riparian environments in Arizona.

Goals:

- Promote education, monitoring, research and conservation related to Arizona's rivers and riparian habitats.
- Facilitate collaborations between students/teachers, citizen scientists and water professionals who study our rivers.
- Build effective networks of watershed-based mentors to support student and classroom research and education about rivers and riparian areas.
- Encourage the use of best practices related to watershed/riparian conservation and management.

High School Riparian Research Experience

Summer 2008 - Success!

RRE 2008 summary

APPLICATION

Program Overview (pdf)

General Schedule (pdf)

Student Application (pdf)

Camp Needs (pdf)

Camp Rules (pdf)

PARENTAL FORMS

Field Consent

Arizona Rivers

Student and Volunteer Monitoring of Arizona Rivers and Riparian Areas

- SfAZ grant, \$280k for 1 year
- Co-I's: Whitaker, Washburne and Madden
- Sub's: Phoenix College - Pepe, NAU – Shannon;
- Focus: Facilitate and coordinate training and effective deployment of volunteer monitors, especially schools
- Leverage:
 - GLOBE database and protocols
 - SAHRA water kits

www.azrivers.org



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Riparian Research Experience

2008 @ Biosphere 2!

- 18 days: Jun 15-Jul 2

2009 @ SW Academy

- 15 days: Jun 6-20

2010 @ TBD?

- 15 days: Jun 11-16

- 3 days – intensive training
- 2 days – skills devel.
- 8 days – exploring & monitoring Arizona's rivers
- 2 days – analysis & report



SAHRA

www.azrivers.org

ter

5

Water in Arizona - TEACHER Resources

- Kits for classrooms
 - Water Quality
 - Aquatic Life
 - Watersheds
 - Urban Hydrology
- Distributed in AZ, NM
- Mapped to Standards
- On-line assessment tool
- Integrated with new programs: AZrivers, Wsviz

www.sahra.arizona.edu/water



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