Water Resources, Climate Change and Institutional Vulnerability: A Case Study of Phoenix, Arizona.

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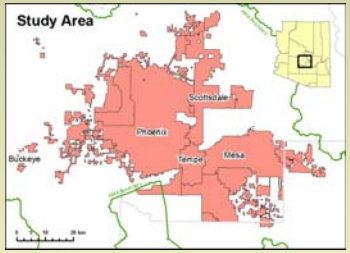
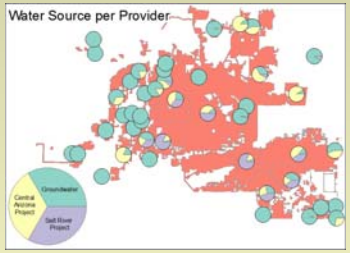
Overview

As one of the fastest growing metropolitan areas in the US, Phoenix constitutes a key site for examining the projected effects of population growth and climate change on water resources. Water providers in the region rely on a mix of sources that include groundwater, water from the Salt/Verde system, and water from the Colorado River. We assess and map patterns of projected institutional vulnerability to reduced water supplies, and discuss options for mitigating potential impacts.



Water provider and Active Management Area boundaries



Water portfolios for each provider

Water Sources

The Salt/Verde System and the Salt River Project

SRP was established in 1903 to deliver water to agricultural land located in south-central Arizona. Today, 90% of that service area has been urbanized. The year 2007 was the 12th year of drought and the longest drought period in SRP history. Annual allocations have been reduced in order to cut water demand.

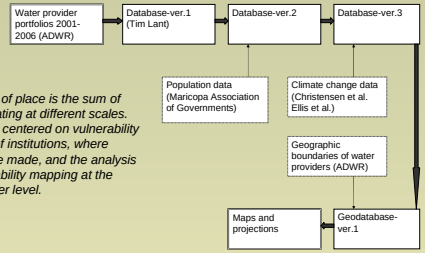
Groundwater

Groundwater supplies 40% of the Phoenix AMA's annual average requirements. Overdraft in the AMA is 251,000 af annually. The 1980 Arizona Groundwater Management Act (GMA) mandated that the Phoenix AMA reach safe yield by 2025, but it is unlikely that goal will be reached. Groundwater overdraft can lead to land subsidence and stream capture long before estimated volumes are depleted.

Colorado River and the Central Arizona Project

The CAP aqueduct was completed to Phoenix in 1987, and delivers 1.5 million af to Central Arizona. It has reduced dependence on groundwater pumping, has allowed Native American water rights settlements, and is a major source of municipal supply. However, in the event of shortages on the river, CAP water users would be the first to experience reduced deliveries.

Methods Flowchart



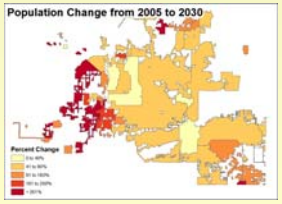
Vulnerability of place is the sum of effects operating at different scales. This study is centered on vulnerability at the level of institutions, where decisions are made, and the analysis uses vulnerability mapping at the water provider level.

Assumptions in this analysis:

- Institutional portfolio mixes remain the same
- Per capita use remains the same
- Provider service areas remain constant
- Groundwater extraction for AMA = safe yield by 2025

Population growth and shifts in consumption

Population growth exceeds conservation savings and municipal demand continues to rise. Historically, municipal demand has been offset by declining agricultural use, but this trend may not continue. Population growth is expected to lead to increased stress on water supplies

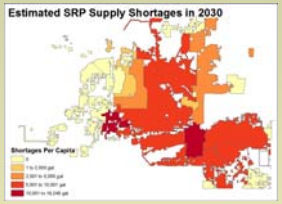


Population growth within metro Phoenix will be highly differentiated geographically. Much of the growth is expected in the peripheral areas

Based on the above assumptions, expected groundwater shortages by 2030 as a result of population increases and compliance with the GMA safe yield limits

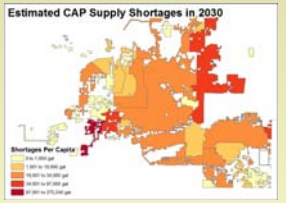
Drought, climate variability, and long term change

Based on the average of climate change scenarios in Ellis et. al., the Salt/Verde river system could see a 23% reduction in runoff from higher regional temperatures. Similarly, warmer temperatures and reduced snowpack in the Colorado river basin may lead to runoff declines.



Expected SRP shortages per capita with 23% reduction in runoff (average of climate predictions) and population increase.

Expected CAP shortages from climate change induced reductions in runoff, population increase, and Arizona's junior rights status.



Conclusions, recommendations, and further work

- Institutional dependence on groundwater is highest in the urban periphery, where population growth is also expected to be highest.
- Cities in the core areas have more diversified water portfolios with better access to renewable supplies.
- Climate change induced reductions in surface water supplies are likely to place additional stresses on groundwater systems
- Regulations and enforcement to encourage conservation and limit growth are necessary to mitigate projected water shortages.
- Further work will examine social and economic variability within the study area to account for finer scales of vulnerability analysis.

Acknowledgments

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