Hydrologic Investigation of the upper and middle Verde Watersheds

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Program Goals and Objectives

- Regional database
- Hydrogeologic framework
- Conceptual model
- Numerical model

Improve the understanding of the regional ground-water system
Ecosystem Restoration Support?

Improve understanding of
• Predevelopment hydrologic system
• Current hydrologic system
• Natural variations in hydrologic processes
• Anthropogenic changes to the system
• Future scenarios - Planning - Impacts

Significant Impacts of Concern
• Water Quantity
• Water Quality

Introduced Species
Total Precipitation

Potential Evapotranspiration
Average Rainfall for all NOAA Coop Rain Gages in the Study Area

Rainfall in the Watersheds
Winter Base-Flow Trends

Y-Axis Base flow in cfs
X-Axis Time in years

Verde River Near Paulden

Verde River Near Clarkdale

Wet Beaver Creek

Oak Creek at Sedona
Number of days per year with daily discharge values above 1 standard deviation at selected gages

Extreme Events Important to Lifecycle of Certain Species
Big Chino water level gradients: 1992

More recent water levels in Big Chino: Similar to 1992 with declines in a few areas.
Little Chino Valley (-0.5 to -2 ft/yr)

Lonesome Valley (-1 to -2 ft/yr)
Ground Water Verde Formation
-5 to -10 ft of decline over 50 yrs
Ground Water C-Aquifer

Local Aquifers
Greater Declines Measured
Water Levels and Base Flow are Responsive to Changes in Rainfall

Rainfall and Base Flow

- Water Levels
- Base Flow
- Rainfall

Depth to Water

Precipitation, in inches

Winter Base flow, in CFS @ Paulden

Depth to water, in feet, Big Chino
Sample Collection in the Upper and Middle Verde Watersheds

- Spring Samples
- Precipitation Samples
- Surface-water Samples
- Ground-water Samples
Seasonal Stable Isotope Ranges in Precipitation

δ²H
δ¹⁸O

Summer Precipitation
Winter Precipitation
Surface- and Ground-Water Quality is Pristine Except ARSENIC
Conclusions

Concerns for Restoration
• Need for basic data to define system
• Current rainfall within bounds over last century
• Temperature increase observed
• Surface water in upper Verde responsive to storage changes
• Ground-water withdrawals impacting base flow of springs
• Winter recharge predominant
• Arsenic is the only water quality factor – natural source
Questions?